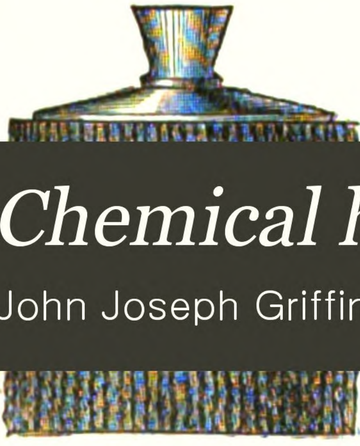
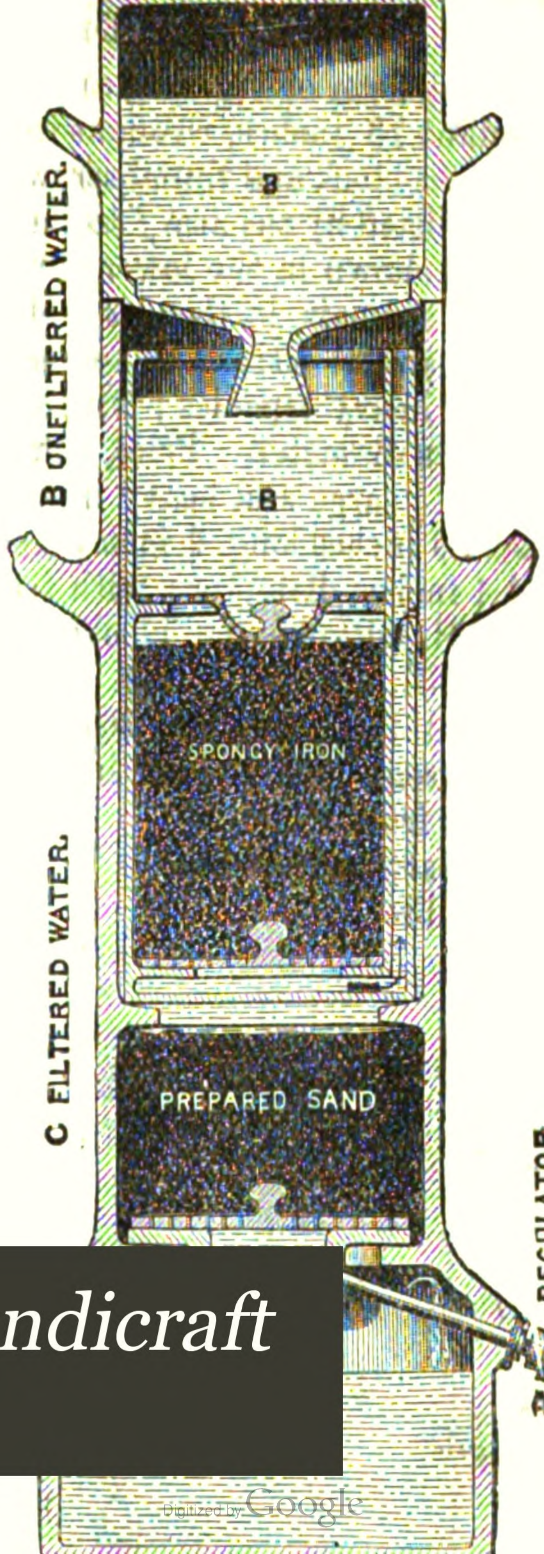
SECTION OF SPONGY IRON VESSEL.

BOTTLE FOR HAND SUPPLY. RUSTIC PATTERN.





Chemical handicraft

John Joseph Griffin

JOHN J. GRIFFIN AND SONS,

CHEMICAL AND PHILOSOPHICAL INSTRUMENT MAKERS,

22 GARRICK STREET, COVENT GARDEN, W.C.,

Two Minutes' Walk from Charing Cross.

London, 1877.

Exhibition Prize Medals.

THE following **PRIZE MEDALS** were awarded to JOHN J. GRIFFIN by the Juries of the **GREAT EXHIBITION** of 1851, and the **INTERNATIONAL EXHIBITION** of 1862.

Great Exhibition of the Industry of all Nations, 1851.
Class X.
Philosophical Instruments.

PRIZE MEDAL
for Graduated Glass Instruments, Exceedingly Accurate and Good; and for Economical and Convenient Chemical Apparatus.

International Exhibition, 1862.
Class XIII.
Philosophical Instruments, and Processes depending on their Use.

PRIZE MEDAL
for General Excellence and Cheapness of the Manufacture of his Apparatus for Chemical Research.

International Exhibition, 1862.
Class XXIX.
Educational Works and Appliances.

PRIZE MEDAL
for a Good Collection of Cheap Apparatus for Instruction in Elementary Science.

O. C. Johnson

CHEMICAL HANDICRAFT:

A Classified and Descriptive Catalogue

OF

CHEMICAL APPARATUS,

SUITABLE FOR THE PERFORMANCE OF CLASS EXPERIMENTS,

FOR EVERY PROCESS OF CHEMICAL RESEARCH

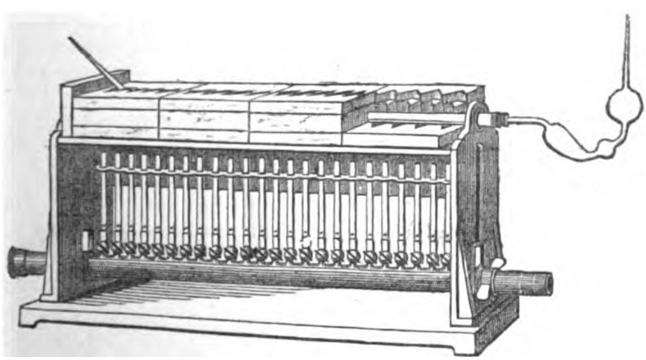
AND FOR CHEMICAL TESTING IN THE ARTS.

ACCOMPANIED BY COPIOUS NOTES, EXPLANATORY OF THE CONSTRUCTION AND USE OF THE APPARATUS.

BY

JOHN JOSEPH GRIFFIN, F.C.S.

Illustrated by upwards of Sixteen Hundred Engravings on Wood.



LONDON:

JOHN JOSEPH GRIFFIN AND SONS,

CHEMICAL AND PHILOSOPHICAL INSTRUMENT MAKERS,

22 GARRICK STREET, COVENT GARDEN.

1877.

GLASGOW:
PRINTED BY BELL AND BAIN,
41 MITCHELL STREET.

PREFACE.

The following work is, in the main, a Price Current of Chemical Apparatus. But a slight examination of it will show that it is something more than that. If, indeed, its commercial character were separable, the residue of the work might fairly be considered *a Report on the Apparatus which the philosophical chemist has at present at command, to aid his original researches, or to demonstrate the truths adduced in his teachings.* In fact, much of the work is of the nature of a treatise on what is termed *Chemical Manipulation.* The materials for it have been collected from all parts of Europe, with much cost and labour; and considerable time has been spent in trying the instruments one against another, and in making modifications and improvements. Under the heads of *Air Pumps, Lamps, Furnaces, Gas Burners, Blast Furnaces, Blowpipe Apparatus, Volumetric Analysis,* and in many other places, the reader will find the results of numerous original experiments of the above character. By a careful classification of the apparatus, and by the use of abundant figures and short descriptive notes, a considerable mass of information on practical points has been condensed into the work. Of the 1500 figures that illustrate it more than 600 have been drawn from the instruments expressly for this Edition. It is hoped that, such as it is, the work will prove useful to all who have occasion to make Chemical Experiments.

JOHN J. GRIFFIN.

22 Garrick Street, Covent Garden, W.C.,
London, 1866.

PREFACE TO THE SECOND EDITION.

In presenting this entirely reworked Second Edition, we desire to direct attention to the fact that a large quantity of obsolete matter has been depleted, and some thirty pages of fresh information added, together with about 100 new Illustrations, expressly drawn for this Edition.

The prices throughout have been very generally reduced, mostly so the Glass Instruments, especially under the head of Volumetric Analysis; and our many additions to the Section on Gas Furnaces and Burners will, we trust, prove acceptable.

JOHN J. GRIFFIN & SONS.

London, 1877.

ADVERTISEMENT.

THE Instruments described in this work are offered for sale at the prices affixed to each. These prices are nett, for ready money. The expense of packing cases and packing materials is charged to purchasers. We employ very careful and experienced persons to pack the instruments securely; but we do not hold ourselves responsible for any breakage that may take place during the carriage of the goods from our manufactory to their places of destination. The packing cases and packing materials are charged at the lowest possible price, and we are compelled to intimate that we cannot take them back, nor allow their value to be deducted from our bills.

Orders from strangers in the country must be accompanied by a REMITTANCE, or by a reference to some person in London. Post-Office Orders are to be made payable at CHARING CROSS. Sums *under* 5s. may be remitted in postage stamps.

Foreign orders must either be accompanied by a remittance, or by instructions for payment in London, on delivery of the bills of lading, without which payment the orders cannot be executed. A large stock of the apparatus described in this work, both British and Foreign, being kept ready for immediate delivery, shipping orders for comprehensive collections can be executed with promptitude.

Such articles in this catalogue as are subject to frequent variations in price—caoutchouc, crude chemicals, &c.—are at all times charged according to the lowest market value. The present prices supersede all those in catalogues of earlier date.

JOHN J. GRIFFIN AND SONS.

22 GARRICK STREET, COVENT GARDEN, W.C.,
LONDON, 1877.

Classification of Chemical Apparatus.

APPARATUS FOR MECHANICAL OPERATIONS.

SUPPORTS FOR APPARATUS.

WEIGHING AND MEASURING.

THERMOMETERS FOR CHEMICAL USE.

APPARATUS FOR DETERMINING THE SPECIFIC GRAVITY OF LIQUIDS.

PNEUMATIC APPARATUS FOR CHEMICAL USE.

APPARATUS FOR THE PRODUCTION AND APPLICATION OF HEAT.

VESSELS FOR PREPARING SOLUTIONS.

BOTTLES FOR CHEMICALS.

FILTRATION, PERCOLATION, EDULCORATION.

EVAPORATION.

DISTILLATION.

THE PREPARATION AND EXAMINATION OF GASES.

APPLICATION OF CHEMICAL TESTS.

VOLUMETRIC ANALYSIS.

BLOWPIPE APPARATUS, AND APPARATUS FOR MICRO-CHEMICAL OPERATIONS.

APPARATUS FOR ASSAYING AND FOR METALLURGIC OPERATIONS IN GENERAL.

MARSH'S ARSENIC TEST.

ORGANIC ANALYSIS.

COLLECTIONS AND CABINETS OF CHEMICAL APPARATUS.

SPECIMENS OF MINERALS, ILLUSTRATIVE OF MINERALOGY, GEOLOGY, AND METALLURGY.

PURE CHEMICAL TESTS, *and other Preparations for Experiments of Demonstration or Research.*

CHEMICAL BOOKS BY JOHN J. GRIFFIN, F.C.S.

SCIENTIFIC HANDICRAFT.

PROSPECTUS.

1866.

It is the intention of the Editor of this work to publish a series of works on the same plan as CHEMICAL HANDICRAFT, but relating to Apparatus suitable for the Experimental Illustration of Elementary Instruction in the following Sciences:—

MECHANICS,	ACOUSTICS,	ELECTRICITY,
HYDROSTATICS,	HEAT,	GALVANISM,
PNEUMATICS,	LIGHT,	MAGNETISM.

The series will be published under the general title of SCIENTIFIC HANDICRAFT. Each work will be abundantly supplied with illustrative engravings, and contain detailed instructions for the effective use of the instruments.

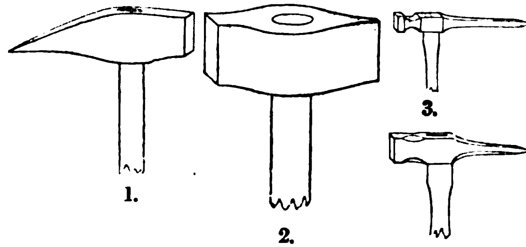
ERRATA.

No.		
116.	*To read*	1s. 2d.
172.	,, ...	10s.
173.	,, ...	5s.
461*b*.	,, ...	17s. 6d.
518*c*.	,, ...	4s.
533.	Scale is ·700 to 2·000.	
548.	*To read*	3s.
563.	,, ...	15s.
631.	Outer Case is Square.	
2378.	If London made, ...	25s.
2391–18.	*To read*	13s.
2391–20.	*Omitted,* is like 2391–3, but with double Electrodes, ...	9s.
2391–21.	*Omitted,* is like 2391–12, but has a Steam Jacket, ...	15s.
2423.	Will detect *one grain* of Acid.	
2873.	(Like 1254), ...	21s.
4464.	(Like 342), ...	1s. 4d.
4744.	(Like 2214), ...	2s. 3d.
4721–5.	(Like 1082), ...	£4, 4s.

Apparatus for Mechanical Operations.

HAMMERS.

A.—Hammers for Geologists.



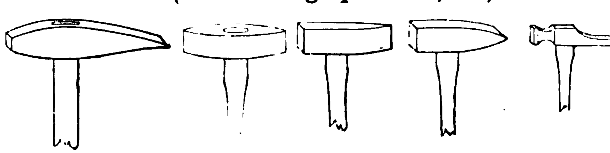
1. 2. 3. 4.

Best make, with stout, tough handles.

Figs. 1 and 2 represent heavy hammers for hewing hard rocks. Figs. 3 and 4 represent picks for extracting fossils from soft rocks.

1. Geological Hammer, head 8 by 2 inches, one face 1½ inch square, and a pick at the other end, weight about 5 lbs.—handle 3 ft. long, 10s. 6d.
2. Geological Hammer, head 6 by 2½ inches, one face 1 by 2¼ inches, and another face ⅓ by 2¼ inches, weight about 5 lbs.—handle 3 feet long, 12s.
3. Small Pick, head 7 inches long, flat square face, $\frac{7}{10}$ inch square, and sharp point at the other end, 3s. 6d.
4. Large Pick, head 7 inches long, flat square face 1 inch square, sharp pick at the other end, 4s. 6d.

B.—Hammers for Mineralogists (for trimming Specimens, &c.)



5. 6. 7. 8. 9.

5. Trimming Hammer, head 5½ by 1 inch, one face ½ inch square, with hard and sharp cutting edge, at right angles to the handle—length of handle 18 inches, 4s. 6d.
6. Trimming Hammer, head 3½ inches long, with two cutting edges parallel to the handle, 2s. 6d.
7. Ditto, head 3½ inches long, flat face 1 inch square, and cutting edge parallel to the handle, 2s. 6d.
8. Ditto, same as No. 7, but the cutting edge at right angles to the handle, 2s. 6d.
9. Blowpipe Hammer, head 2½ inches, flat square face ½ inch square, cutting edge at right angles to the handle, 1s. 9d.

C.—Hammers for Assayers.

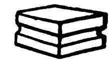
10. Hammer for flattening buttons of silver for silver assays. *a*, small size, 3s. 6d.; *b*, large size, 4s.
11. Heavy hammer for flattening gold for gold assays, about 6 lbs. weight, bright face, 9s.
12. Square-faced hammer for breaking a crucible after a fusion, 2s. 6d.

ANVILS.

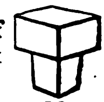
POLISHED SLABS OF HARDENED STEEL, WELDED ON IRON BLOCKS.


13.

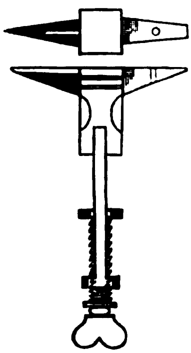
13. Anvil for blowpipe experiments, surface $1\frac{1}{2}$ by $1\frac{1}{2}$ inch, block $\frac{5}{8}$ inch thick, Fig. 13, 2s.

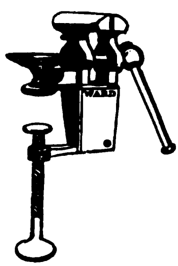

15.

14. Anvil for blowpipe experiments, surface 2 by 2 inches, block $\frac{7}{8}$ inch thick, Fig. 13, 3s.
15. Anvil for blowpipe experiments, and for flattening heavier beads of metals than those afforded by blowpipe experiments, surface 2 by 2 inches, block 2 inches thick, Fig. 15, 6s.
16. Stake or Anvil for assayers, used for flattening large beads of gold and silver, form of Fig. 16, surface $3\frac{1}{2}$ by $3\frac{1}{2}$ inches, block 3 inches thick, fang 3 by 2 inches, 25s.


16.

17. Stake, mounted on a solid block of hard wood, 5 inches in the cube, 31s.
18. Anvil, adapted to screw to a table, for the repair of small apparatus, for bending and coiling wires, or slips of metal, &c., Fig. 18, 6s. 6d.


18.



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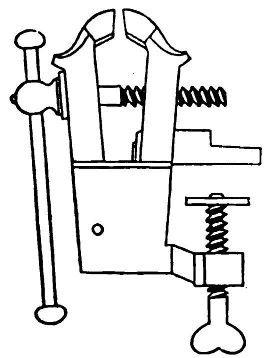
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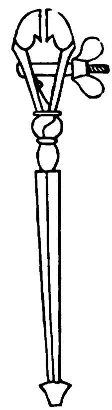

21.

VICES.

Useful in the Construction or Repair of Apparatus.

19. Vice and Anvil combined, to screw to a table, Fig. 19, 15s.
20. Vice to screw to a table, Fig. 20, 12s.
21. Vice (watchmaker's) to hold small articles steadily in the hand, Fig. 21, 5s.
22. Bench Vice, powerful, 4-inch faces, weight 36 lbs., 40s.

Adapted for use in conjunction with the Lathe No. 23.

23. LATHE, suitable for the manufacture and repair of most articles of Chemical and Physical Apparatus, £30.

***Description.*—Foot-Lathe, with a 3-ft. planed iron bed and standards, 5-in. centre, mandril head and cylinder poppet, iron treadle and wood bench, 7-inch gun-metal pulley, $26\frac{1}{2}$-inch turned four-motion wheel, two catgut bands with steel hooks, $9\frac{1}{2}$-inch surface chuck, 4 wrought-iron chucks, 1 centre chuck, 1 reel, and 2 ties.**

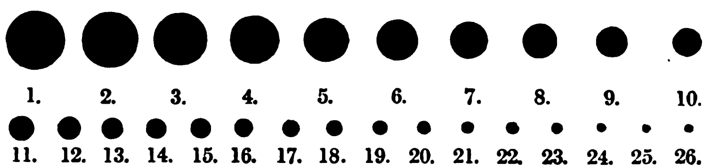
24. COLLECTION OF CHUCKS AND TURNING TOOLS for the Lathe, £5 to £10.
25. Set of Instruments for cutting $\frac{1}{4}$, $\frac{3}{8}$, and $\frac{1}{2}$-inch Wooden Screws, consisting of three iron tools and three wooden screw blocks (as described in Williams's "Chemical Manipulation"), 15s.

26. Flatting Mill, or Steel Rollers, for rolling metals into sheets, used in particular for flattening alloys of gold and silver, in preparation for the operation of parting, 3-inch rollers, £7.
27. Press for making Potassium and similar soft metals into wires, in case, 16s.

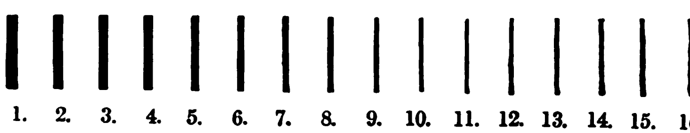
WIRE and METAL-PLATE GAUGES.

38. In sending orders for Platinum Wires, Platinum Plates, Copper Wires, for galvanic purposes, &c., and in specifying the *thickness desired* for metallic articles formed of wires or plates, such as Capsules, Crucibles, &c., customers are requested to state their wishes by reference to the following figures, which show, as nearly as can be done in print, the thicknesses of the Copper and Platinum Wires, and the sheets of Platinum, that are commonly kept in stock :—

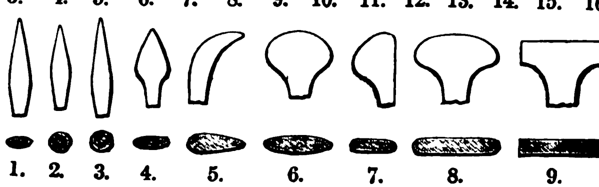
Wire Gauge.



Metal Plate Gauge.

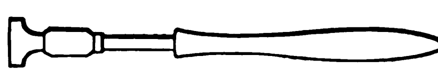


39. Agate Burnishers,—finely polished, not mounted; all the patterns, Nos. 1 to 9, at 1s. each.

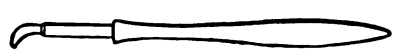


Agate Burnishers of the foregoing patterns mounted on polished Rosewood or Mahogany handles, with Brass fittings, as follows :—

40. Similar to Nos. 4, 7, 8, 9, Fig. 39, mounted in the style of Fig. 40, 6s. each.


40.

41. Similar to Nos. 1, 2, 3, 5, 6, Fig. 39, mounted in the style of Fig. 41, 3s. 6d.


41.

42. Steel Burnishers, finely polished, many patterns, mounted on wooden handles, 1s. 6d. to 5s. 6d. each.
43. Agate Caps for mounting Compass Needles and other instruments that turn on steel points, finely polished, $\frac{3}{16}$ inch diameter, 1s. each.

MORTARS and PESTLES.

Every Mortar in the following list is furnished with a Pestle at the price quoted; and in all cases the Pestle is in one piece, not mounted on wood, unless specially so stated.

I. CAST-IRON AND STEEL MORTARS.

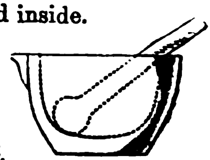
44. Cast-Iron Mortars, similar to Fig. 44, not polished.

No.	Diameter.	Price.	No.	Diameter.	Price.
1.	5 inch.	2s.	5.	10 inch.	9s.
2.	6 inch.	4s.	6.	11 inch.	14s.
3.	8 inch.	5s.	7.	12 inch	18s.
4.	9 inch.	7s.			

44.

45. Cast-Iron Mortars, bowl-shaped, Fig. 45, turned and polished inside.

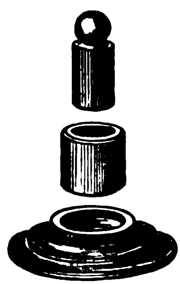
No.	Diameter.	Price.	No.	Diameter.	Price.
1.	4 inch.	2s. 0d.	4.	6½ inch.	5s. 0d.
2.	5 inch.	3s. 6d.	5.	7 inch.	5s. 6d.
3.	5½ inch.	4s. 6d.	6.	7½ inch.	6s. 6d.



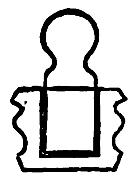
45.

STEEL CRUSHING MORTARS, or Diamond Mortars, for pounding hard minerals for analysis, previously to grinding them in Agate Mortars,—all made of hardened steel :—

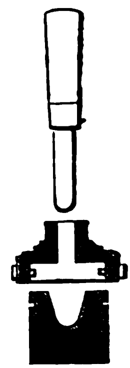
46. Mortar and Pestle, in two pieces, Fig. 46, bore $\frac{3}{8}$ inch, 6s.
47. Mortar and Pestle, bore $\frac{5}{8}$ inch, Fig. 47 or 48, each 14s.
48. Mortar and Pestle, bore $1\frac{1}{8}$ inch, Fig. 47 or 48, each 25s.
49. Mortar and Pestle, in three pieces, Fig. 49, with long pestle, 31s. 6d.



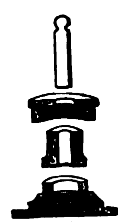
47.



46.



49.



48.

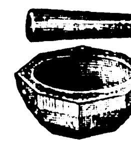
Owing to the shape of the smallest mortar, No. 46, it is impossible to make the bottom of it so hard as the steel plate that is let into the bottom piece of No. 47. It is not, therefore, so effective or so durable as the other mortars. The pestles of Nos. 46 and 47 are rather troublesome to work, in consequence of there being no air-way between the pestles and the mortars. When the pestle of No. 47 is struck, the compressed air forces the cylinder to rise, and some of the powder is blown away. To remedy this defect, the mortar Fig. 48 is made with a screw, which fixes down the cylinder to the base, and prevents the escape of powder. All these instruments are worked by striking the short, flat-bottomed pestle with a hammer, after putting the mineral into the cylinder of the mortar,—and the pulverization is a rather slow operation.

The largest of these mortars, No. 49, is constructed upon a different principle. The interior of the mortar is spherical, like that of an ordinary porcelain mortar, so that the substance to be pounded falls back to the bottom after every stroke of the pestle. The top or cover of the mortar is fastened on by two bayonet catches, and is easily put on and off. The pestle is heavy, and large enough to be grasped by the hand and used to pound the mineral without the help of a hammer. Owing to the air-way between the pestle and mortar, and the protection of the horizontal cover, much less of the powder is blown out than usually happens with poundings in the other mortars. The required pulverization of a mineral is, for these reasons, rapidly and easily effected in a mortar of this construction. The bottom of the mortar, turned upside down, can be used as a blowpipe anvil.

II. AGATE PESTLES AND MORTARS, for the fine pulverization of siliceous and other hard minerals. Best quality, sound pebbles, well polished; form of Fig. 50.

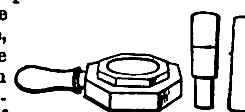
50. *Diameters of Mortars.*

1 inch,	2s. 6d.	2¾ inch,	12s.	4½ inch,	42s.
1¼ inch,	3s. 6d.	3 inch,	17s.	4¾ inch,	52s.
1½ inch,	4s. 0d.	3¼ inch,	21s.	5 inch,	63s.
1¾ inch,	5s. 0d.	3½ inch,	25s.	5¼ inch,	70s.
2 inch,	7s. 0d.	3¾ inch,	30s.	5½ inch,	80s.
2¼ inch,	8s. 0d.	4 inch,	35s.	5¾ inch,	88s.
2½ inch,	9s. 0d.	4¼ inch,	38s.	6 inch,	95s.


50.

52. MOUNTED AGATE MORTARS. Fig. 52.

To facilitate the pulverization of hard substances when required in quantity, which is a laborious operation when the pestle is short or small, agate mortars and pestles are mounted in the manner shown by Fig. 52, *a* and *b*. The former represents an agate mortar sunk in a solid block of mahogany, and provided with a handle, by which the mortar can be held securely with one hand while the other makes use of the pestle. Fig. 52 *b* represents the pestle, which consists of an agate pestle of the usual form, fastened to a long boxwood handle by means of a collar of polished iron; the total length of this combination being about six inches.


52. *a*, *b*, *c*.

4 inch Mortar, 47s.	5 inch Mortar, 76s.	5¾ inch Mortar, 105s.
4½ inch Mortar, 58s.	5¼ inch Mortar, 84s.	6 inch Mortar, 115s.

53. MOUNTED AGATE PESTLES.

Any of the Mortars under No. 50 can be furnished with Mounted Pestles like Fig. 52 *b*, at 4s. 6d. extra.

54. LONG AGATE PESTLES, IN ONE PIECE.

These consist of solid blocks of agate, cut into long cylinders, like Fig. 52 *c*, and polished at both ends. Price, without Mortars—

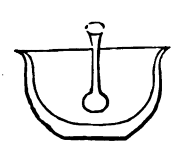
No. 1. 6 inches long, 1 inch to 1⅛ inch diameter, 8s.
2. 5 inches long, ⅞ inch to 1 inch diameter, 7s. 6d.
3. 4 inches long, ⅝ inch to ¾ inch diameter, 6s.

III. PORCELAIN MORTARS.

55. DRESDEN PORCELAIN MORTARS, biscuit within, glazed without, the pestles in one piece.

No. 3. 3½ inch diameter, 2s. 3d.
2. 4½ inch diameter, 3s. 0d.
1. 5¼ inch diameter, 4s. 0d.

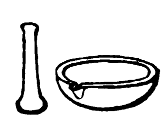

55. Nos. 1, 2, 3.


56.

56. Dresden Porcelain Blowpipe Mortar, 1½ inch diameter, glazed within, a cheap but inferior substitute for an agate mortar in blowpipe experiments, with Pestle, Fig. 56 and Fig. 68, No. 4, 6d.

57. Mortars for use in Organic Analysis, for mixing powders, broad and flat, glazed inside, glazed pestle, Dresden porcelain, with sharp spout, Fig. 57.

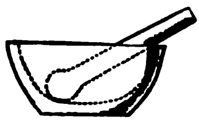
No. 6. 5 inch diameter, contains 10 ounces of water, 3s. 6d.
7. 4 „ „ „ 5 „ „ 2s. 9d.

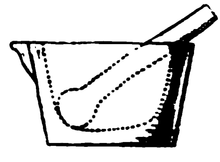

57.

Thuringian Porcelain Mortars, thick in the body, with large spouts, glazed outside, biscuit inside, all with **Pestles**.

58. Shallow and wide, Fig. 58, but with spout.

No. 8.	1¾ inches wide,		0s. 6d.
6.	2¼ ,, ,,		1s. 0d.
5.	3½ ,, ,,		1s. 4d.
3.	4¾ ,, ,,	10 ounces,	2s. 0d.
1.	6 ,, ,,	18 ,,	2s. 9d.
00.	7½ ,, ,,	36 ,,	4s. 0d.


58.

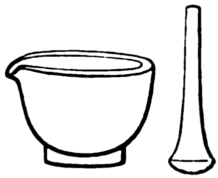

60.

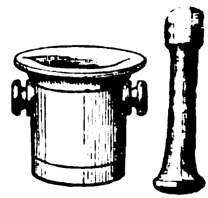
59. Hemispherical, with large spout and foot, Fig. 59.

No. 11.	3¼ inches wide,		1s. 9d.
10.	3¾ ,, ,,		2s. 0d.
8.	5 ,, ,,	18 ounces,	2s. 6d.
5.	7½ ,, ,,	50 ,,	5s. 6d.

60. Conical, Fig. 60.

No. 6.	2¼ inches wide,		0s. 9d.
5.	3 ,, ,,		1s. 0d.
3.	4 ,, ,,	8 ounces,	1s. 8d.
1.	5 ,, ,,	18 ,,	2s. 9d.
00.	6½ ,, ,,	32 ,,	4s. 6d.


59.

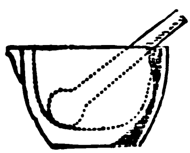

61.

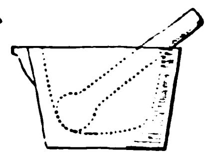
61. Deep and Stout Mortar, for mixing mercurial ointments, &c., with handles, without spout, form of Fig. 61.

No. 0. 7 inches high, 7½ inches wide, contents 30 ounces, 9s.
1. 5½ inches high, 6 inches wide, contents 20 ounces, 4s. 6d.

62. **Berlin Semi-Porcelain Mortars**, deep form, with spout, glazed outside, biscuit within, all with Pestles.

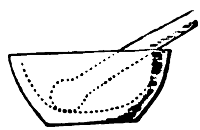
The hemispherical form, Fig. 62 A, and the conical form, Fig. 62 B, are the same in price.


61 A.


62 B.

No. 00.	2¼ inch diameter,	5d.		No. 4.	6 inch diameter	2s. 0d.
0.	2½ ,, ,,	7d.		5.	6¾ ,, ,,	2s. 6d.
1.	3¼ ,, ,,	9d.		6.	7¾ ,, ,,	3s. 0d.
2.	4 ,, ,,	1s. 0d.		7.	9¼ ,, ,,	4s. 6d.
3.	5 ,, ,,	1s. 6d.				

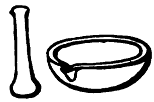
63. Berlin Semi-Porcelain Mortars, shallow and wide form, Fig. 63, but with spout like Fig. 64, glazed outside, biscuit inside.


63.

No. 2.	3¾ inch diameter,	1s. 0d.		No. 9.	8½ inch diameter,	3s. 6d.
3.	5 ,, ,,	1s. 6d.		11.	9½ ,, ,,	4s. 6d.
6.	6¼ ,, ,,	2s. 0d.		12.	10¼ ,, ,,	5s. 6d.

64. Mortars for use in Organic Analysis, for mixing powders; broad and flat, with spout, glazed inside, with glazed pestle, Berlin semi-porcelain, Fig. 64.

No. 3. $4\frac{1}{4}$ inch diameter, 2s. 0d.
4. 5 „ „ 2s. 3d.



64.

65A. Mortars and Pestles of Wedgwood ware, similar to Fig. 59.

1 inch	0s. 6d.	5 inch	2s. 6d.	9 inch	7s.
2 „	1s. 0d.	6 „	3s. 0d.	10 „	9s.
3 „	1s. 3d.	7 „	4s. 0d.	11 „	14s.
4 „	1s. 9d.	8 „	5s. 6d.	12 „	18s.

IV. GLASS MORTARS.

66. Hard Bohemian Glass Mortars, broad flat form, very stout, with spouts and strong pestles.

$2\frac{1}{4}$ inch, $1\frac{1}{2}$ oz.	8d.	$6\frac{1}{4}$ inch, 30 oz.	1s. 8d.
$3\frac{1}{4}$ inch, 4 oz.	10d.	$7\frac{1}{4}$ inch, 50 oz.	2s. 6d.
$4\frac{1}{4}$ inch, 10 oz.	1s. 0d.	$8\frac{1}{4}$ inch, 70 oz.	3s. 3d.
$5\frac{1}{4}$ inch, 20 oz.	1s. 2d.		

V. SERPENTINE MORTARS.—Green Marble.

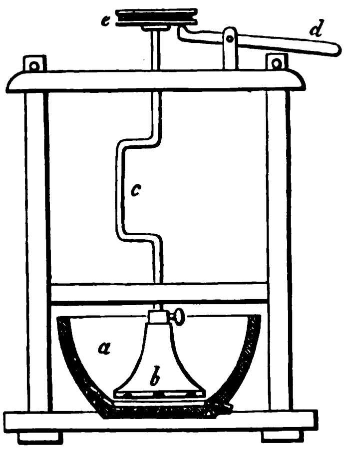
67. Mortars of Serpentine, broad and flat, with sharp spouts, for mixing soft powders with water, &c., highly polished, Fig. 64.

$4\frac{1}{2}$ inch	1s. 3d.	$5\frac{1}{2}$ inch	1s. 6d.	$6\frac{1}{2}$ inch	2s. 6d.

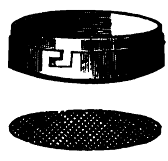
69. Porcelain Levigating Machine, Fig. 69.

No. 0. 18 inch Mortar, 42s.
3. $10\frac{1}{2}$ inch Mortar, 28s.

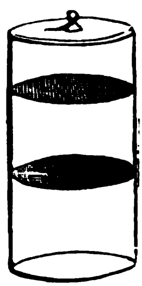
This apparatus consists of a Thuringian Porcelain Mortar, *a*, Fig. 69, with a flat-bottomed grooved pestle, *b*. This is attached to an iron crank, *c*, which is mounted in a strong wooden frame. If the crank is turned by the hand applied at *c*, or by a band passing round *e*, the pestle rotates and levigates the substance in the mortar. There is a spout at the bottom of the mortar for running off the mixture when sufficiently ground.



69.



70.



71.

SIEVES.—Sifting Apparatus.

70. Flat Sieve, for separating small stones, grit, sand, and fine sand, in the mechanical analysis of soils; consisting of two short japanned metallic cylinders, united by a bayonet catch, with three movable bottoms of metallic gauze: diameter of Sieve, 5 inches; Apertures in the gauze, 30, 50, and 100 to the inch. (Fig. 70.) Per set, 3s.

71. Box Sieve, Cylindrical, 3 inches in diameter, japanned metal, with three divisions each, having a metallic gauze bottom; size of the gauzes, 100, 50, and 30 to the inch; with cover. Fig. 71. By this Sieve, a powder is divided by one operation into three degrees of fineness. 4s.

Porcelain Sieves.—Refer to the article on "Drainers," under the head of Filtration.

72. Sieves with Metal Wire Bottoms and Wooden Rims.

Diameter.	17 Hole Iron Wire, 289 Apertures per sq. inch.	30 Hole Iron Wire, 900 Apertures per sq. inch.	17 Hole Brass Wire, 289 Apertures per sq. inch.	30 Hole Brass Wire, 900 Apertures per sq. inch.	70 Hole Brass Wire, 4,900 Apertures per sq. inch.
5-inch,	1s. 8d.	1s. 10d.	1s. 10d.	2s. 6d.	4s. 3d.
6-inch,	1s. 8d.	2s. 0d.	2s. 0d.	2s. 8d.	4s. 6d.
8-inch,	1s. 10d.	2s. 3d.	2s. 3d.	2s. 10d.	4s. 9d.
10-inch,	2s. 0d.	2s. 6d.	2s. 6d.	3s. 0d.	5s. 6d.

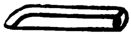
Sieves of other sizes or forms, and with Lawn or Horsehair Bottoms, can be supplied to order.

72a.	Iron Gauze,	4 to 6	hole,	1s.	per super. foot.
	"	11 to 17	"	8d.	" "
	"	54	"	2s.	" "
	Brass Gauze,	54	"	2s.	" "
	"	100	"	6s.	" "
	Copper Gauze,	120	"	9s.	" "

POWDER SCOOPS, or Powder Lifters.

74. Thuringian Porcelain, Fig. 73.
No. 1. 5½ inches by 2¼ inches wide, 10d.
No. 2. 4½ inches by 2 inches wide,
75. Berlin Semi-Porcelain, Fig. 75, 4½ inch, 8d.

73.



75.

77.

76. Berlin Semi-Porcelain, Fig 73, 4½ inch, 1s.
77. Horn, Fig. 77, 3 inch, 6d.; 4 inch, 8d.; 4½ inch, 10d.

SPOONS.

78. Berlin Porcelain Spoon for Acids, size and shape of a teaspoon, glazed, 10d.
79. Spoons of German Semi-Porcelain, with hard white porcelain glaze, form of a teaspoon, Fig. 82—contents 1½ drachm, 6d.

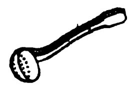
82.

80. Spoons of German Semi-Porcelain, form of a table-spoon, Fig. 82—contents 7 drachms, 1s.

83.

80a. Spoons of Wedgwood Ware—tablespoon size, 8d.
" " dessert spoon " 6d.
" " teaspoon " 4d.

Dresden Porcelain Spoons, glazed.



81. Round Bowl, 1½ inch diameter, holds ¼ ounce, Fig. 87 *b*, 1s. 3d.
82. Form and size of a tablespoon, Fig. 82, 3s.

84.

83. Round Bowl, pierced with holes, Fig. 83, for lifting crystals from a solution, 4s. 6d.
84. Ditto, Fig. 84, 2s.

85. Bohemian Glass Spoons, massive, Fig. 85.

85.

No. 1. 2 drachms, 9d.
No. 2. 4 drachms, 10d.
No. 3. 5 drachms, 1s.
No. 4. 5 drachms, cut and polished all over, 3s. 6d.

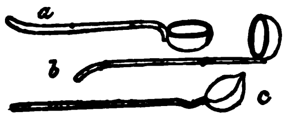
86. Bohemian Glass Spoons, massive, form of Fig. 86.

No. 1. 2 drachms, 9d. | No. 3. 5 drachms, 1s.
No. 2. 4 drachms, 10d.

86.

87. German Glass Spoons, slight, 6-inch, various forms (Fig. 87, *a*, *b*, *c*), 2d. each.

87A. Metallic Wire Gauze Spoon, for placing Potassium, Sodium, &c., under liquids, 2s.



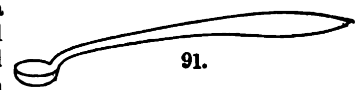
87.

88. Horn Teaspoon, 5 inch, 4d.

89. „ Dessert Spoon, 6½ inch, 7d.

90. „ Tablespoon, 9 inch, 10d.

91. Test Spoon of polished German silver, with a bowl ¼-inch diameter, for lifting small quantities of powder, the handle fashioned into a spatula for mixing fluxes, &c. in blowpipe and other experiments, 3½ inches long, 3d.



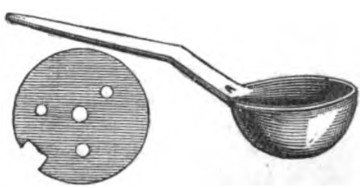
91.

92. Small Iron Spoons, for trying whether substances are combustible or incombustible, for charring organic bodies, or for preliminary fusions in analysis, &c., ¾-inch bowl, 2d. each; per dozen, 1s. 6d.

92.

95. Iron Spoon, hemispherical bowl, ½ inch in diameter, turned thin and polished, with thin iron cover, and neat polished wood handle, for preparing black flux, or igniting substances over the spirit lamp, Fig. 95, but with a turned wood handle, 3s.

Platinum Blowpipe Spoons. See "Blowpipe Apparatus."



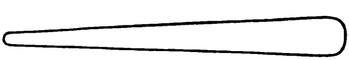
95.

SPATULAS and STIRRERS.

I.—Metal Spatulas.

96. Platinum Spatulas, form of Fig. 96.

The following prices are merely approximate, and vary with the weight of the spatula and the market price of the metal.



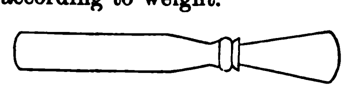
96.

No.	Length.	Greatest Width.	Weight.	Price.
1.	2½ inch.	3/8 inch.	80 grains.	8s. 6d.
2.	3 inch.	7/16 inch.	100 „	10s. 6d.
3.	3½ inch.	½ inch.	130 „	12s.
4.	4 inch.	9/16 inch.	170 „	18s.
5.	4½ inch.	5/8 inch.	200 „	21s.
6.	6 inch.	5/8 inch.	300 „	32s.

If Platinum Spatulas are made thick in the middle and feathered off towards the sides, the prices are higher than as stated above.

97. Platinum Spatulas made of round or flatted platinum wire, from 1/20 inch to 1/10 inch thick, and 2, 3, or 4 inches long, price according to weight.

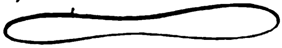
99. Polished Steel Spatulas, flexible blades, with coco handles and balance shoulders, Fig. 99.



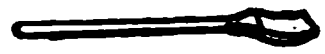
99.

4 inch, 8d.	7 inch, 1s. 3d.	10 inch, 2s. 6d.
5 inch, 10d.	8 inch, 1s. 8d.	11 inch, 3s. 6d.
6 inch, 1s. 0d.	9 inch, 2s. 0d.	12 inch, 4s. 0d.

100. Polished Steel Spatula, 3-inch, bone handle, Fig. 99, 8d.
101. Polished Steel Spatula, without handle, 4 inches long, Fig. 101, 1s.

101. 

II.—Porcelain Spatulas, glazed.

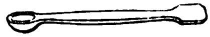
103. 

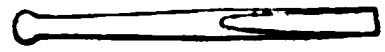
103. No. 1. Fig. 103, 8 inches long, 1s.
104. No. 2, Fig. 104, 11 inches long, 2½ inches broad, 3s.

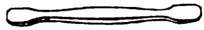

104.

Thuringian Porcelain Spatulas,
Figs. 105, 106, and 107, stout, glazed all over.

N.B.—The inches are Leipsic measure, and about $\frac{1}{12}$ less than English.

105. 

106. 

107. 

105. Spatula with Spoon at one end.

No. 1. 18 inch, 2s. 6d.	No. 3. 12 inch, 1s. 5d.	No. 5. 6 inch, 8d.
„ 2. 15 inch, 1s. 9d.	„ 4. 9 inch, 10d.	

106. Spatula with handle.

No. 1. 18 inch, 3s. 0d.	No. 3. 12 inch, 1s. 9d.	No. 5. 6 inch, 1s. 3d.
„ 2. 15 inch, 2s. 4d.	„ 4. 9 inch, 1s. 6d.	

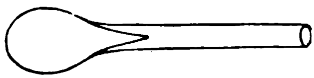
107. Double Spatula.

No. 1. 18½ inch, 2s. 4d.	No. 3. 12½ inch, 1s. 3d.	No. 5. 6 inch, 8d.
„ 2. 15 inch, 1s. 8d.	„ 4. 9 inch, 1s.	

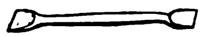
108. Berlin Semi-Porcelain Spatulas, form of Fig. 106, with handle, glazed.

4, 5, or 6 inch, each 9d.	10, 11, 12 inch, each 2s. 3d.
7, 8, 9 inch, each 1s. 6d.	13, 14, 15 inch, each 3s.

109. Dresden Porcelain Spatulas.
No. 1. Single, form of Fig. 109, 5½ inch, 5d.
8½ inch, 6d.
No. 2. Double, form of Fig. 107, 8½ inch, 8d.


109.

No. 3. Double, form of Fig. 109 *a*, 12½ inch, 1s. 4d.


109 *a*.

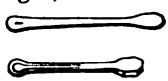
III.—Fireclay and Stoneware Stirrers.

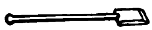
110. Infusible Fireclay Stirrers for mixing powders in crucibles, in assaying.

7 inch, 6d.	8 inch, 8d.	14 inch, 10d.

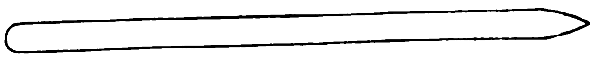
IV.—Glass Spatulas and Stirrers.

113. Bohemian Glass Spatulas, massive, from 8 to 10 inches in length, the broad end 1 inch to 1¼ inch, the rod ½ inch thick; Fig. 113.
No. 1. Cut and polished all over, Fig. 2, 2s.
„ 2. The broad end cut and polished, 1s.
„ 3. Uncut, Fig. 1, 10d.


113.

114. Glass Spatula, with broad end, Fig. 114, 6 inches long, 3d.  114.

115. Glass Stirrers, made of round glass rod, with one end pointed for dropping tests, and the other end rounded, Fig. 115. *Per dozen.*


115.

3 inch, 2d.	9 inch, thin, 8d.	12 inch, thin, 1s.
6 inch, 4d.	9 inch, thick, 1s.	12 inch, thick, 1s. 6d.

116. Glass Rod in lengths of about 3 feet, and from $\frac{1}{8}$ inch to $\frac{1}{2}$ inch in thickness; per lb., 1s. 2d

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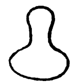
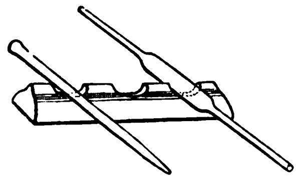
117. Horn Spatulas, for cleansing mortars, &c., various shapes, Fig. 117 and others, at 4d. to 1s. each.

118. Porcelain Rests for Stirrers and Pipettes, to keep the wet end from the table.

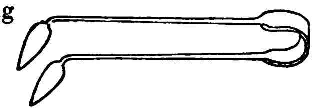
a. 3 inch with 6 notches, 4d.
b. 4 inch with 8 notches, 6d.
c. 6 inch with 12 notches, 8d.


117.

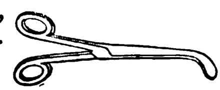

118.

TONGS, FORCEPS, PLYERS, &c.

120. Charcoal Tongs, with bent points, for arranging charcoal in furnaces, &c., Fig. 120, bright iron.
14 inch, 2s. 16 inch, 2s. 6d. 18 inch, 3s.


120.

121. Small Crucible Tongs, for use with Platinum Crucibles, with ring handles and bent points, 8 inches long, Fig. 121.
Iron, 1s. 6d. Brass, 1s. 6d.

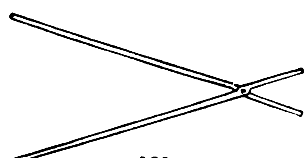

121.

122. Small Crucible Tongs, of German silver polished, form of Fig. 122, which either clip a crucible by the edge, or grasp it round the middle, 8 inch, 3s. 6d.


122.

Tongs for Large Crucibles, Black Iron, stout, unpolished.

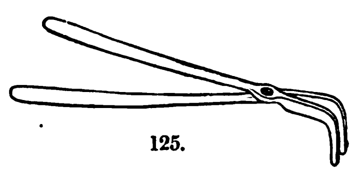
123. Straight Tongs, Fig. 123.
14 inch, 2s.
18 inch, 2s. 6d.
25 inch, 3s. 6d.


123.

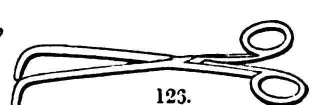
124. Bow Tongs, Fig. 124.
14 inch, 2s.
18 inch, 2s. 6d.
25 inch, 3s. 6d.


124.

125. Bent Tongs, Fig. 125.
14 inch, 2s. 3d.
18 inch, 2s. 9d.
25 inch, 3s. 0d.


125.

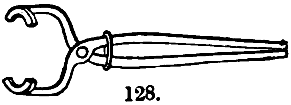
126. Tongs for large Crucibles, polished iron, stout, Fig. 126.
16 inch, bent points, 6s.


126.

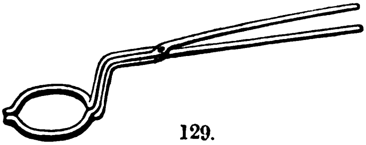
127. Ditto, 16 inch, straight points, 5s. 6d.

128. Basket Tongs for lifting heavy crucibles perpendicularly out of furnaces, black iron, unpolished, form of Fig. 128.

a. 24 inches long,	3	inch basket,	4s. 6d.
b. 24 „	$3\frac{3}{4}$	„	4s. 6d.
c. 25 „	$6\frac{1}{2}$	„	6s.
d. 32 „	$8\frac{1}{4}$	„	8s.

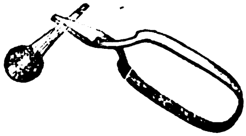

128.

129. Bow Tongs, with bent neck, for lifting crucibles out of furnaces without exposing the hands to the fire.
a. 18 inch handles, $2\frac{1}{2}$ inch bow, 3s. 6d.
b. 20 „ 5 „ 5s. 6d.


129.

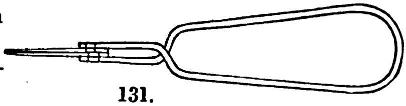
130. Spring Steel Tongs, for holding platinum cups or spoons in a flame, Fig. 130*a*, or Fig. 130*b*, 6d. each.

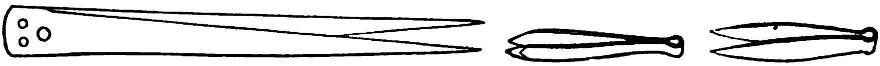

130.


130*b*.

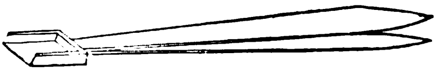
131. Spring Steel Tongs, mounted with platinum points, Fig. 131, 3s. 6d.

For other varieties of Blowpipe Tongs, consult the article "Blowpipe Apparatus."


131.


132*a*. *b*. *c*.

132. Brass Tongs, slight, for lifting weights, trimming lamp wicks, &c., Fig. 132 *a*, *b*, *c*, about $2\frac{1}{2}$ inches long, 3d. to 4d. each.
133. Iron Tongs for lifting weights, trimming lamps, &c., strong, about $4\frac{1}{2}$ inches long, form of Fig. 135, without the spoon, 9d.
135. Iron Tongs, with spoon-handle, form of Fig. 135, size above $4\frac{1}{2}$ inches long, 1s.

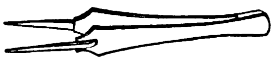

135.

137. Brass Tongs, polished, with fine points, 3s.

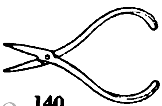

137.

138. Iron Tongs, the same pattern, 2s.

139. Brass Tongs, polished, with ivory points, 3s.


139.

140. Plyers, black steel, with rough points, useful in the repair of apparatus, Fig. 140, 2s.


140.

140A. Round Rosed Plyers, for bending wire into circles, for blowpipe experiments, &c., 2s. 6d.

141. Cutting Plyers, for cutting wires or pieces of minerals, 3s. 6d.

Also, many other kinds of Tongs, suitable for different descriptions of crucibles and furnaces.

Shears and Scissors.

142. Tinman's Shears for cutting sheet metals, 3s.

143. Scissors for cutting filters, trimming lamps, &c., 1s. 3d.

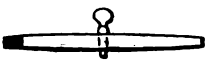
STOPCOCKS.

Solid Glass Stopcocks.

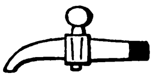
144. Stopcock in the middle of a straight narrow glass tube, 12 inches long, and about $\frac{1}{3}$ in. thick, 2s.

144, 145.

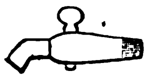
145. Stopcock in the middle of a straight tube, large size, $\frac{1}{2}$ to $\frac{3}{4}$ inch wide, and 20 inches long, Fig. 145, Bohemian glass, 7s. 6d.



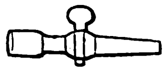
146, 147.



148, 149.



150.



151.

146. Stopcock in the middle of a straight tube, both ends conical, 6 inch, 2s. 6d.

147. Ditto, large size, Bohemian glass, massive, 6s.

148. Stopcock, the delivering end of which points downwards, 6 inch, 2s. 6d.

149. Ditto, large size, 8 inch, Bohemian glass, massive, 6s.

150. Stopcock, the delivering end of which points downwards, and is enlarged to receive a cork, 2s. 6d.

151. Stopcock in a straight tube, the delivering end of which is enlarged to receive a cork, 2s. 6d.

Stoneware Stopcocks.

152. Nearly resembling Fig. 149, $\frac{1}{4}$ inch, 3s., $\frac{1}{2}$ inch, 3s.

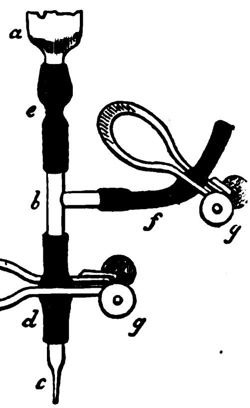
153. Nearly resembling Fig. 146, $\frac{1}{4}$ inch, 3s., $\frac{1}{2}$ inch, 3s.

Brass Stopcocks.—See "Pneumatic Apparatus," No. 697.

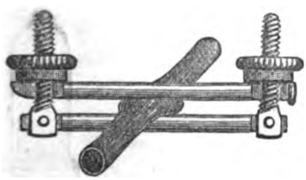
Pinchcocks.

156. Mohr's Pinchcock, Fig. 156 *g*, for closing flexible tubes, to prevent the passage of liquid or gases, three sizes :—

No. 1. Usual size for Alkalimeters, 6d.
2. Smaller than No. 1, 6d.
3. Larger than No. 1, 6d.



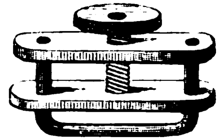
156.



157.

157. Bunsen's Lever Pinchcock, for regulating the flow of gases or liquids through flexible pipes, so as to keep up a constant action at a fixed rate, Fig. 157, 1s.

157A. The same, another pattern, Fig. 157 *a*, 1s.
157B. The same pattern, of much larger size, for 1 inch tubes, 1s. 6d.



157 *a*.

158. BRUSHES FOR CLEANING TEST TUBES AND BOTTLES.

1. Brush for cleaning test tubes that are of from ½ inch to 1 inch diameter, 3d., or 2s. 6d. per dozen.

158, 1.

2. Brush for cleaning narrow tubes, namely, those less than ¼ inch diameter, 2d., or 1s. 6d. per dozen.
3. Brush for cleaning long tubes or Alkalimeters, such as Mohr's Burette, form of Fig. 158, 1, but on long wire, 21 inch, 6d.
4. Brush to clean open narrow tubes, with bristles in the middle, Fig. 158, 4, 2s. per dozen.

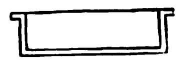
158, 4.

5. Brush for 5-ounce flasks, 4d.	7. Brush for 2-pint flasks, 8d.
6. Brush for 12-ounce flasks, 6d.	8. Brush for 3-pint flasks, 1s.

TRAYS.

Trays for holding jars in water when filled with gas. These trays also serve to hold acid bottles, and protect the table from corrosion.

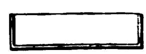
159. Round Trays, Berlin Semi-Porcelain, glazed, adapted to receive glass jars when filled with gas, to hold acid bottles, &c., depth ½ inch to 1¾ inch, Fig. 159.



159.

No. 000. 2½ inch, 3d.	No. 1. 4½ inch, 8d.	No. 4. 7½ inch, 1s.
„ 00. 3 „ 3d.	„ 2. 5½ „ 9d.	„ 5. 8½ „ 1s. 3d.
„ 0. 3½ „ 5d.	„ 3. 6½ „ 10d.	„ 6. 9½ „ 1s. 6d.

160. Round Trays of Saltglazed Stoneware, flat bottoms, vertical sides, form of Fig. 160, about 1 inch deep,



160.

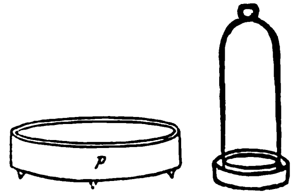
2 inch,	2d.	4 inch,	3d.	6 inch,	4d.
2½ inch,	2d.	4½ inch,	3d.	7 inch,	6d.
3 inch,	2d.	5 inch,	3d.	8 inch,	7d.
3½ inch,	2½d.				

161. The Set of 10 Trays, 2 to 8 inch, 2s. 9d.
162. The Set of 4 Trays, 3, 4, 6, and 7 inch, 1s. 2d.
163. Trays of white glazed Wedgwood Porcelain. Depth ¾ inch to 1 inch.

3 inch,	3d.	3½ inch,	3d.	4 inch,	4d.

164. Berlin Porcelain Tray, for Gas Tubes, 1¼ inch, 2d. Glass Trays, form of Fig. 160; see "Apparatus for Evaporation."
165. Earthenware Trays, yellow colour, glazed, form of Fig. 165, 2 inches deep.

9 inch diameter, 1s. | 12 inch diameter, 1s. 9d.



165.

166. Rectangular Trays, or Flat Pans, of Wedgwood Porcelain, in which to place acid bottles, small furnaces, &c.

Shallow Trays, $1\frac{1}{4}$ *to* $1\frac{1}{2}$ *inch deep.*

Length.	Width.	Price.	Length.	Width.	Price.
6 inches,	5 inches,	10d.	11 inches,	9 inches,	2s.
8 inches,	6 inches,	1s. 2d.	12 inches,	10 inches,	2s. 6d.
10 inches,	8 inches,	1s. 8d.	15 inches,	11 inches,	5s.

CORKS.

168. Best Quality.

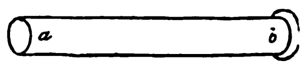
LONG CORKS.				BUNGS.			
No.	Diameter at small end.	Length.	Per Dozen.	No.	Diameter at small end.	Length.	Per Dozen.
1.	$\frac{3}{8}$ to $\frac{1}{2}$ inch.	$\frac{7}{8}$ inch.	2d.	8.	$\frac{3}{4}$ inch.	$\frac{5}{8}$ inch.	2d.
2.	$\frac{5}{8}$ inch.	1 inch.	3d.	9.	1 inch.	$\frac{1}{2}$ inch.	3d.
3.	$\frac{3}{4}$ inch.	$1\frac{1}{4}$ inch.	4d.	10.	$1\frac{1}{4}$ to $1\frac{3}{8}$ inch.	$\frac{5}{8}$ inch.	6d.
4.	$\frac{3}{4}$ inch.	$1\frac{3}{4}$ inch.	7d.	11.	$1\frac{5}{8}$ to $1\frac{3}{4}$ inch.	$\frac{5}{8}$ inch.	7d.
5.	$\frac{7}{8}$ inch.	$1\frac{3}{4}$ inch.	9d.	12.	$1\frac{1}{4}$ to $1\frac{1}{8}$ inch.	1 inch.	7d.
6.	1 inch.	2 inch.	1s. 3d.	13.	$1\frac{3}{8}$ to $1\frac{5}{8}$ inch.	$1\frac{1}{4}$ inch.	8d.
7.	$1\frac{1}{8}$ inch.	2 inch.	1s. 3d.	14.	$1\frac{7}{8}$ to 2 inch.	1 inch.	1s.

168a. Small Corks and bungs, assorted, 5s., 7s., and 10s. per gross.
168b. Larger Bungs, best quality, 30s. per gross.

CORK BORERS AND CORK SQUEEZERS.

Cork Borers, for piercing cylindrical holes in corks, so as to adapt glass tubes to gas bottles, &c., made of polished brass, with sharpened edges, 6 inches long, and respectively $\frac{1}{8}$, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$, $\frac{7}{16}$, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, $\frac{7}{8}$, 1, $1\frac{1}{4}$ inch in diameter.

Fig. 169 represents a Cork Borer: *a*, the sharpened end; *b*, the handle. The use of these borers saves a great quantity of time in the adjustment of tube apparatus for experiments with gases, and, if good corks are used, prevents, in many cases, the necessity of employing lutes. The borer should be kept well sharpened, and be slightly oiled when used.

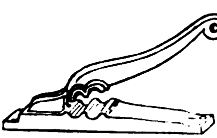


169.

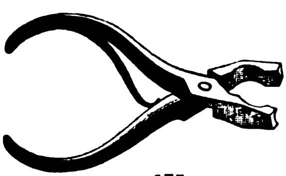
169. Price of the set of Twelve Borers, in a japanned tin case, with a flat file for resharpening the edges when necessary, and a rod for expelling the corks from the Borers, 5s.

170. The Six smallest Borers, polished and sharpened, with File, and Rod, in a case, 2s. 6d.

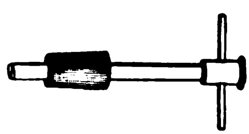
171. A selection of Four Borers, namely, those of $\frac{3}{16}$, $\frac{1}{4}$, $\frac{5}{16}$, $\frac{3}{8}$ inch diameter, with handles, polished and sharpened; per set, 1s.



174.



175.



172.

CORK BORERS, SUPERIOR QUALITY, strengthened with a collar and milled head, the collar being pierced to receive a steel rod, to help in pressing the borer through a large cork. Fig. 172.

172. The set of Twelve Borers, from $\frac{1}{8}$ inch to $1\frac{1}{4}$ inch bore, in a Case, with File and Steel Rod, ~~9s.~~ 10s

173. The set of Six small Borers, from ⅛ to 7/16 inch bore, in a Case, with File and Rod, 4s. 5,8

174. Cork Squeezers, japanned iron, Fig. 174.

a. Medium size, for corks up to 1 inch, 2s.
b. Massive, for large corks, 4s.

175. Cork Tongs, steel, Fig. 175, 3s. 6d.

The use of the Cork Squeezers and Cork Tongs is to soften corks by pressure, so as to increase their elasticity, and make it more easy to fit them air-tight to gas bottles.

176. Knife for cutting Corks, 1s.

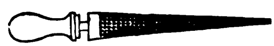
FILES AND RASPS, for Shaping Corks, all in neat Wooden Handles.

177. Round File, bastard cut, 4-inch, 8d.
178. " " 5-inch, 9d.
179. " " 6-inch, 10d.
180. " " 7-inch, 1s.
181. Flat File, " 6-inch, 9d.
182. " " 8-inch, 1s.
183. " " 10-inch, 18d.
184. Half Round File, bastard, 6-inch, 10d.
185. " " " 8-inch, 1s.

186. Flat Rasp, rough cut, 4-inch, 8d.
187. " " 8-inch, 10d.
188. Round Rasp, " 4-inch, 8d.
189. " " 5-inch, 10d.
190. " " 6-inch, 1s.
191. Half Round Rasp, 6-inch, 1s.

192. Flat File for sharpening Cork Borers, 6d.

177.



186.

192a. Shoemakers' Last Rasp, with a File cut on its back, without handle, 10d.

192 *a.*

193. Elastic Air-Tight Stoppers for Bottles or Tubes, of the form of Corks, but made of Vulcanised Caoutchouc.

N.B.—These Stoppers are solid, but can be easily pierced with holes to fit glass tubes by means of the ordinary Cork Borers, which must be sharp, clean, and wetted with alcohol when used for this purpose. See Fig. 172.

No. 0	1	1 (*a*)	2	3	3 (*a*)	4	5	5 (*a*)	6	7	8	9	10
in. ½ to 5/16	in. ⅝ to ½	in. ¾ to ⅝	in. ⅞ to ¾	in. 1 to ¾	in. 1⅛ to ⅞	in. 1¼ to 1	in. 1⅜ to 1⅛	in. 1¼ to 1½	in. 1¾ to 1½	in. 1⅞–1⅝	in. 2⅛–1¾	in. 2 to 2¼	in. 2¼–2½
1/9	2/4	2/6	3/	4/	4/9	5/	6/6	7/	8/	9/6	11/6	16/	18/

193a. Red Caoutchouc Cones or Stoppers, devulcanised. Size, about 5½ inches long, ¾ inch at small end, and 1½ inch at large end. These stoppers can be cut to any length, and afford an easy method of fitting tightly any medium-sized orifice. Price, 2s. 6d. each.

ATOMIC SYMBOLS.

194. Atomic Symbols for the Illustration of Theoretical Subjects at Chemical Lectures: consisting of Coloured Cubes of Pottery, about two inches square, intended to represent chemical atoms or gaseous volumes. They can be easily grouped so as to illustrate the atomic constitution of compounds, the theory of combination in volumes, and the double decomposition of salts, and to illustrate various chemical doctrines by equations.

The following series of sixty models is sufficient to explain the formulæ of most frequent occurrence. *Price of the Set of Sixty Models, in a neat Black Wood Cabinet*, 31s. 6d.

195. The Models separately at the following prices :—

White Biscuit Ware, 4d.
Painted any Colour, 6d.

Gilt, Silvered, Coppered, or Two Colours, 8d. each.

Colour of Models.	Elements Indicated.	Pieces in the Set.	Colour of Models.	Elements Indicated.	Pieces in the Set.
Black	Carbon	10	Pink	Phosphorus	2
Pale Blue	Hydrogen	20	Gold Bronze	Light Metals	2
Scarlet	Oxygen	6	Copper Bronze	Heavy Metals	2
White	Nitrogen	4	Blue and Black	Organic Radicals	4
Pale Green	Chlorine	4	Brown	Neutral Gases	4
Yellow	Sulphur	2			

STENCILS FOR PREPARING DIAGRAMS.

196. Diagram Alphabets, or sets of Stencil Plates, for making letters or figures upon diagrams, cut in thin zinc.

A, B, C, to Z.	a, b, c, to z.	Set of 10 Figures.
1 inch, 3s.	1 inch, 3s.	1 inch, 1s.
2 „ 6s.	2 „ 6s.	2 „ 2s.
3 „ 7s. 6d.	3 „ 7s. 6d.	3 „ 3s. 6d.

197. Cakes of Black Ink for stencil painting, 4d. 198. Stencil Brushes, 4d.

199. Diagram Paper, very stout, hard sized, bearing colours ; size, 56 inches by 36 inches ; per sheet, 4d. 200. Ditto, per quire, 6s.

201. Diagram Paper, mounted on cloth, in sheets measuring 56 inches by 36 inches ; per sheet, 2s.

CHEMICAL DIAGRAMS FOR CLASS ILLUSTRATIONS, consisting of large Coloured Engravings, mounted on cloth, with brass eyelet holes to facilitate suspension by hooks.

203. Diagram of a Gas-Works, showing the progress of the gas from the retort where it is made through the condensers, purifier, governor, meter, into the main ; size, 33 inches by 63 inches ; coloured, mounted on cloth, 5s.

204. Diagram of the Interior of a Glass-House, with glass-blowers at work ; size, 35 inches by 52 inches ; coloured, mounted on cloth, 3s. 6d.

205. Diagram, showing the chief Chemical Ingredients in twenty-three of the most important articles of Food ; size, 35 inches by 78 inches ; coloured to show percentages ; mounted on cloth, 5s.

206. Diagram of National Dietaries ; coloured to show the chief chemical ingredients of the food in ounces per week ; eleven examples ; size, 35 inches by 26 inches ; mounted on cloth, 1s. 6d.

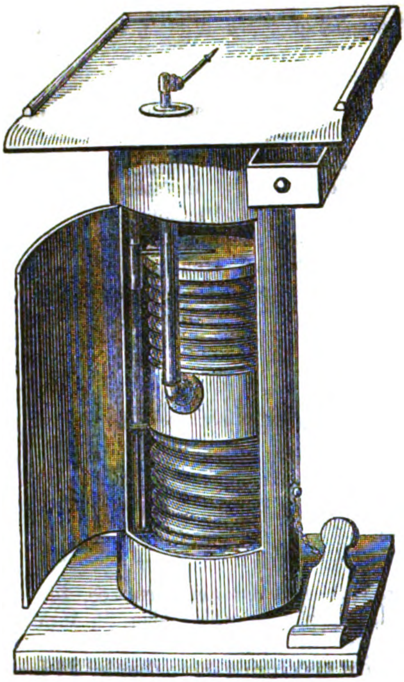
GLASS-BLOWING.

211. Glass-blower's Table, 31 by 22 inches, covered with zinc ; 14-inch double bellows, with brass ball and socket jet, and two iron weights for the bellows, £4, 4s.

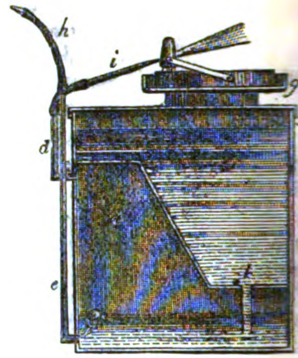
Letter *c*, Fig. 211, represents the gas jet, No. 227.

212. Another similar Table, of smaller size, top 27 by 18 inches, covered with zinc, bellows 12 inches, £3, 12s.

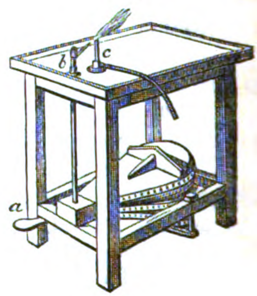
214. Glass-blower's Table, French pattern, with circular bellows, in iron cylinder, and hardwood foot and table, top covered with zinc, 24 by 18 inches, with ball and socket jet, Fig. 214, £4, 4s.



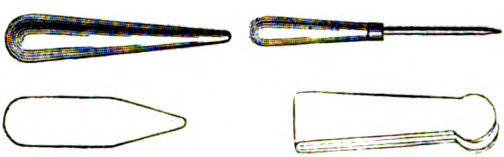
214.



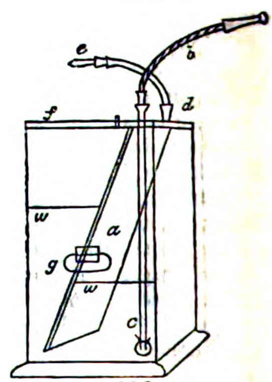
215.



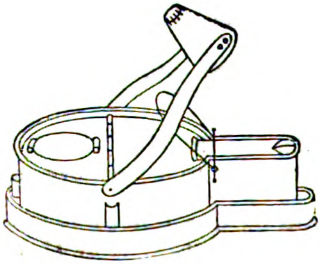
211.



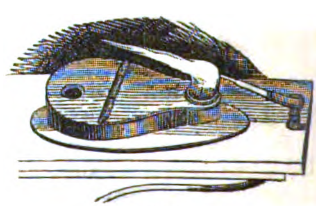
228.



216.



223.

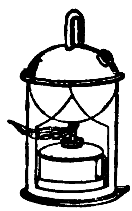


224.

215. Table similar to No. 214, but having four legs, as in Fig. 211, to support the table, all of hard wood, £4, 14s. 6d.
216. Table, &c., same as the last, but made of deal wood, £4, 4s.
217. Tate's Water-pressure Blowpipe, Fig. 215. This apparatus serves also for use as a pneumatic trough, and will be found so described under the head of Gas Apparatus, 16s.
218. Tilley's Water-pressure Blowpipe, Fig. 216, height 17 inches, width 5 inches, length 9 inches, japanned tinplate, 15s.

a, partition separating the apparatus into two parts; *w*, *w*, height of the water; *b*, flexible cloth pipe by which air is blown in; *c*, valve to prevent the return of water; *d*, flexible metal pipe leading to the flame; *e*, glass jet; *g*, one of two handles by which the blowpipe can be strapped to a stool.

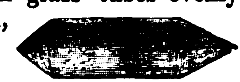
221. Eolipile, or Spirit Blowpipe, with copper ball, for bending glass tubes, 5s.
223. Danger's Improved Glass-blower's Lamp, with arrangement for altering the size and height of the wick, and hood to prevent smoke, increase the heat, and keep the flame from the operator's eyes, and with tray to catch overflowing oil, Fig. 223, 4s. 6d.
224. Glass-blower's Lamp, common oval form, with tray, tinplate, Fig. 224, 3s.


221.

225. Cotton Wick for the Glass-blower's Lamp, per bundle, sufficient for three large wicks, 1s.
226. Blowpipe Jet to screw to a table, with ball and socket joint, adapted either for a lamp or a gas flame, Fig. 211 *b*, and on Fig. 214, 6s. 6d.
227. Gas-burner to use with the Glass-blower's Table, with foot and stopcock, *c*, Fig. 211, 2s. 6d.
228. Set of Glass-blower's Tools, consisting of iron rod in handle, iron cone, pair of flat brass tongs, flat iron plate, Fig. 228, 2s. 6d.
229. Triangular File for cutting glass tubes, 3 in., with handle, 8d.


229.

230. Pastilles, Fig. 230, but 6 inches long; for cutting off the necks of retorts, flasks, &c., and dividing thick glass tubes evenly, (being applied with a red-hot point), per dozen in a box, 1s. 6d.

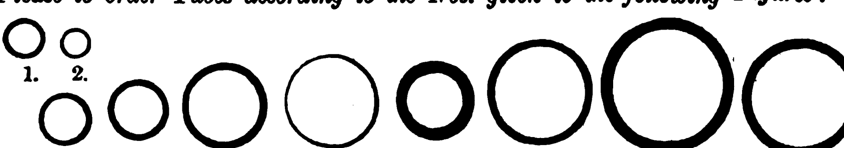

230.

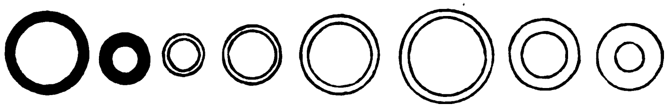
231. *a*, Cutting Diamond, for cutting glass plates, 18s.;
b, Writing or Scratching Diamond, for writing labels, &c., 5s. 6d.;
c, Ditto, superior, with turned point, 8s. 6d.

GLASS TUBES.

Glass tubes are kept in stock, in pieces from 3 to 4 feet long, sometimes 6 feet long; but it often happens that it is not easy, or rather, not *economical* to pack them when of that length. On this account, when only 1 lb. or 2 lbs. is ordered, they are generally cut to the length of 18 to 24 inches. Those who desire to have them of the full length are desired to give orders to that effect, in which case packing boxes will be made to suit them.

Please to order Tubes according to the Nos. given to the following Figures:—


1. 2. 3. 4. 5. 6. 7. 8. 9. 10.



11. 12. 13. 14. 15. 16. 17. 18.

232. One pound of any kind of Glass Tube, from No. 234 to 238, at 1s. 2d.
233. Twenty pounds, assorted, at 1s.
234. Soft French Glass, free from lead, easy to work at a lamp, adapted for gas delivery tubes, $\frac{1}{8}$, $\frac{1}{4}$, $\frac{3}{8}$, and $\frac{1}{2}$ inch diameter.
235. Soft German Glass, free from lead, from $\frac{1}{4}$ inch to $\frac{3}{4}$ inch diameter.
236. Hard Bohemian Tube, $\frac{1}{8}$, $\frac{1}{6}$, $\frac{1}{5}$, $\frac{1}{4}$ inch in diameter, for blowpipe experiments.
237. Soft Bohemian Tube, free from lead, from $\frac{1}{4}$ inch to $\frac{3}{4}$ inch diameter.
238. Bohemian Combustion Tubes, for organic analyses, of the most infusible glass, $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$ inch bore.
240. Short Lengths (6 to 11 inches) of Bohemian Hard Glass Tube, $\frac{1}{2}$ inch to $\frac{3}{4}$ inch bore, per lb. 4d.
241. Solid Glass Rod, for making stirrers, from $\frac{1}{8}$ inch to $\frac{1}{2}$ inch diameter, 1s. 2d. lb.
242. Spindle Tube, of hard glass, size of Figs. 1 to 5, but extremely thin in the glass, in order that minute crystals of arsenious acid or other sublimates, deposited inside, may be brought easily within the focus of high powers of the microscope, per lb. 1s. 9d.
243. Enamel Glass, for thermometers, &c., per lb. 2s. 6d.

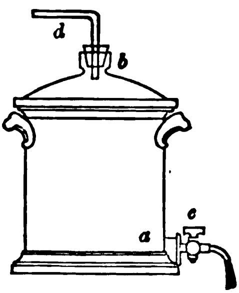
GAUGE TUBES.

244. Bohemian Glass Tubes for Steam-engine Boiler gauges, of infusible well-annealed glass, capable of enduring sudden changes of temperature without cracking; substance of the glass $\frac{1}{10}$ inch to $\frac{1}{12}$ inch.
  a. Any length from 12 to 15 inches, and $\frac{1}{2}$ inch to $\frac{5}{8}$ inch outside diameter, per dozen, 6s.
  b. Any length from 16 to 18 inches, and $\frac{1}{2}$ inch to $\frac{5}{8}$ inch outside diameter, per dozen, 7s.

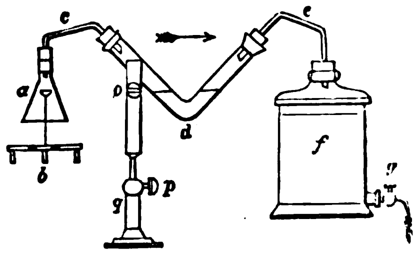
SUPPLY OF WATER. ASPIRATORS, WATER BOTTLES.

245. When a vessel which is sufficiently large to contain a considerable quantity of water is provided with one narrow neck at the top and another at the side near the bottom, it can be used both as a water bottle to supply the condensing water required in distillations, or as an aspirator to draw gases through liquids.

Thus, Fig. 246 represents a WATER BOTTLE, which supplies water by the tap *c*, fixed in the neck *a*, while air enters through the tube *d*, fixed in the neck *b*. And Fig. 247 represents an ASPIRATOR, where the discharge of water from the tap *g* causes a current of air to pass from the funnel *a*, in the direction *c*, *d*, *e*, into the bottle *f*, acting in its passage chemically upon the liquid placed in the tube *d*. Vessels made for these purposes may be made of glass, stoneware, or metal; and the stopcocks, or taps, of glass, stoneware, or brass. The capacity must be regulated by the work intended to be done.



246.



247.

246. Water Bottle, form of Fig. 246, cylindrical saltglazed stoneware :—

1.	Contents, 1 gallon,	2s.	Or fitted with brass tap,	3s. 6d.
2.	„ 2 „	4s.	„ „	5s. 6d.
3.	„ 3 „	6s.	„ „	7s. 6d.
4.	„ 4 „	8s.	„ „	10s. 0d.
5.	„ 5 „	10s.	„ „	12s. 0d.
6.	„ 18 „	54s.	„ „	56s. 0d.

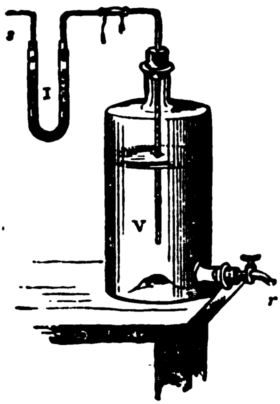
248. Water Casks, Barrel form, saltglazed stoneware, with brass taps :—
1 gallon, 4s. ; 2 gallons, 6s. ; 4 gallons, 10s.

249. Water Bottles, German glass, tall cylindrical form, with neck at the side, Fig. 249, but without stopcock.

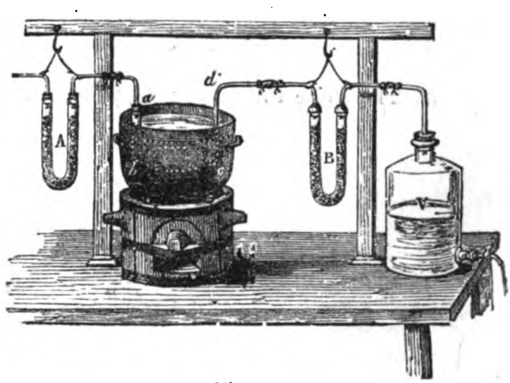
½ pint,	10d.	3 pints,	1s. 9d.	1 gallon,	3s. 6d.
1 „	1s. 0d.	4 „	2s. 6d.	2 „	6s. 6d.
2 „	1s. 6d.	5 „	3s. 0d.	(*These two are French.*)	

250. Water Bottles, German glass, with two necks, Fig. 250, V, with glass stopcock, ground to the lower neck :—

6 pints ...	8s.	10 pints ...	10s.	20 pints ...	14s.
8 „ ...	9s.	16 „ ...	12s.	24 „ ...	16s.

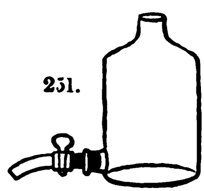


249.



250.

251. Water Bottles of fine white Bohemian glass, with a massive glass stopcock ground to the neck at the side, Fig. 251, capacity 25 to 30 pints, 18s.



251.

252. Water Bottles, Bohemian glass, with two necks, Fig. 251, but without stopcock.

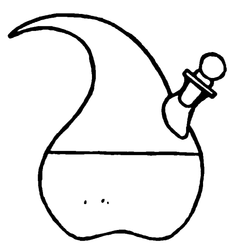
Contents, 2 pints,	2s.	Contents, 10 pints,	8s.
„ 4 „	3s.	„ 20 „	12s.
„ 8 „	6s.	„ 30 „	14s.

254. Water Bottle, with double tubes, intended for supplying a small quantity of water, or for easily filling tubes and narrow-mouthed vessels with water without using a funnel; Half-pint size, 1s., Pint size, 1s. 6d.

255. Water Bottles for supplying water to flasks, small tubes, filters, &c., stoppered. Can be used with hot water if required.

No. 1.	Contents	2 ounces,	6d.
2.	„	24 „	1s. 6d.
3.	„	36 „	2s. 0d.

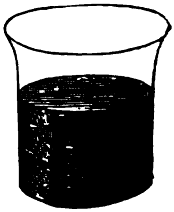
254.



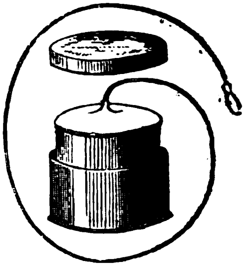
255.

256. **Stoneware Stopcock for Water Bottles and Filters**, 3s. 6d.

257. **Strong Glass Cylindrical Vessel**, beaker form, of fine white Bohemian glass, to receive water when run from an aspirator, or to serve as a well in hydrostatic experiments, or as a dye-bath, &c., capacity about 30 pints, 10s. 6d.



257.



A.

FILTERS.

258. **Silicated Carbon Filters**—

A. Syphon Filters for Travellers, Fig. *A.*

No. 1.	$2\frac{1}{2}$ inch,	2s. 6d.	
„ 2.	$3\frac{1}{2}$ „	5s.	
„ 3.	$3\frac{1}{2}$ „	with plated tap, 7s.	

B. Table Filter, Fig. *B.*

No. 1.	plain, 5s.;	ornamental, 7s. 6d.
„ 2.	„ 7s. 6d.;	„ 10s.

C. Domestic Filter, Fig. *C.*

No. 1. 2 gallons, 21s. | No. 2. 4 gallons, 32s.

Ice compartments, 4s. extra.

D. The Prize Filter, Fig. *D*, price, with electroplated tap, £3, 10s.

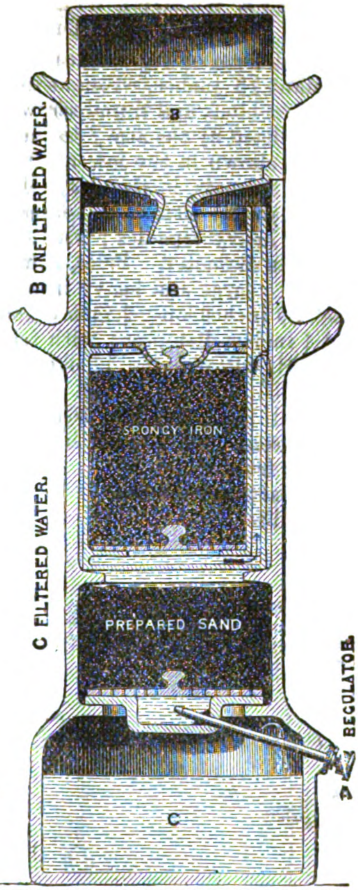
B.

C.

D.

259. **Bischof's Patent Spongy Iron Filter**, officially recommended by Royal Commission as the most efficient filter for domestic purposes, and superior to all other filters tested. See Sixth Report of "The Royal Commission on Rivers Pollution," on the domestic water supply of Great Britain, presented to Parliament by command of her Majesty (session 1875), p. 219, also the Report of the Registrar-General for 8th January, 1876 (p. 2, 6, and 7).

SECTION OF SPONGY IRON VESSEL.



BOTTLE
FOR HAND SUPPLY.
RUSTIC PATTERN.

SECTION OF FILTER WITH BOTTLE & SPONGY IRON VESSEL IN POSITION.

Prices, "A," or Column Pattern, Plain or Rustic, ex depot, charged with filtering materials.

No. of Filter.	Yield in 24 hours.	Domestic Filters. With Bottle. £ s. d.	Ship Filters. With Bottle. £ s. d.	Packing for Transport. s. d.	Materials for Re-charging Spongy Iron. s. d.	Sand. s. d.
1.	9 galls.	1 10 0	2 0 0	2 0	1 9	1 0
		With Cover.				
2.	16 „	2 2 0	2 15 0	3 0	2 6	1 6
3.	24 „	2 15 0	3 10 0	4 0	3 9	2 3
4.	32 „	3 10 0	4 7 6	5 0	5 3	3 3
5.	48 „	4 7 6	5 7 6	6 0	6 9	4 3
6.	64 „	5 5 0	6 6 0	7 0	8 3	5 3

Bottles for supplying Filter, 2s. 6d. to 8s. each, according to size. Glass Ball-cocks for constant water supply, 6s. and 7s. each. Screw arrangement for fastening bottle to ship filters, 5s. extra.

A small size for office use, &c., price, 17s. 6d.

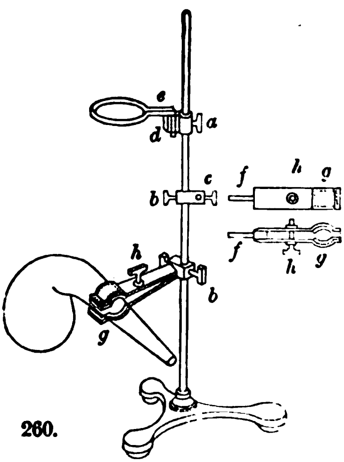
Supports for Apparatus.

Class I.—MASSIVE RETORT STANDS, with Iron Rods of $\frac{5}{8}$, $\frac{3}{4}$, or $\frac{7}{8}$ inch Diameter.

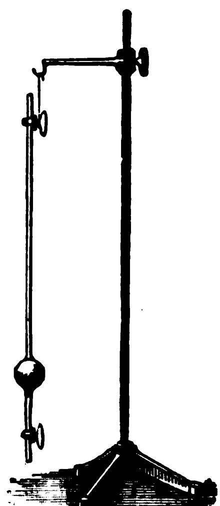
260. Retort Stand, form of Fig. 260, cast-iron foot, with flat upper surface and three balls distant 13 inches, wrought-iron rod 36 inches long, $\frac{7}{8}$ inch diameter; *c*, solid brass block and thumbscrew; *g*, strong brass vice, 6 inches long by $1\frac{1}{2}$ inch wide, fitted by the arm *f* to the hole *c*. This vice serves to support heavy Retorts, as shown in the lower part of the figure; the mouth of the vice is lined with chamois leather; *a*, solid brass socket with thumbscrew, having a square vertical socket, *d*, adapted to the arm of a solid brass ring, for supporting heavy capsules; with three solid brass cast rings, 5 inch, 6 inch, and 7 inches diameter. Price, complete, 21s.

261. Retort Stand; large and heavy iron tripod base, 13 inches from end to end; iron rod, 36 inches long, $\frac{3}{4}$ inch diameter; three malleable cast-iron rings, 9, $6\frac{1}{2}$, and 4 inches diameter; with triangular collars and thumbscrews; form of Fig. 261, without the blocks and branches marked *a*, *b* (for which see Nos. 278, 281, and 285). 12s.

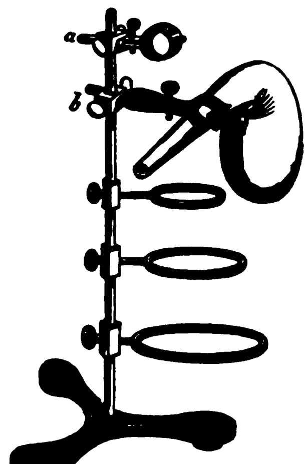
261A. Iron Tripod Base, like Fig. 261, but heavier, with brass levelling screw in the feet, strong iron rod 48 inches high, with iron block and sliding horizontal rod, from which to hang apparatus on the lecture table, 18s.



260.



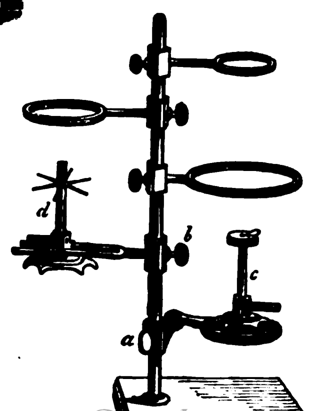
261 *a*.



261.

262. Retort Stand; rectangular iron foot, $9\frac{1}{2}$ by 6 inches; iron rod, 28 inches long, $\frac{5}{8}$ inch diameter; three rings of malleable cast-iron, $6\frac{1}{2}$, 5, and 3 inches diameter; with triangular collars and screws; form of Fig. 262, exclusive of the parts marked *a*, *b*, *c*, *d* (for which see Nos. 273 and 274, and the article "Gas Burners"). 7s. 6d.

263. Retort Stand; rectangular iron foot, $9\frac{1}{2}$ by 6 inches; brass rods, 30 inches long, $\frac{5}{8}$ inch diameter; with four strong turned brass rings, $6\frac{1}{2}$, 5, 4, and $2\frac{1}{2}$ inches diameter; made with square arms that slip into square sockets of the form shown by *a*, *d*, *e*, Fig. 260; with two sockets. 16s.



262.

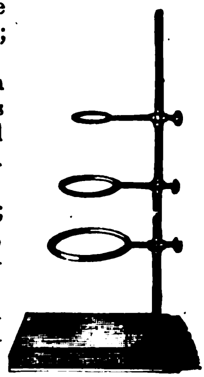
Class II.—RETORT STANDS OF MEDIUM SIZE, having Iron Rods of ½ inch diameter.

264. Retort Stand; rectangular iron foot, 7½ by 4½ inches; brass rod, 20 inches long, ½ inch diameter; three turned brass rings, 4½, 3½, and 2¼ inches diameter; made with square arms that slip into square sockets in the manner represented by *a*, *d*, *e*, Fig. 260; with two sockets. 12s.

265. Retort Stand; rectangular iron foot, 9½ by 6 inches; iron rod, 24 inches long, ½ inch diameter; three turned brass rings, 5½, 3½, and 2½ inches diameter, each connected with a triangular socket and thumbscrew, Fig. 265. 10s. 6d.

266. Retort Stand; rectangular iron foot, 9½ by 6 inches; iron rod, 24 inches by ½ inch; four bronzed brass rings, 5½, 4½, 3½, 2¼ inches; with brass collars and thumbscrews. 8s.

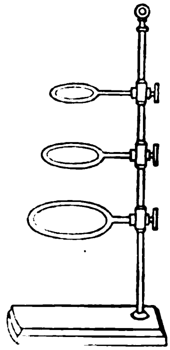
267. Retort Stand; rectangular iron foot, 7½ by 4½ inches; iron rod, 24 inches by ½ inch; three iron rings, 5½, 4½, 3½ inches; with triangular collars and thumbscrews of the form shown by Figs. 287, 278. 6s.



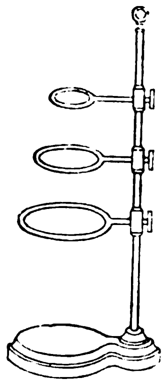
265-6-7-8.

268. Retort Stand; rectangular iron foot, 7½ by 4½ inches; iron rod, 20 inches long, ½ inch diameter; three bronzed brass rings, 4½, 3½, 2½ inches diameter. 6s.

269. Retort Stand, oval iron foot, 6 inches diameter; iron rod, 20 inches long, ½ inch diameter; three iron rings, 4½, 3¼, 2 inches diameter; with triangular collars and thumbscrews of the form shown by Figs. 287, 275. 4s.



268.



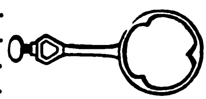
269.

EXTRA FITTINGS FOR LARGE RETORT STANDS.

These fittings are provided with triangular collars, which are made of two sizes: the larger of which suits vertical rods of ¾ inch or ⅝ inch in diameter, and the smaller suits rods of ⅝ inch and ½ inch diameter.

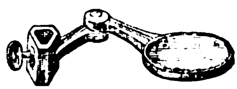
272. Extra Ring, having three teeth projecting inwards, to support basins over a lamp without cutting off the rising hot air, and without permitting the vessels to become *fixed* in the rings, attached to triangular collars with thumbscrews. Fig. 272. *Four sizes:—*

1.	Ring,	5	inch, collar to fit	½	inch and	⅝	inch Rods,	1s. 8d.
2.	„	6¼	„ „ „	½	„	⅝	„	1s. 9d.
3.	„	6½	„ „ „	⅝	„	¾	„	2s. 0d.
4.	„	9	„ „ „	⅝	„	¾	„	2s. 6d.



272.

273. Iron Table, 4½ inches diameter, to support spirit lamps, gas burners, &c., upon the Retort Stand, with triangular socket and thumbscrew, and hinged arm, represented by Fig. 273, and by *a* in Fig. 262, suitable for ½ inch and ⅝ inch rods. 3s.



273.

274. Fork, to support Bunsen's Gas Burner on a Retort Stand, with triangular collar, suitable for ½ in. and ⅝ in. rods, represented by *b* in Fig. 262, 1s. 9d.

275. Iron Block, for attaching to a Retort Stand the following fittings, being such as require a rotating movement for their adjustment. It has a vertical triangular collar to suit the rod of the retort stand, slotted in such a manner as to render it removable from the rod laterally without disturbing other rings, &c., and a horizontal collar of the same form (*unlike the Fig.*) to suit the handles of the respective fittings, Fig. 277:—

276. Block adapted to ½ inch and ⅝ inch rods, 1s. 6d.

277. Block adapted to ⅝ inch and ¾ inch rods, 1s. 9d.

275.

278. Iron Block, with one Side slotted, as shown in Fig. 275, and the other side, or collar, so made that rods can be held either horizontally or perpendicularly. This is the most useful form of Block. Large size, 2s. 6d.; Small size, 2s.

279. Desaga's Clamp, with universal joints to admit of motion in every direction, japanned iron with brass screws, Fig. 279, letters *h* to *n*. Price 6s. 6d.

Letter *e* represents the iron block No. 277, and *f* is the thumbscrew that fixes it at the required height on the rod of the Retort Stand; *g* fixes the arm of the clamp *h*, or allows it to be pushed backwards and forwards, or turned round about. The screw *i* permits the clamp *k* to be turned round horizontally. The screw *l* regulates the opening of the clamp, by working against a spiral spring, which tends to keep the jaws of the clamp apart. *n* and *n* are the forks or jaws of the clamp. Opposite *m*, at the end of the bar leading from *l*, is a screw which permits the upper jaw of the clamp to turn a little about, so as to adapt the figure of the two forks to the conical shape of retort neck.

The Retort Stand, Fig. 279, represents also the following articles:—

279A. Iron Rod and Foot, form of Fig. 279 A; size of foot, 9½ inches by 6 inches; rod, 28 inches long, ⅝ inch diameter. 4s. 6d.

279B. Plain Malleable Cast-Iron Rings, with bar, adapted to the block No. 278; 3 inch Ring, 8d.; 5 inch, 10d.; 6½ inch, 1s. 2d.; 9 inch, 1s. 6d. Fig. 279 *b*.

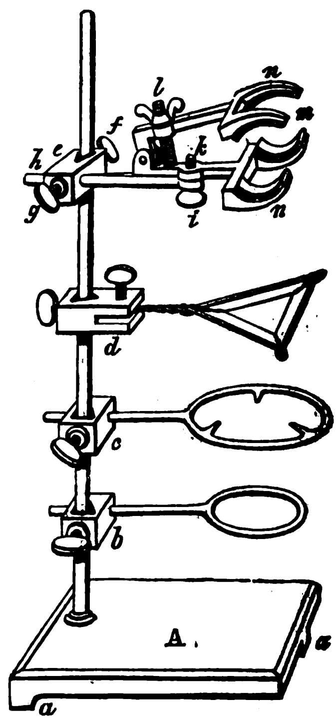
279C. Toothed Rings, similar to Fig. 272, but having an arm adapted to the iron blocks; 5 inch Ring, 10d.; 6½ inch, 1s. 2d.; 9 inch, 1s. 6d. Fig. 279 *c*.

279D. Vice to secure the ends of triangles (see Nos. 299 to 308). 3s. Fig. 279 *d*.

Some of the triangles can be held by the block No. 277, and others can be simply laid across a large ring.

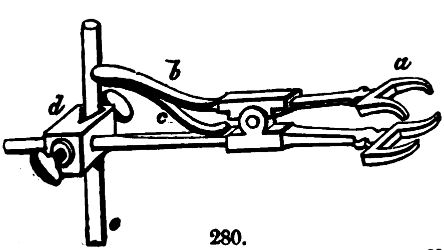
280. Von Babo's Iron Clamp to fasten Retorts to Retort-holders; length from end of *a* to end of *b*, 8 inches. Fig. 280. Price without block, 5s. 6d.

The Retort is held between the forks *a*. The upper fork is movable on its axis, to adapt the holder to the conical shape of the retort neck. The lever *b* serves to loosen the grip of the forks. The spring *c* keeps the forks close together when there is no pressure on the lever *b*; consequently, the action of the clamp is readily modified, and the Retort easily placed in any desired position. *e* is the rod of the Retort Stand, and *d* the block by which the clamp is fastened to it.

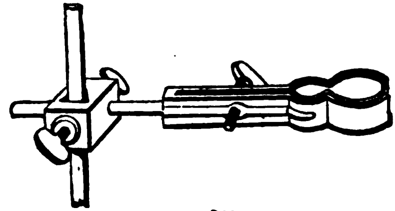


279.

281. Iron Vice for fixing Retorts to a Retort-holder; form of Fig. 281; length of the vice part, 7 inches; with hinge (not represented in the figure). Price, without the block, 3s. 6d.



280.



281.

282. Iron Vice, of similar form but smaller size; length of the vice part, 5 inche Price, without the block, 2s. 6d.

285. Iron Vice, form of Fig. 283; length of vice part about 3 inches; adapted to Blocks 276 and 277. Price, without block, 1s. 9d.

283.

283 Iron Vice, form of Fig. 283 *a*, but larger size; length of vice part about 4 inches; adapted to Blocks 276 and 277. Price, without block, 2s. 6d.

284. Brass Vice for fixing a Retort to a Retort-holder, represented by *f, g, h*, Fig. 260, and by *b*, Fig. 261, made of strong brass plates, 6 inches long, and $1\frac{1}{2}$ inch wide; with screw. Price, without the block, 5s.

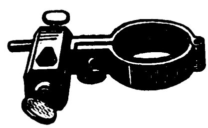
285A. Brass Vice, form of Fig. 283, with brass block and thumbscrew, adapted for retort-stand rods.

285B. No. 1 size, to fit $\frac{3}{8}$ inch rods, price 3s.

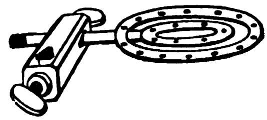
285C. No. 2 „ „ $\frac{1}{2}$ „ „ 4s.

285D. No. 3 „ „ $\frac{1}{2}$ „ „ 5s. 6d. No. 3 is like Fig. 281.

286. Condenser Collar, consisting of a strong iron collar for fixing a Liebig's Condenser to a Retort-holder, Fig. 285, which shows the collar in connection with a block, No. 277. Price of the collar alone, 3s.



285.



286.

286A. Gas Branch for attaching to the iron block No. 277, by which gas may be adjusted below any article that requires to be heated. See article "Gas Burners," No. 936, for particulars.

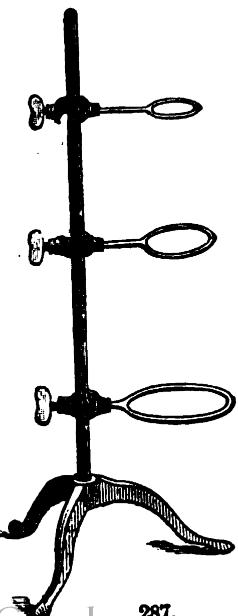
Whenever it is desired to expose to heat small objects upon the rings of large Retort-stands, aid must be derived from the TRIANGLES described at Nos. 299 to 308.

CLASS III.—SLIGHT RETORT STANDS, HAVING IRON RODS OF LESS THAN $\frac{1}{2}$ INCH DIAMETER.

287. Retort Stand, tripod foot, form of Fig. 287, with 3 rings, iron rod; rod 15 inches long, $\frac{3}{8}$ inch diameter; three cast-iron rings, $3\frac{1}{2}$, 3, and 2 inches, with collars similar to the block, Fig. 278 A, each of which can be removed from the rod without disturbing the rest. Price, 3s.

288. Retort Stand; rectangular iron foot, $5\frac{1}{2}$ by $3\frac{1}{2}$ inches; iron rod, 14 inches long, $\frac{3}{8}$ inch diameter; three bronzed brass rings, $3\frac{1}{2}$, $2\frac{1}{2}$, $1\frac{1}{2}$ inch; with brass collars and thumbscrews, Fig. 287. 2s. 3d.

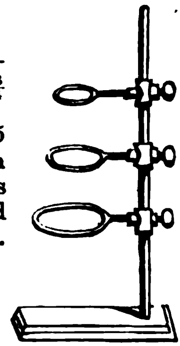
289. Retort Stand; rectangular iron foot, 3 by 2 inches; iron rod, 7 inches long, $\frac{1}{5}$ inch diameter; one brass ring, $1\frac{3}{4}$ inch; with collar and thumbscrew. 1s.



287.

290. Retort Stand, similar to the preceding, but with two brass rings, $1\frac{3}{4}$ inch and $1\frac{1}{4}$ inch. 1s. 6d.

291. Retort Stand; round iron base, 5 inches diameter, on three feet; iron rod, 11 inches by $\frac{3}{8}$ inch; one brass ring, 3 inches; with collar and thumbscrew, and one iron triangle. Fig. 291. 1s. 9d.



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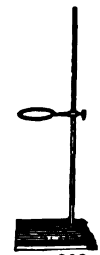
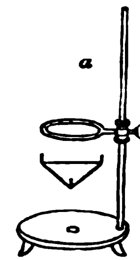


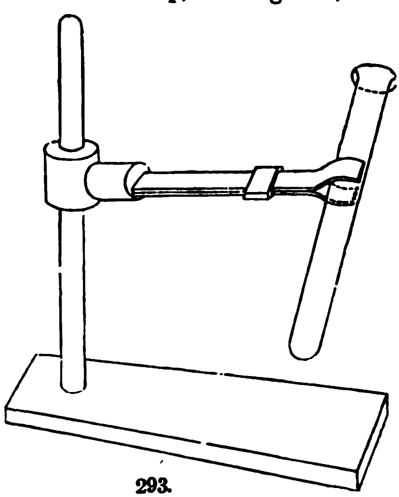
289.



291.

CLASS IV.—TUBE CLIPS, TRIPODS, TRIANGLES, &c.

292. Brass Tube Clip, like Fig. 388, with block to attach it to a $\frac{3}{8}$ inch rod, 1s. 9d.



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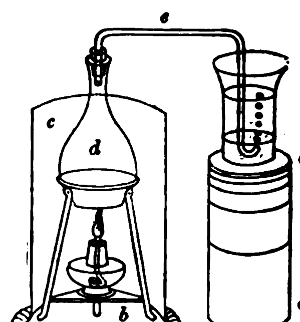


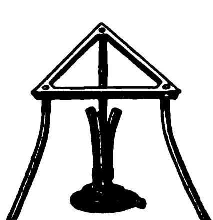
295.

293. Griffin's Tube Holder, for supporting tubes, retorts, and flasks over a lamp; japanned iron plate, with 16-inch rod and a foot of polished black wood. strongly made, Fig. 293, 2s.

294. The same, with rod and foot, of polished mahogany, 2s. 6d.

295. Tripod Stand, for supporting Flasks and Retorts over a small spirit lamp, tinplate body, with zinc legs, Fig. 295 *b*, 1s. 6d.

296. Screen to use with the Tripod Stand, to preserve the flame of the spirit lamp from currents of air, 12 inches high, zinc, Fig. 295 *c*, 1s.



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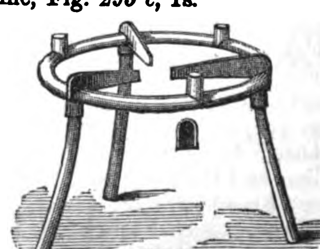
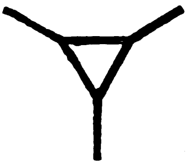


298.

297. Iron Tripods, or Triangles on three iron legs. Fig. 297.
No. 1. 5-inch triangle, 8 inches high, 9d.
No. 2. 8-inch triangle, 9½ inches high, 1s.
No. 3. 10-inch triangle, 9½ inches high, 1s. 3d.

298. Iron Tripod, circular form, Fig. 298, on three iron legs, 9½ inches high, adapted for the support of large or small objects. The three upright knobs are covered by clay caps to prevent large basins cracking, 3s.

TRIANGLES, to support Crucibles, Basins, &c., on Rings, Tripods, or Furnaces. The following measurements signify the length of one side of the Triangle. In general, each *Arm* is equal in length to one of its *Sides*.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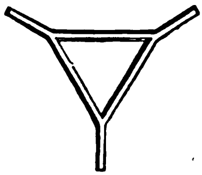
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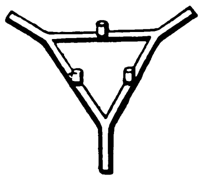
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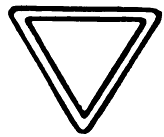
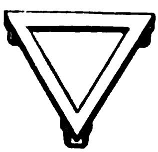

304.

299. Iron Wire Triangles, with twisted arms, Fig. 299. 3-inch, 2½d.; 4-inch, 3d.; 6-inch, 4d.
300. Malleable Cast-Iron Triangles, Fig. 300. 3-inch, 2d.; 5-inch, 3d.
301. Malleable Cast-Iron Triangles, with pegs on which fireclay cylinders can be supported, to keep basins, &c., from contact with the hot iron, Fig. 301. 3-inch, 3d.; 5-inch, 4d.
302. The same, with the pegs placed where the arms join the triangle, same price as No. 301.
303. Fireclay Cylinders for ditto, per set of three, 6d.
304. Malleable Cast-Iron Triangles, without arms, slender, Fig. 304. 5-inch, 6d.; 8-inch, 9d.; 10-inch, 1s.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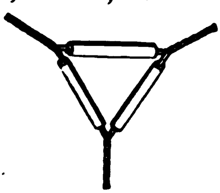
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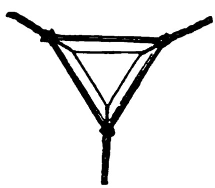
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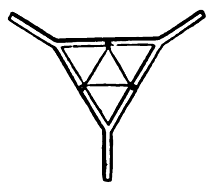
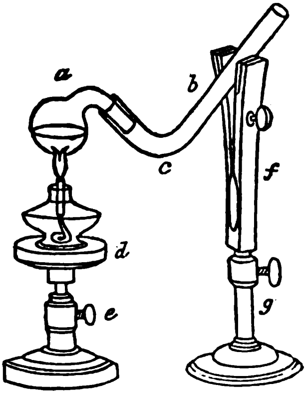

308.

305. Massive Cast-Iron Triangles, with short feet, Fig. 305. 7-inch, 9d.; 8-inch, 9d.; 10-inch, 9d.; 11-inch, 1s.; 12-inch, 1s.
306. Iron Wire Triangle, mounted with clay pipes, to prevent contact of the hot iron with a platinum crucible, Fig. 306, 4-inch, 3d.
307. Stout Iron Wire Triangle, 3-inch, fitted with a slender triangle of platinum wire, to support platinum crucibles, Fig. 307, 2s.
308. Malleable Cast-Iron Triangle, fitted with a platinum triangle to support a platinum crucible, Fig. 308, 2s.

WOODEN SUPPORTS AND HOLDERS.

WOODEN CLAMPS; for holding Tubes, Retorts, and other Apparatus in any desired position.

311. Vertical Clamp, for supporting tubes, small retorts, &c., Fig. 311, *f*, *g*, mahogany, French polished, 11 inches, rising to 15 inches high, 3s.
312. The same, in polished black wood, 2s. 9d.
313. Vertical Clamp of a fixed height, 11 ins., Fig. 313, polished black wood, 1s. 8d.



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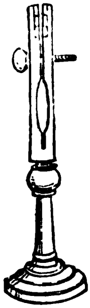

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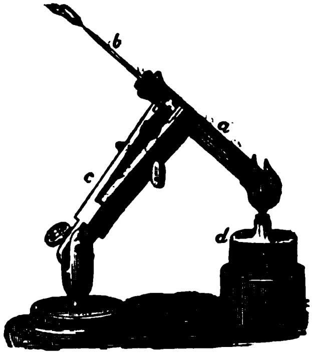
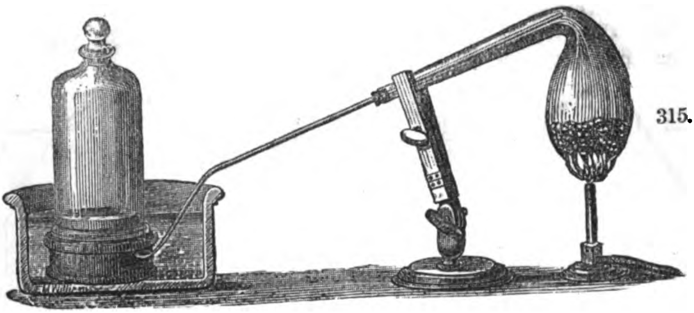


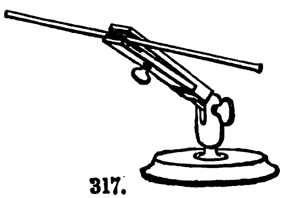
314.

314. Hinged Clamp, Figs. 314, 315, and 330, for holding tubes in any inclined position, especially useful in distillations and in gas preparations, with tube apparatus, polished mahogany, 3s. 6d.
315. The same, in polished black wood, 3s.
317. Hinged Clamp, for supporting tubes in a horizontal position, but at various elevations, useful in adjusting complex arrangements of glass apparatus, Fig. 317, in polished mahogany, 3s. 6d.
318. The same, in polished black wood, 3s.



315.

319. Bunsen's Clamp, with Universal Joint, Figs. 319 and 320*a*, with which tubes and other apparatus can be held at any elevation, and in any required position—horizontal, vertical, or oblique. It is strong enough to hold large vessels, as shown by Fig. 320*a*, and delicate enough to suspend small articles by a silk thread. Polished wood.



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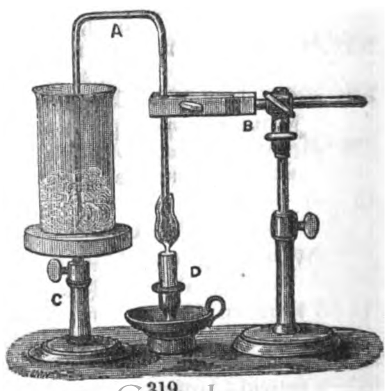
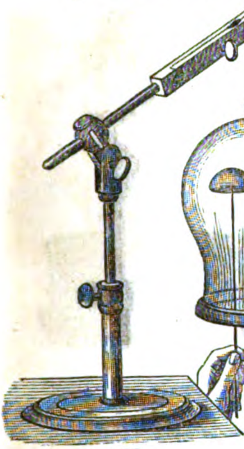
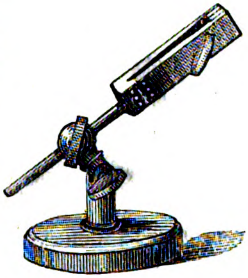


319

No. 1. Small size, black wood, 5s.
2. Small size, mahogany, 6s.
No. 3. Large size, black wood, 6s. 6d.
4. Large size, mahogany, 8s.

320. Bunsen's Universal Holder, small size, of mahogany, but without the pillar. The joint is fixed on to the foot, and being lower is very useful for many purposes, Fig. 320, 4s. 6d.


320*a*.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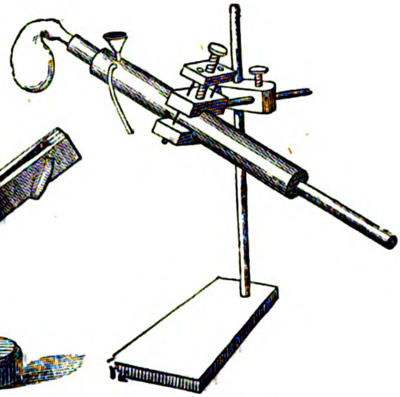
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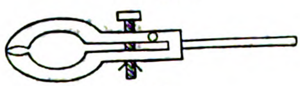
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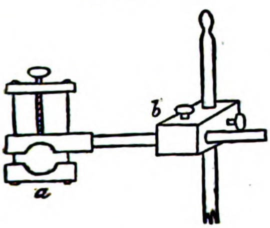

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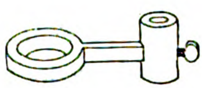
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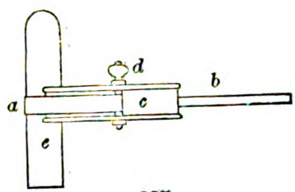
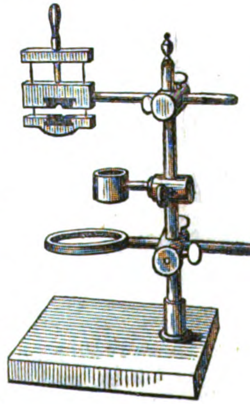


325.

321. Universal Support, adapted for distillations, complicated arrangements of tube apparatus, &c., containing the following articles, all made of hard polished black wood, with boxwood screws, which are sold singly, or altogether for 12s. 6d. :—

322. The Foot, Rod, and Block, for supporting the other pieces, Fig. 322, *a*, *b*, *c*, 2s. 6d.
323. Sefstroem's Retort and Flask Holder, Fig. 322 *d*, and 323 *a*, 4s.
324. Gay Lussac's Vice for supporting Tubes, Retorts, &c., Fig. 324, 2s. 6d.
325. Gahn's Cylinder Holder, for experiments with gases, Fig. 325, 2s. 6d.
326. Berzelius's Funnel Ring, Fig. 326, 1s. 6d.
327. The Set of Universal Supports, in polished mahogany, very elegant and substantial, 18s.
328. Universal Support, consisting of a rod and foot, with table branch, funnel-holder, and Sefstroem's retort-holder, Fig. 328, stained and polished wood, 7s. 6d.

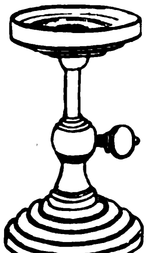

328.

PEDESTAL TABLE SUPPORTS.

Mahogany Table Supports, with loaded foot, French polished :—

329. Table, 3 inches, to rise from 5 inches to 8 inches, 2s. 6d.

330. Table, 4 inches, to rise from 7 inches to 12 inches, 3s. 6d.



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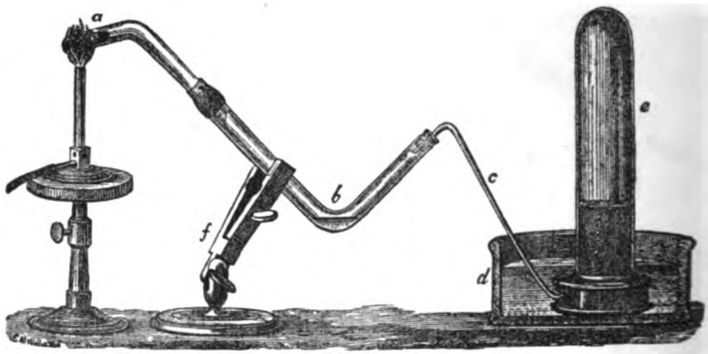


330.

331. Table, 5 inches, to rise from 9 to 14 inches, 4s.

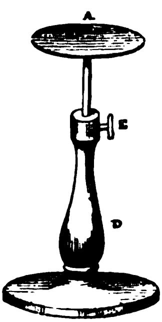
332. Table, 6 inches, to rise from 12 to 18 inches, 6s.

333. Berzelius's Table Support, polished black wood, consisting of a sliding rod, foot, and table, 4 inches diameter, upon which a lamp or small furnace can be raised and firmly supported at any height from 12 to 18 inches above the surface of the work-table, Fig. 333 ; with a Crook to support tubes, Fig. 335, and a Tripod for globes, basins, &c., Fig. 334. Price 4s.

336. Strong Table Support, for Water Bottles, &c., white wood, 7-inch top, to rise from 17 inches to 27 inches, 6s.

CROOK SUPPORTS FOR TUBES.

337. Crook, or Support, for Tubes which require to be held horizontally at any height between 6 and 10 inches from the table, consisting of two brass crooks, with a black wood foot and stem, with screw, Fig. 337. The set, 1s. 6d.



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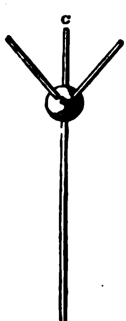
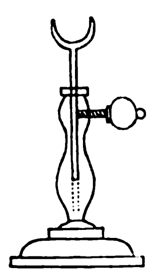


334.

335.



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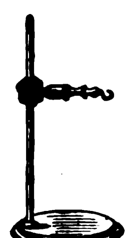

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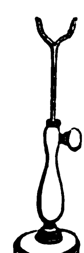


340.

338. Mahogany Sliding Crook Support, round foot 5 inches diameter, rod 14 inches by ⅜ inch, with sliding block and crook, Fig. 338, 2s.

339. Black wood Sliding Crook, same size and pattern as the last, Fig. 338, 1s. 8d.

340. Crook of the pattern of Fig. 340, one pedestal with two crooks, to rise from 6 to 10 inches, both of black wood, 2s.
341. Ditto, ditto, polished mahogany, 3s. 3d.

FUNNEL HOLDERS.

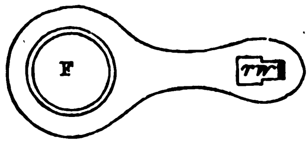
Wooden Funnel Holders, consisting of a Foot, Rod, and Funnel Ring, which can be fixed at any height by a collar and thumbscrew. All of polished mahogany with boxwood screws, or of polished hard black wood, Figs. 342, 343, 346.

Small Size, *for Funnels of* 1½ *to* 4 *inches diameter.*

342. For one Funnel, black wood, 1s. 4d.
343. For two „ „ 2s. 3d.
344. For one „ mahogany, 1s. 6d.
345. For two Funnels, mahogany, 3s.
346. For four „ black wood, 3s. 6d.
347. For four „ mahogany, 4s. 6d.

Large Size, *for Funnels above* 3 *inches diameter.*

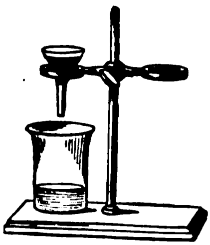
348. For one Funnel, black wood, 3s. 6d.
349. For two „ „ 4s. 6d.
350. For one „ mahogany, 5s.
351. For two „ „ 6s.
352. For one „ „ extra large foot, 6s. 6d.

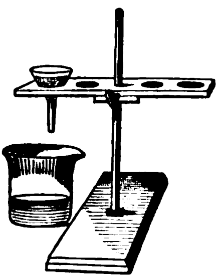


353.

353. Funnel Holder, polished black wooden rod and foot, with a glazed earthenware arm, similar to Fig. F, fixed by a screw, Figs. 353 and 353*a*, 9d.

For some purposes, the ring F can be used to hold the filter without a funnel.


343.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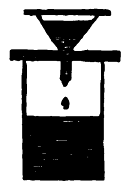
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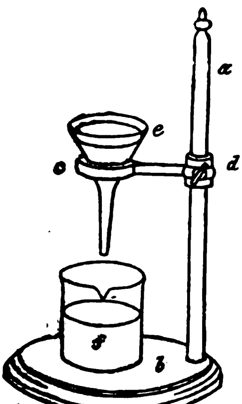

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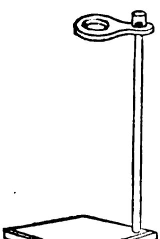
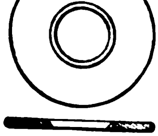
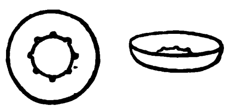

353*a*.


356.


357.

Funnel Holders in the form of perforated Circular Glass Discs, which serve also as covers for the solution jars, to keep out dust, &c., as shown in Figs. 355, 356.

355. Glass Discs, thick sheet glass, with 1-inch hole in the centre.
4-inch disc, 1s.; 5-inch disc, 1s. 2d.; 6-inch disc, 1s. 4d.

357. Thuringian Porcelain Funnel Holders, circular, slightly concave, with a funnel hole in the centre, with serrated edges, Fig. 357.
No. 1. 7½ inch, 1s. 6d. No. 2. 5½ inch, 1s. 3d.

SUPPORTS FOR TEST TUBES.

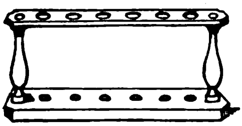
The following Tube Frames are made of sizes to support the tubes that are commonly used for testing liquids. These tubes are usually 4, 5, 6, or 7 inches long, and $\frac{1}{2}$, $\frac{5}{8}$, $\frac{3}{4}$, or $\frac{7}{8}$ inch in diameter; and, as a general rule, the frames are constructed to support tubes of those sizes. In some of the smaller frames two holes are made larger than the others, to receive tubes suitable for submitting the liquors to boiling.

A. Frames for Sets of Tubes, with Holes without Pegs.

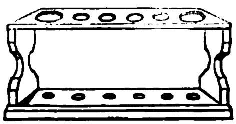
358. For 6 Tubes of one size, white wood, Fig. 358, 6d.
359. For 6 Tubes of two sizes, white wood, Fig. 359, 6d.
360. For 12 Tubes, one row, white wood, 1s. 4d.
361. For 24 Tubes, in two rows, white wood, Fig. 361, 2s.
362. For 24 Tubes, in two rows, mahogany, Fig. 361, 5s.
363. For 12 Tubes, in two stages, stained wood, plan of Fig. 364, 2s.
364. For 19 Tubes, in two stages, stained wood, Fig. 364, 2s. 6d.
365. For 24 Tubes, in two stages, stained wood, Fig. 364, 4s.
366. Portable Test Tube Frame, for travelling mineralogists, japanned tinplate, 4½ inches long, holds 6 tubes of $\frac{1}{2}$ inch diameter, folds up flat by means of four hinges, Fig. 366, 10d.
367. Another, similar, 9 inches long, for 6 tubes of 1 inch diameter, 2s.

B. Frames for Test Tubes, having both Holes and Draining Pegs.

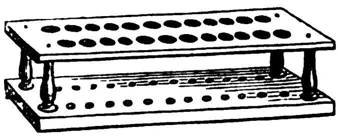
368. For 6 Tubes, of $1\frac{1}{4}$ inch diameter, white wood and white wood pegs, 1s. 2d.
369. For 6 Tubes, of $1\frac{1}{4}$ inch diameter, black wood and stoneware pegs, 2s.
370. For 4 Tubes, of $\frac{7}{8}$ inch diameter, black wood and stoneware pegs, 1s.
371. For 8 Tubes, white wood and white wood pegs, 1s. 2d.
372. For 8 Tubes, black wood and stoneware pegs, Figs. 372, 373, 2s.



358.



359.



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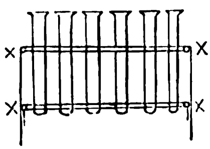

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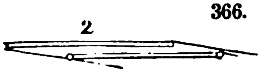

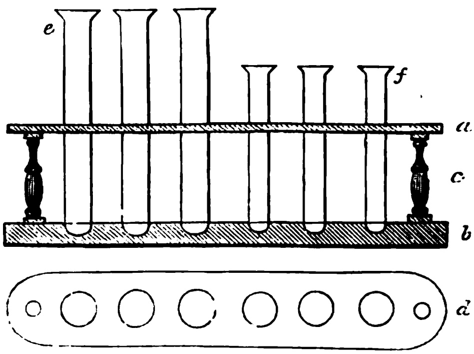

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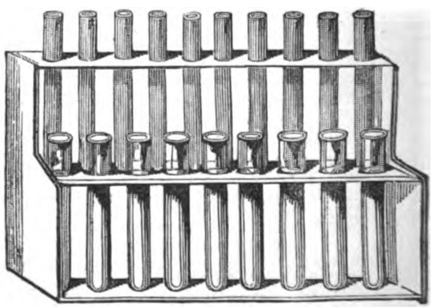
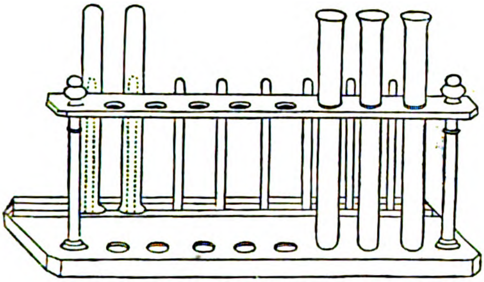
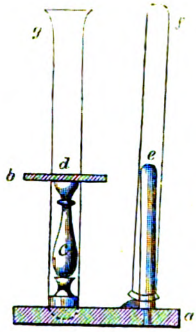


364.



371.



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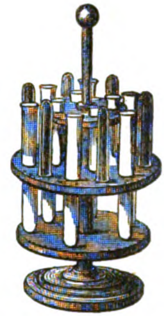
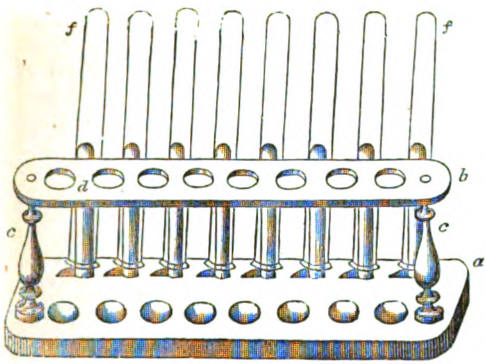
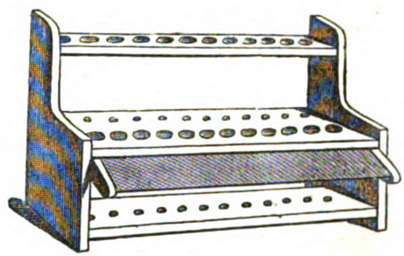


376.



372.



380.

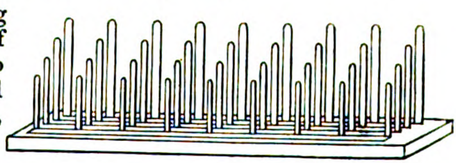
374. For 12 Tubes, black wood and stoneware pegs, 2s. 6d.
375. For 12 Tubes, white wood, wooden pegs, 1s. 9d.
376. Revolving Vertical Tube Stand, with two movable stages, containing 13 holes and 7 pegs, Fig. 376, in polished black wood, 6s.
377. The same, in polished mahogany, 7s. 6d.

C. Supports for Test Tubes, with Slate Scales on which to mark the Names of the Tests tried.

378. Support, with slate scale, for 9 Tubes, stained wood, 3s.
379. Support, with slate scale, for 12 Tubes, in one row, stained wood, 3s. 6d.
380. Support, with slate scale, for 24 Tubes, in two rows, Fig. 380, stained wood, 5s.

D. Frames for Test Tubes, with Pegs only.

385. Stock Rack for Tubes, consisting of 36 glazed stoneware pegs, of three different sizes, adapted to tubes of 2 to 6 inches long, fixed on a polished black wooden base, 3s. 6d.



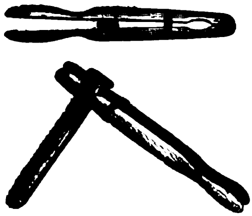
385.

The stoneware pegs are intended for draining the test tubes after they have been washed, and preserving them from dust, so as always to be ready for use. The frames in classes A, B, C are most generally useful in testing. The stock rack is intended to hold a supply of tubes on a side shelf in the laboratory.

E. Supports for Hot Test Tubes.

Tube Clips for holding a single Test Tube when hot :—

386. Wooden Clip, 6d.
387. Brass Wire Clip, with handle, 6d.
388. Spring Brass Clip, with handle, 10d.
389. Spring Steel Clip, „ 1s. 3d.



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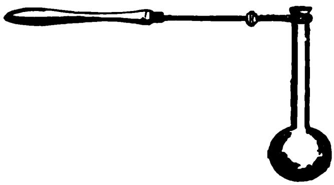
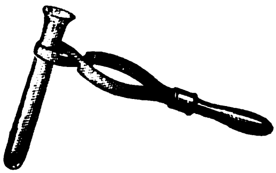
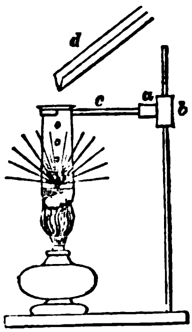


387.

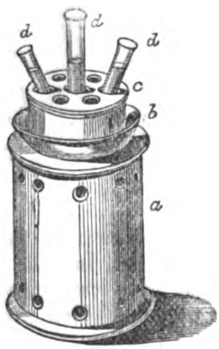


388, 389.

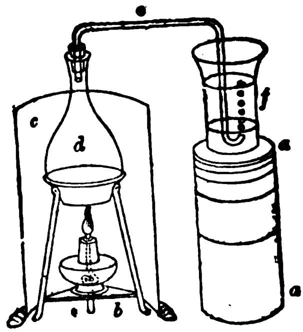
390. Brass Clip, with a collar and thumbscrew to fix it to the vertical rod of a retort stand. See No. 285.
391. Crook, with rod and foot, for supporting a Test Tube vertically over a spirit lamp or gas light, Fig. 391, 1s. 6d.



391.



392.



393.

392. Support for Test Tubes over a sand bath, Fig. 392 ; consisting of a stoneware apparatus which supports seven tubes. (In the Figure, *a* is the cylinder which surrounds the lamp ; *b*, the sand bath ; *c*, the tube support.) 6d.

MISCELLANEOUS SUPPORTS.

Block Supports :—

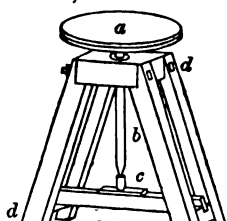
393. Set of Six round Wooden Blocks, for supporting and adjusting the heights of apparatus, 4 inches diameter, and $\frac{1}{8}$, $\frac{1}{4}$, $\frac{1}{2}$, 1, 2 and 4 inches high ; Fig. 393 *a a* ; the set, 1s. 9d.
394. The same, in Mahogany, 2s. 6d.
395. Sets of Five round Blocks, of $\frac{1}{2}$, 1, 2, 3, 5 inches thick.

5 inch diameter, 3s. 6d. ; 6 inch, 5s. ; 7 inch, 6s. ; 8 inch, 7s.

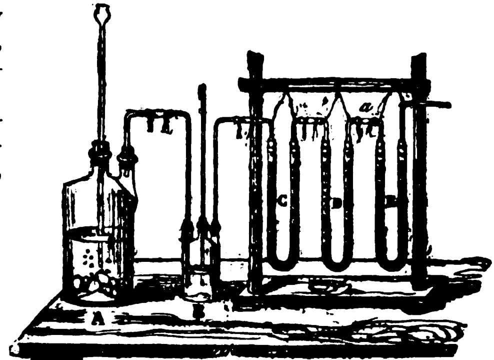
Condenser Supports : see article "Distillation."
Pouret Supports : see article "Centigrade Testing."
Stoneware Support for Furnaces on a Table ; see "Furnaces, Stoneware."

396. Gahn's Hand, recommended by Berzelius, for lifting small pans, &c., that have a flat handle, boxwood, 4s.

397. Whirling Table, useful in exhibiting models and other heavy apparatus at a lecture, or in museums, Fig. 397, 50s. to 90s.



397.



398.

398. Support of Polished Black Wood for a series of Desiccating Tubes (U Tubes) with three hooks, Fig. 398, C, D, E.

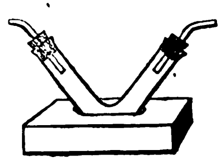
	Breadth.	Height.		
398.	13 inches,	11 inches,	for Three 6-inch U Tubes,	3s.
399.	12 „	16 „	for Three 9-inch U Tubes,	3s. 6d.
400.	15 „	18 „	for Three 12-inch U Tubes,	5s.

401. Support for V Tubes, black wood, 1s.

402. Cork Rings for supporting flasks, retorts, basins, &c., 2-inch to 4-inch bore, each 2d.

403. Watch-glass Holders, iron wire, with handle, for use in heating a watch-glass, 6d.

404. Stoneware Support, to sustain basins, retorts, and other vessels with round bottoms, in an upright position when containing liquids, 9d.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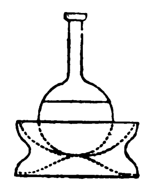

404.

405. Round Plates of Clay upon which to put crucibles and other articles when hot to protect the table.

½ inch thick,	2-inch, 2d.	2½-inch, 2d.	3-inch, 3d.	4-inch, 3d.	6-inch, 4d.	8-inch 8d.	diameter. each.
1 inch thick,	3d.	3d.	4d.	4d.	6d.	1s.	each.

Cylinders of Fireclay, for supporting basins, retorts, &c., on the table.

See the description of the Cylinders for setting up temporary gas furnaces, under the head of "Gas Burners," No. 1023.

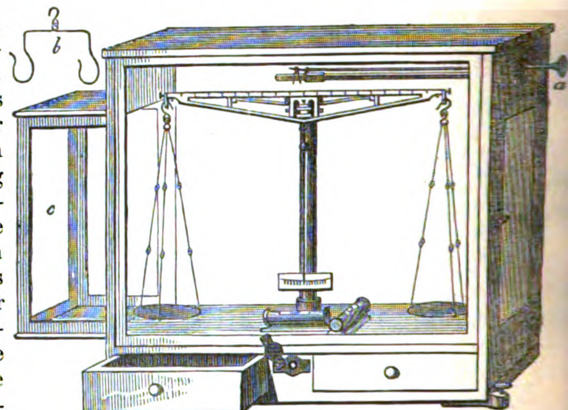
Saltglazed Stoneware Cylinders. See the details of "Griffin's Lamp Furnace," No. 1191.

406. Wooden Stools, with round tops and three round legs, hard white wood.

1. 6-inch top, 10-inch legs, 2s. 3d.
2. 8-inch top, 30-inch legs, 4s.
3. 6-inch top, 14-inch legs, with hole in the centre of the top, 2s. 6d.

Weighing and Measuring.

A.—BALANCES IN GLASS CASES.

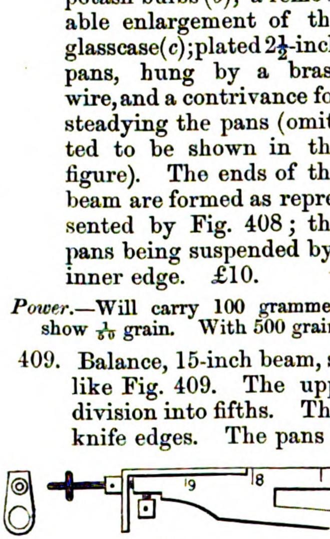


407.

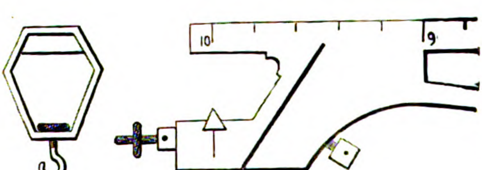
407. Balance with 15-inch beam, with steel bearings, mounted as represented in Fig. 407, in mahogany glass case, with apparatus for moving a rider on the beam (*a*); a hook for supporting potash bulbs (*b*); a removable enlargement of the glasscase (*c*); plated 2½-inch pans, hung by a brass wire, and a contrivance for steadying the pans (omitted to be shown in the figure). The ends of the beam are formed as represented by Fig. 408; the pans being suspended by steel hooks resting on steel rings sharpened on the inner edge. £10.

Power.—Will carry 100 grammes, and show 1 milligramme; will carry 1,600 grains, and show $\frac{1}{50}$ grain. With 500 grains, it shows $\frac{1}{100}$ grain.

409. Balance, 15-inch beam, superior description. The ends of the beam are formed like Fig. 409. The upper part is graduated into ten divisions, and each division into fifths. The beam rests at its centre with agate planes on steel knife edges. The pans hang upon hooks like Fig. 410, which contain agate



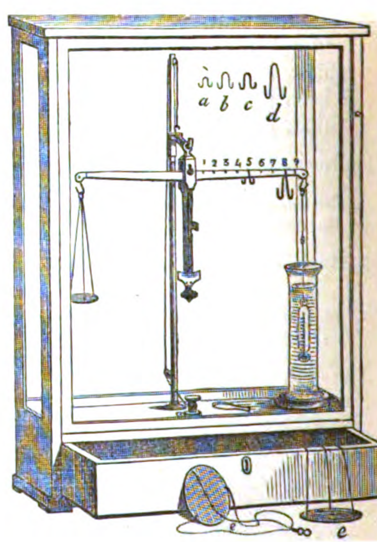
408.



409.

410.

413.



421.

planes to rest on the steel knife edges at the ends of the beam. The two screws shown in Fig. 409 serve to justify the beam. The pans are steadied at the moment the beam is put into motion by a screw moved outside the balance case. There is a small mahogany stool and glass vessel with platinum wires for weighing substances in water. In the front of the glass case are two small doors to give access to the pans without lifting the front of the case. There are spirit levels and screws to put the case into horizontal position. £12, 12s. *r* 7.

Power.—To carry 100 grammes, and indicate $\frac{1}{8}$ milligramme. With 1,600 grains, to show $\frac{1}{800}$ grain.

411. Balance of the best quality, like No. 409, and fitted in a mahogany glass case in the same style, but made of greater size and power, the beam being 18 inches long, divided into ten parts, and each tenth into halves. £16, 16s. *r* 4.

Power.—To carry 500 grammes in each pan, and turn with a milligramme; that is to say, when loaded with above 1 lb. avoirdupois in each pan, it will show less than $\frac{1}{50}$ grain.

412. Balance with $12\frac{1}{2}$-inch beam, fitted in mahogany glass case, as represented by Fig. 407, and agreeing with the description given of No. 407. £7. *r* 17.

Power.—Will carry 50 grammes, and show one milligramme. With care, it may be weighted to 1,000 grains, and will show $\frac{1}{50}$ grain. With 500 grains, it shows $\frac{1}{100}$ grain.

413. Balance with $12\frac{1}{2}$-inch beam of superior quality, fitted in a mahogany glass case; the ends of the beam made as shown in Fig. 413; the beam and pans resting on agate planes; the beam divided into ten parts, nine of which are marked upon it; the pans supported on hooks, like Fig. 410, as described at No. 409. £10. *r* 15.

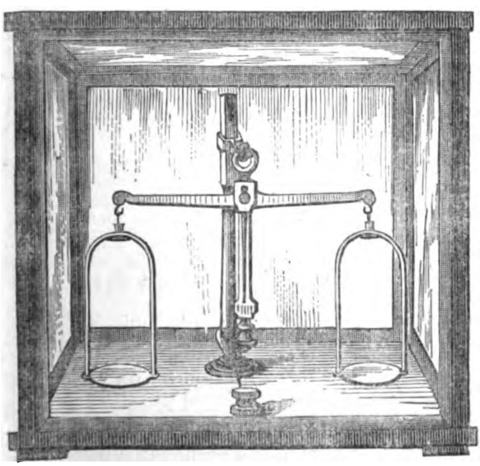
Power.—Will carry 50 grammes, and show $\frac{1}{8}$ milligramme. With care, will carry 1,000 grains, and show $\frac{1}{100}$ grain. With 500 grains, it shows $\frac{1}{500}$ grain.

414. Balance with $12\frac{1}{2}$-inch beam, in mahogany glass case, of the same fine quality, and fitted upon the same style as the 15-inch beam, No. 409. £12. *r* 14.

Power.—To carry 50 grammes, and show $\frac{1}{8}$ milligramme. To carry 1000 grains, and show $\frac{1}{300}$ grain. With 500 grains, will show $\frac{1}{500}$ grain.

416. Balance with 8-inch beam, mounted on a mahogany box, with a mahogany glass case. £3, 3s. *r* 27.

Power.—To carry 500 grains, and to turn with $\frac{1}{50}$ grain. With 20 grammes, to show 1 milligramme.



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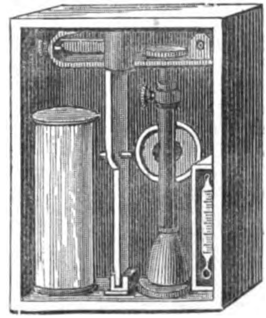


420*a*.

417. Balance with 9-inch beam, mounted on a mahogany box, with a mahogany glass case. £4. *r* 25.

Power.—To carry 500 grains, and turn with $\frac{1}{60}$ grain. Will carry 30 grammes, and show 1 milligramme. With 300 grains, it shows $\frac{1}{100}$ grain.

418. Assay Balance, for the accurate weighing of very small quantities, described at No. 434, in a portable box, with mahogany glass case, which can be removed from it for readier transport, £3, 10s. *r* 30.

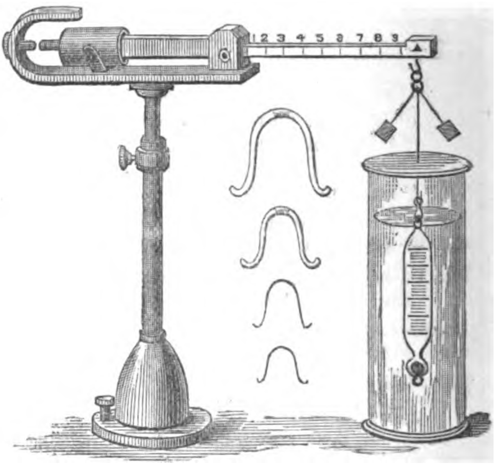
419. Assay Balance, for weighing gold and silver beads, 10-inch beam, in mahogany glass case, £8, 8s. *r* 20.

Power.—Will carry 160 grains, and show $\frac{1}{100}$ grain. Will carry 10 grammes, and show $\frac{1}{10}$ milligramme.

420. Balance, with an 8-inch beam, in mahogany glass case, brass pillar, and pans and supports, £2, 12s. 6d.

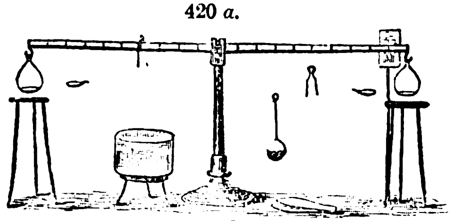
Power.—Will carry 20 grammes, and show 1 milligramme.

420A. Apparatus for determining the specific gravity of liquids, consisting of balance—viz., support and beam, divided lever, set of weights and riders, plummet, with thermometer and solution jar, the whole in a polished walnut case, £3.



420 *a*.

420B. Assay Balance, for assaying and for blowpipe purposes, will carry 50 grains, and turn with $\frac{1}{1000}$ grain. Price, with weights, water-pan, &c., complete in case, measuring $12\frac{1}{2} \times 3 \times 2$ inches, £2, 2s.



420 *b*.

It consists of an upright brass support with knife edges, a 12-inch wooden beam, divided on both arms, two removable aluminium pans, two small extra pans of equal weight, for weighing powder, two stools or pan supports, and one stool for supporting the glass basin for holding water when taking the specific gravity of solids; glass basin, improved weight tongs, and ivory index scale; platina supports for holding solids in water and counterpoise, and three small bottles containing a set of grain weights, a set of tenths of grains, and a set of riders of a tenth of a grain. These riders will be found exceedingly useful, as by being moved along the divided beam they can be made to show hundredths, and even thousandths, of a grain. The balance is extremely sensitive, and indicates to the third place in decimals with great facility. It recommends itself by its cheapness, compactness, lightness, and delicacy, and by not being likely to get out of order. The whole apparatus is securely packed in a divided mahogany case.

N.B.—Should the beam be, from the absorption of moisture, not quite equipoised, it may be accurately adjusted by holding the heavier end for a moment over the flame of a spirit lamp.

421. Mohr's Balance for taking the specific gravities of liquids by an easy method, which gives the specific gravity without calculation, and requires but a small quantity of liquid, and no other apparatus than is represented on Fig. 421. Price in mahogany glass case, including a portable mahogany box, 84s.

422. Ditto, in a mahogany box without glass case, 50s.

423. The essential Apparatus,—namely, beam, plummet, set of riders, and a simple support,—without the mahogany box and extra fittings, 30s.

Description of Mohr's Specific Gravity Balance.—This apparatus consists of the articles represented in Fig. 421; namely, a 10-inch beam, of which one branch is divided into ten parts; a glass plummet, which contains a thermometer, and is attached to a platinum wire by which it can be suspended from the beam; a glass cylinder, and a mahogany tray for it; a brass weight to counterpoise the plummet; a pair of pans, marked *e e* in the figure, for the ordinary weighing of solid bodies; a set of riders, marked *a b c d*, of which *d* is equal to the weight of the water displaced by the plummet, while $c = \frac{1}{10}$ of d, $b = \frac{1}{10}$ of c, and $a = \frac{1}{10}$ of b. The apparatus can be dismounted and packed in the mahogany box, and then removed from the glass case for travelling.

The scale of the thermometer included in the glass plummet is usually that of Reaumur, for which reason I give the following equivalents of the degrees most likely to be observed:—

R.	F.	R.	F.	R.	F.	R.	F.
20°	77·°	16°	68·°	12°	59·°	8°	50·°
19	74·75	15	67·75	11	56·75	7	47·75
18	72·5	14	63·5	10	54·5	6	45·5
17	70·25	13	61·25	9	52·25	5	43·25

Process.—1. When the small pan is attached to one end of the beam and the plummet to the other end, the beam rests in equilibrium. 2. If the plummet is plunged into distilled water, that end of the beam rises. 3. If in that case one of the largest riders, *d*, is put on the hook at that same end of the beam, the equilibrium is again restored. This result shows that the rider *d* is equal in weight to the displacement of the plummet.

4. If a liquid lighter than water is submitted to trial, the large rider *d* must be placed somewhere on the divided branch of the beam, where it will produce equilibrium. But when, as commonly happens, this occurs at some point between two notches on the beam, it is best to rest the rider on the notch of lowest value of the two between which it rests, and then to apply the next sized rider, *c*, to determine the difference. Thus, in Fig. 421, we see the large rider at 8, and the small rider at 5. In this case, the former represents 8 in the first place of decimals, and the latter represents 5 in the second place of decimals. Thus, 0·85. If the rider *c* does not effect an equilibrium, when fixed in a notch, but falls between 4 and 5, then it must be placed in 4, and the third-sized rider, *b*, must be employed to find the exact point of equilibrium. This third size of rider stands for the third place of decimals in the expression of the specific gravity; and finally, the smallest rider, *a*, expresses the fourth place of decimals, thus:—

a is = ·0001 to ·0009	}	According as they stand in the notches 1 to 9 on the beam when at rest.
b is = ·001 to ·009		
c is = ·01 to ·09		
d is = ·1 to ·9		

5. If a liquid heavier than water is tried, the process goes on exactly as above described, with the addition that one of the riders *d* is in every case hung at 10, the extreme end of the beam, to serve as the equivalent of the weight of water, while the riders which show the difference between water and the given heavy liquid cross the beam at the proper points. A few examples will illustrate this principle. In the following plans, the figures represent the notches on the beams, and the letters the respective sizes of riders:—

1	2	3	4	5	6	7	8	9	10	
	b		*c*				*d*		*d*	= 1·842 Sulphuric Acid.
		dc							*d*	= 1·33 Caustic Potash.
					c			*d*		= 0·96 Ammonia.
				c		*d*				= 0·75 Ether.
			d	*b*				*c*	*d*	= 1·495 Nitric Acid.

Power of the Balance to weigh solids.—It will carry 1,000 grains, and show $\frac{1}{10}$ grain. With 500 grains, it shows $\frac{1}{20}$ grain; and with 300 grains, it shows $\frac{1}{30}$ to $\frac{1}{50}$ grain.

B.—BALANCES IN MAHOGANY BOXES.

These are furnished with supports that screw into the top of the boxes, as represented by the different figures, and pack inside the boxes for travelling.

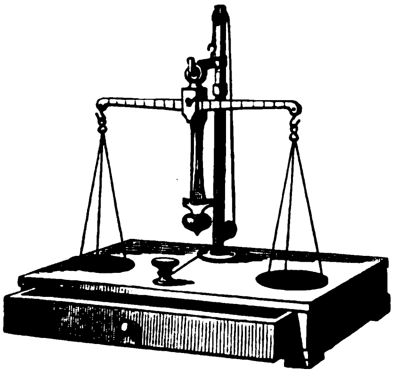
The four Balances No. 424 to No. 427 are made of the form represented by Fig. 424. The beams and pans are of brass, and the pans hung with silk cord; the boxes, of polished mahogany. The quoted sizes of the boxes are only approximate.

424. Balance with beam 8 inches long; pan 2 inches wide; box 11¼ inches long, 5½ inches wide, 2¼ inches deep, 31s. 6d. *r* 44.

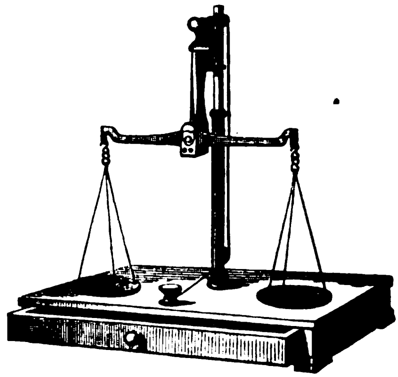
Power.—Will carry 800 grains, and show $\frac{1}{20}$ grain. With 500 grains, it shows $\frac{1}{50}$ grain.

425. Balance with beam 10 inches long; pans 2½ inches wide; box 12½ inches long, 6⅜ inches wide, 2½ inches deep, 36s. *r* 40.

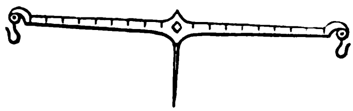
Power.—Will carry 1000 grains, and show $\frac{1}{20}$ grain. When loaded with 500 grains, it shows $\frac{1}{50}$ grain.



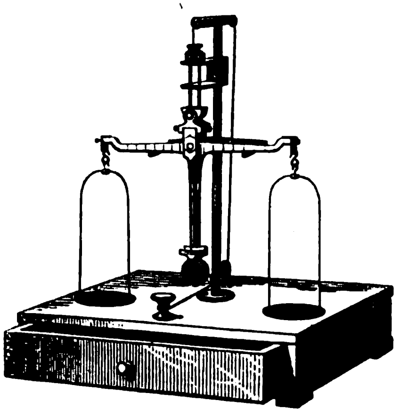
424.



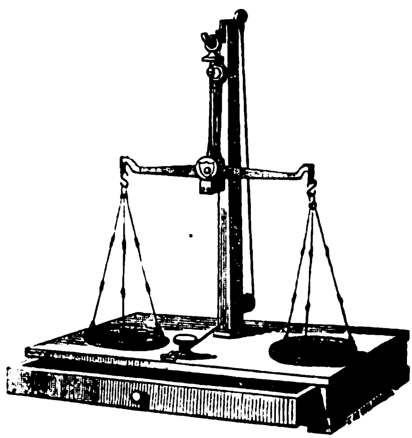
428.



429.



430.



431.

426. Balance with beam 10½ inches long; pans 2½ inches wide; box 13½ inches long, 6½ inches wide, 2½ inches deep, 38s. *r* 39.

Power.—Will carry 4 ounces, and show $\frac{1}{20}$ grain. With 1,000 grains, it shows $\frac{1}{50}$ grain.

427. Balance with beam 11½ inches long; pans 3 inches wide; box 15 inches long, 7 inches wide, 2⅜ inches deep, 42s. *r* 38.

Power.—Will carry 6 ounces, and show $\frac{1}{10}$ grain. With 1,000 grains, it shows $\frac{1}{20}$ grain. With 500 grains, it shows $\frac{1}{50}$ grain.

428. Balance with $8\frac{1}{2}$-inch beam; $2\frac{3}{4}$-inch pans, with silk strings; mahogany box $13\frac{1}{2}$ inches long, $6\frac{1}{2}$ inches wide, $2\frac{1}{2}$ inches deep; fitted up as represented by Fig. 428. 45s. *r* 37.

Power.—Will carry 8 ounces, and show $\frac{1}{10}$ grain. With 1,000 grains, it shows $\frac{1}{20}$ grain. With 500 grains, it shows $\frac{1}{50}$ grain.

429. Balance resembling No. 424, excepting that the beam is slight, and of the form of Fig. 429. Length of beam $8\frac{1}{2}$ inches; pans $2\frac{1}{4}$ inches, hung with silk cords; box $11\frac{1}{4}$ inches long, $5\frac{1}{4}$ inches wide, $2\frac{1}{2}$ inches deep. 35s. *r* 43.

Power.—Will carry 500 grains, and show $\frac{1}{50}$ grain. With 25 grammes, it turns with 1 milligramme.

430. Balance with $9\frac{1}{2}$-inch divided beam; $2\frac{1}{2}$-inch brass pans; mahogany box 14 inches long, $7\frac{1}{2}$ inches wide, 4 inches deep; fitted up as represented by Fig. 430. 55s. *r* 36.

Power.—Will carry 8 ounces, and show $\frac{1}{20}$ grain. With 1,000 grains, it shows $\frac{1}{50}$ grain.

431. Balance, $9\frac{1}{2}$-inch beam; 3-inch pans, suspended by brass links; square mahogany pillar $12\frac{1}{2}$ inches high; mahogany box $13\frac{1}{2}$ inches long, $6\frac{3}{4}$ inches wide, $2\frac{1}{2}$ inches deep. The pillar does not pack into the box. 35s. *r* 41.

Power.—Will carry 8 ounces, and show $\frac{1}{5}$ grain. With 1,000 grains, it shows $\frac{1}{10}$ grain.

432. Balance with $8\frac{1}{2}$-inch beam; 3-inch pans, with silk cord; mahogany box $13\frac{1}{2}$ inches long, $6\frac{3}{4}$ inches wide, $2\frac{1}{2}$ inches deep. This balance has a beam like that of 431, but is fitted with a brass support that packs in the box like No. 424. 40s. *r* 42.

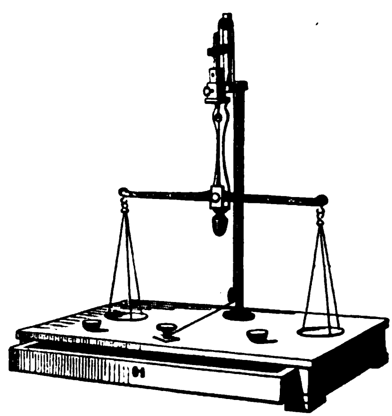
Power.—Will carry 8 ounces, and show $\frac{1}{20}$ grain. With 1,000 grains, it shows $\frac{1}{50}$ grain.

433. Balance similar to the above (No. 431), with 13-inch beam; $4\frac{1}{2}$-inch pans, with brass links; mahogany box 15 inches long, $9\frac{1}{2}$ inches wide, $2\frac{1}{2}$ inches deep; mahogany pillar support. 50s. J 298 *c.*

Power.—Will carry 1 lb., and show $\frac{1}{2}$ grain. With $\frac{1}{2}$ lb. shows $\frac{1}{5}$ to $\frac{1}{10}$ grain.

434. Assay Balance for weighing gold and silver in small quantities; beam $6\frac{1}{2}$ inches long; pans $1\frac{1}{4}$ inches wide, with extra $\frac{3}{4}$-inch cups. Packs into a polished mahogany box, $10\frac{1}{2}$ inches long, $5\frac{3}{4}$ inches wide, $2\frac{1}{4}$ inches deep. 50s. *r* 29.

Power.—Will carry 20 grains, and show $\frac{1}{500}$ grain. With 10 grains it shows $\frac{1}{1000}$ grain.



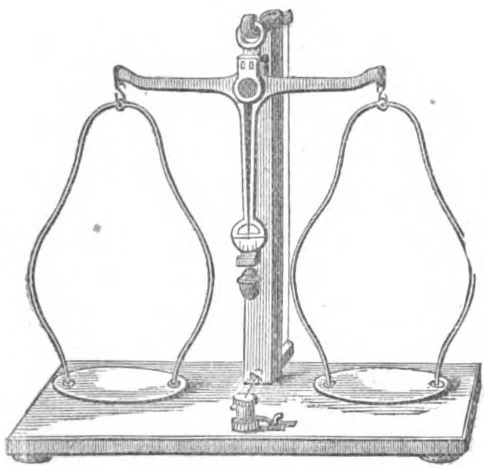
434.

435. Plattner's Balance, for the accurate determination of very small weights, used as part of his portable collection of apparatus for the quantitative assay of gold, silver, ores of copper, lead, &c., by the blowpipe. Length of beam $6\frac{1}{2}$ inches; power to carry 1 gramme, and show $\frac{1}{10}$ milligramme: that is to say, to carry 15 grains, and turn with $\frac{1}{650}$ of a grain. With a set of gramme weights. The whole arranged in cavities, cut in two boards that are hinged together, and form, when shut up, a base for the support of the balance. £4. *r* 21.

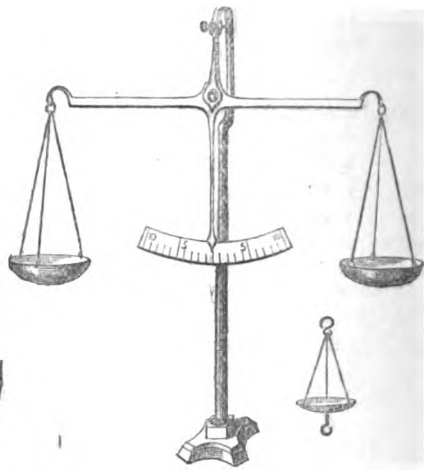
436. Balance, with a brass beam 12 inches long, in a mahogany box, with a support adapted to the top of the box. The pans rest on the box, and are moved by a lever. Will carry 1,000 grains in each pan, and turn with $\frac{1}{50}$ grain: with 300 grains, it shows $\frac{1}{100}$ grain. The beam is divided into ten parts from the fulcrum to the end, for a *rider.* With a set of weights from 500 grains to $\frac{1}{10}$ grain. £5, 15s. 6d. *r* 33.

COMMERCIAL BALANCES.

437. Apothecaries' Scales and Weights, to weigh quantities up to half an ounce, in plain oak box, with set of weights, 3s.
438. Ditto, superior, with glass pans, in oak box, 5s.
439. Ditto, superior, with box-end beam and glass pans, in mahogany box, 10s. 6d.
440. Ditto, with ivory pans, 14s.
441. Balance to carry 1 lb. and turn with 1 grain, 10-inch beam, 5-inch brass pans, in oak box, 21s.
442. Balance, with large pans for physical purposes and commercial weighings, &c., with solid mahogany foot and upright support; with 10-inch beam; carrying 300 grammes, will turn with 1 centigramme. Price 45s.
443. Balance similar to 442, but with 12-inch beam; will carry 1,000 grammes, and turn with 2 centigrammes; or, carrying 1 lb., will turn with 0·3 grain. Price, £2, 12s. 6d.
444. Balance of large size for physical experiments; length of beam, 2 feet; height from table, 3 feet; length of index, 1 foot; with a pair of 5½-inch



422.



444.

brass pans, with brass chains, Fig. 444, or stout wires, like Fig. 422, and a small pan with a hook below for use in taking specific gravities; will carry 2 lbs. in each pan, and then turn with 1 grain. The upright support unscrews in the middle for the convenience of packing. Fig. 444. Price 31s. 6d.

C.—WEIGHTS.

445. Grain Weights. Set of accurate weights, consisting of 600, 300, 200, 100, 60, 30, 20, 10 grains in brass, and 6·, 3·, 2·, 1·; ·6, ·3, ·2, ·1; ·06, ·03, ·02, ·01 grain, in platinum; in a mahogany box, with tongs. 28s.
446. Grain Weights, accurate, from 1,000 grains to ·01 grain, in a mahogany box, with tongs, 35s.
447. Grain Weights, less accurate, from 600 grains to $\frac{1}{10}$ grain, in a box, 16s.

448. Another set, less accurate, 600, 300, 200, 100, 60, 30, 20 grains, in brass, with knobs; and 10, 6, 3, 2, 1, ½ grains, in brass foil, without box, 8s.
449. Ditto, in a wooden case, 10s. 6d.
450. Accurate set, 100, 50, 30, 20, 10, 6, 5, 4, 3, 2, 1, and ½ grains, in brass, without a case, 4s. 6d.
451. Grain Weights and Decimal Fractions, in platinum; namely, 6·, 3·, 2·, 1·; ·6, ·3, ·2, ·1; ·06, ·03, ·02, ·01. The set, 12s.
452. Set of Grains, 6·, 3·, 2·, 1·, in a box, 8s.
453. Set of Tenths, ·6, ·3, ·2, ·1, in a box, 3s. 6d.
454. Set of Hundredths, ·06, ·03, ·02, ·01, in a box, 3s. 6d.
455. Standard Gramme Weights, according to Mohr, justified according to the Platinum Kilogramme of Dr. Schumacher in Altona. The weights made of German silver, in the following series :—50, 20, 10, 10, 5, 2, 1, 1, 1, ·05, ·02, ·01, ·01, ·005, ·002, ·001, ·001; with three gilt riders, and ivory tongs, in mahogany box, 28s.
456. Gramme Weights, accurate, 50 grammes to 10 grammes, in brass, and ·5 to ·001 grammes, in platinum, in a mahogany box, with tongs, 35s.
457. Gramme Weights, containing the series, 100, 50, 20, 10, 10, 5, 2, 1, 1, 1, in brass, and ·5, ·2, ·1, ·1, ·05, ·02, ·01, ·005, ·002, ·002, ·001, ·001, in platinum, with four riders, and tongs, in a mahogany box, 40s.
458. Gramme Weights, containing the series 500, 200, 100, 100, 50, 20, 10, 10, 5, 2, 1, 1, 1, in albata, and 5, 2, 1, 1, ·05, ·02, ·01, ·01, ·005, ·002, ·001, in platinum, with four riders, ivory tongs, and two weight-lifters, in a mahogany box, 63s.
458A. Gramme Weights, less accurate; the series, 200, 100, 50, 20, 20, 10, 5, 2, 2, 1, 0·5, 0·2, 0·2, 0·1, 0·05, 0·02, 0·02, 0·01; in all, 18 weights. In a square wooden box, price 12s.
459. Pound Pile of Avoirdupois Weights in brass, round and flat, adjusted, consisting of 1 lb., ½ lb., ¼ lb., 2, 1, ½ and ¼ oz., 5s. 6d.
460. Pound Pile of Avoirdupois Weights, cast-iron, round and flat; set of 7 weights adjusted, 1 lb., ½ lb., ¼ lb., 2 oz., 1 oz., ½ oz., and ¼ oz., the last two of brass. Per set, 1s. 6d.

461. COMMERCIAL GRAMME WEIGHTS.

a. Cast-Iron Pile, 1 kilo to ½ gramme. The series, 1,000, 500, 200, 100, 50, 20 grammes in cast-iron; 10, 5, 1, ½ grammes in brass. Price of the set, 3s.
b. The above Pile in brass, 7s. 6d.

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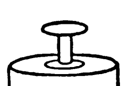
462. Set of Apothecaries' Grain Weights, 2 drachms to ½ grain; viz., 2, 1, ½ dr.; 2, 1, ½ scruples; 6, 5, 4, 3, 2, 1, ½ grains. 1s.
463. Riders to slide on the balance beam, Fig. 463.

A. English, $\frac{1}{10}$ grain, 4d. | B. French, 1 centigramme, 4d.


463.


445.


467.

467. Weight Lifter, for lifting knobbed weights, Fig. 467, brass or zinc, 3d.
468. Ivory Tongs for lifting weights, common, 1s.; fine, 3s.
469. Brass Tongs for lifting weights, common, 9d.; fine, 2s.

D.—GRADUATED LINEAL MEASURES.

470. Boxwood Rule, folding in four, best make, having a metre scale divided into millimetres, from end to end, on one side, and a scale of English inches on the other, 10s. 6d.
471. Boxwood Rule, folding in four, but of much inferior make, and with common hinges, and the millimetre scale marked on only one end, 6s.
472. Boxwood Rule, without joints, metre scale, with millimetres at one end only, 7s. 6d.

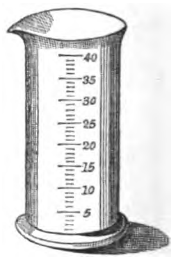
E.—GRADUATED LIQUID MEASURES.

These Measures are graduated with the same degree of care as the measures for Volumetric Analysis, and may be depended upon for accuracy. None are done by the common rough process with the glass-cutter's wheel. The graduation agrees with the bottom of the dark curve formed by the surface of the liquid.

CYLINDRICAL GLASS MEASURES, Fig. 475, graduated into IMPERIAL OUNCES of WATER.

60 minims to the drachm, 8 drachms to the ounce, 16 ounces to the pound, 20 ounces to the pint.

475.	1 drachm,	showing	12 spaces	=	5 minims,	1s. 0d.
476.	2 drachms,	,,	24 ,,	=	5 ,,	1s. 3d.
477.	1 ounce,	,,	16 ,,	=	½ drachm,	0s. 9d.
478.	2 ounces,	,,	16 ,,	=	1 ,,	1s. 0d.
479.	5 ,,	,,	20 ,,	=	¼ ounce,	1s. 3d.
480.	10 ,,	,,	20 ,,	=	½ ,,	1s. 6d.
481.	20 ,,	,,	40 ,,	=	½ ,,	2s. 6d.
482.	40 ,,	,,	40 ,,	=	1 ,,	3s. 6d.



475.

CYLINDRICAL GLASS MEASURES, graduated into divisions of the LITRE, form of Fig. 475. [1 litre = 1,000 grammes.]

483.	30 grammes,	showing	30 spaces	=	1 gramme,	1s. 0d.
484.	60 ,,	,,	30 ,,	=	2 grammes,	1s. 3d.
485.	150 ,,	,,	30 ,,	=	5 ,,	1s. 6d.
486.	300 ,,	,,	30 ,,	=	10 ,,	2s. 0d.
487.	600 ,,	,,	30 ,,	=	20 ,,	3s. 0d.
488.	1,200 ,,	,,	60 ,,	=	20 ,,	4s. 0d.

For Graduated Bottles, Test Mixers, Pipettes, Burettes, &c., see the section on "Volumetric Analysis."

Thermometers for Chemical Use.

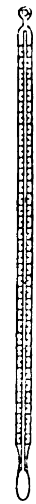
The scales of these Thermometers are entirely enclosed in glass tubes, so that the instruments can be safely immersed in hot, caustic, or acid liquors.

Pasteboard Boxes for the Thermometers are included in the following prices:—

	With Fahrenheit's Scale.	212°	400°	500° to 600°
501	Paper Scales, outer tube, ½ to ⅝ inch,	1s. 9d.	2s. 0d.	2s. 6d.
502	Paper Scale, outer tube, ⅜ in., . . .	1s. 9d.	2s. 0d.	2s. 6d.
503	Milk-glass Scale, outer tube, ½ to ⅝ in.,	2s. 6d.	3s. 0d.	4s. 0d.
504	Milk-glass Scale, outer tube, ⅜ in., .	2s. 6d.	3s. 0d.	4s. 0d.
506	Scale engraved on enamelled rod, ⅜ in.,	3s. 6d.	4s. 6d.	5s. 0d.

	With Centigrade Scale, ¼ to ⅜ inch.	100°	200°	360°
507	Paper Scale, ...	1s. 9d.	2s. 0d.	2s. 6d.
508	Milk-glass Scale, ...	2s. 6d.	3s. 0d.	4s. 0d.
510	Scale engraved on white enamelled rod,	3s. 6d.	4s. 6d.	5s. 0d.

504.



505.

511. Thermometers with Two Scales, Fahrenheit's and the Centigrade. At 1s. each beyond the price of those with Fahrenheit's scale only.

THERMOMETERS FOR MANUFACTURERS.

513A. Brewers' and Distillers' Thermometer, in a rod with brass bands and safety frame, the scale on milk-glass; length, 3 to 4 feet. 15s.

513B. Ditto, without the brass bands. 8s.

513C. Brewers' Thermometer; paper scale in glass cylinder, with wooden frame, about 20 inches long, 7s. 6d.

513D. Brewers' Thermometers, with silvered brass scale, fixed in black wood frame. 16 inch, 4s.; 24 inch, 5s.; 36 inch, 6s.

514. Varnish-makers' Thermometer, 3 to 4 feet long, scale to 600°, in an iron case, with brass scale and safety frame, 30s.

514A. Hot-Blast Thermometer, with milk-glass scale to 600° F., for testing hot air at ironworks, 6s.

515. Very small and heavy Thermometer to sink in oil of vitriol, paper scale, 1s. 3d.

515A. Thermometer, small size, for taking temperatures in specific gravity bottles, having only three marks, 55°, 60°, 65° F., 1s. 6d.

516. Daniel's Pyrometer, for measuring high temperatures in furnaces, with a platinum bar, £6.

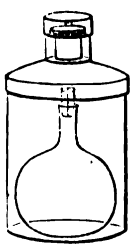
Apparatus for Determining the Specific Gravity of Liquids.

SPECIFIC GRAVITY BOTTLES.

Determination of the Specific Gravity of Liquids by the Weighing of Measured Quantities.

518. Specific Gravity Bottle, slight blown glass, with perforated stopper, in japanned tin case, with counterpoise, Fig. 518.

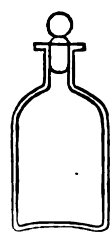
Contents : *a*, 1000 grains, 5s.; *b*, 500 grains, 4s. 6d.; *c*, 250 grains, ~~3s. 6d~~ 4½.



518.

520.

520*a*.



521.

522.

519. Specific Gravity Bottle, carefully adjusted with ground stoppers, and counterpoise, in neat leather cases.

100 grains,	3s. 6d.	10 grammes,	3s. 6d.
250 ,,	5s. 6d.	20 ,,	5s. 0d.
500 ,,	6s. 6d.	25 ,,	5s. 6d.
1000 ,,	8s. 0d.	50 ,,	6s. 6d.
		100 ,,	8s. 0d.

520. Specific Gravity Bottle, slight blown glass, with perforated stopper, without case or counterpoise, Fig. 520 and 520*a*.

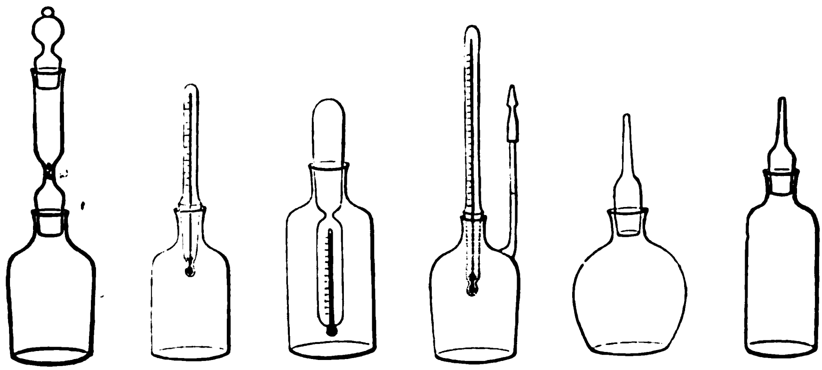
100 grains,	1s. 6d.	10 grammes,	1s. 4d.
250 ,,	2s. 0d.	20 ,,	1s. 8d.
500 ,,	2s. 6d.	25 ,,	1s. 9d.
1000 ,,	3s. 0d.	50 ,,	2s. 6d.
1 cubic inch,	1s. 0d.	100 ,,	3s. 0d.

521. Specific Gravity Bottles, of stout glass, with solid stoppers, having a slit cut down the side; Fig. 521, *at the same prices as the slight blown glass,* No. 520.
522. Specific Gravity Bottle, on the plan recommended by Regnault, Fig. 522.

250 grains, 1s. 6d.	500 grains, 2s.	1000 grains, 2s. 6d.
25 grammes, 1s. 6d.	50 grammes, 2s.	100 grammes, 2s. 6d.

In using this form of bottle, the liquor is filled in above the mark, the temperature is determined by inserting a thermometer, the liquor is adjusted to the mark by a pipette, or a fold of filter paper, and the stopper is then inserted.

523. Specific Gravity Bottle, with ground funnel and ground stopper, contents about half an ounce of water, Fig. 523, 1s. 9d.
524. Specific Gravity Bottle, with thermometer stopper, Fig. 524, contents, 1000 grains, 5s. 6d.
525. Ditto, with the thermometer finely divided, 10s.



523. 524. 526. 527. 528*a*. 528*b*.

526. Specific Gravity Bottle, with thermometer stopper, Fig. 526.

250 grains, 4s.	500 grains, 5s.	1000 grains, 5s. 6d.
25 grammes, 4s. 6d.	50 grammes, 5s.	100 grammes, 5s. 6d.

527. Specific Gravity Bottle, in the form of a Woulff's bottle, with two necks, one consisting of a long capped graduated tube, and the other containing a delicate thermometer, contents, 1 cubic inch, Fig. 527, 9s.
528. Specific Gravity Bottles, of slight blown glass, with wide necks and perforated stoppers, for taking the specific gravity of solid bodies; capacity about half-ounce of water, not adjusted, Figs. 528*a*, 528*b*, each 6d.

HYDROMETERS.

HYDROMETERS WHICH SHOW DIRECT SPECIFIC GRAVITY, WATER BEING TAKEN AT 1·000.

Pasteboard Cases for single hydrometer spindles are charged 2d. each., unless they are unusually large.

A.—HYDROMETERS IN SETS.

Hydrometers, in the form of Glass Spindles, Fig. 534, for determining the specific gravity of all solutions from sp. gr. ·700 to sp. gr. 2·000, water being considered

= 1·000. The delicacy of this instrument increases with the number of spindles contained in the set. The entire scale, from ·700 to 2·000, may be contained on one spindle, or on 2, 3, 4, 5, or 7 spindles.

533. Universal Hydrometer, consisting of One Spindle, scale from ·700° to 2·000°; price 4s. 6d. With a solution tube, Fig. 533, *and a pasteboard box*, 6s.

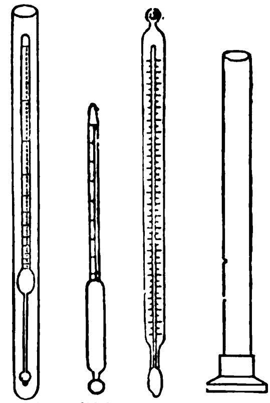
A useful instrument for preliminary trials, for students, or for common use when approximate indications are sufficient. It shows the specific gravity of all liquids, from alcohol to oil of vitriol.

HYDROMETERS IN SETS, having spindles of the form of Fig. 534, each set with a Thermometer, Fig. 535, and Trial Jar for solutions, Fig. 536, in a polished Mahogany Box, Fig. 539.

537. Box containing Two Spindles, with Thermometer, and a Trial Jar for the solutions, 20s.

·700° to 1·000°	1·000° to 2·000°

538. Box containing Three Spindles, form of Fig. 534, with Thermometer and Trial Jar for solutions, 24s.

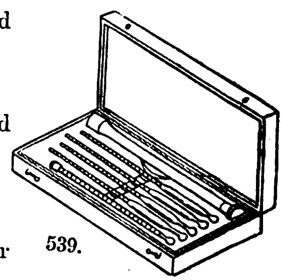


533. 534. 535. 536.

·700° to ·1000°	1·000° to 1·400°	1·400° to 1·970°

539. Box containing Four Spindles, with Thermometer and Trial Jar for solutions, Fig. 539, 28s.

·700° to 1·000°	1·300° to 1·600°
1·000° to 1·300°	1·600° to 1·950°



539.

540. Box containing Five Spindles, with Thermometer and Trial Jar for solutions, 30s.

·700° to 1·000°	1·400° to 1·640°
1·000° to 1·200°	1·640° to 1·900°
1·200° to 1·400°	

541. Box containing Seven Spindles, with Thermometer and Trial Jar for solutions, 40s.

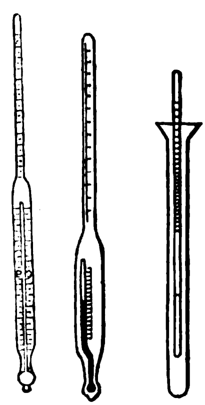
·700° to ·850°	1·400° to 1·600°
·850° to 1·000°	1·600° to 1·800°
1·000° to 1·200°	1·800° to 2·000°
1·200° to 1·400°	

542. Set of Hydrometers, Two Spindles, in pasteboard cases, from ·700° to 2·000°, 4s. 6d.

543. Set of Hydrometers, Three Spindles, in pasteboard cases, ·700 to 2·000, 8s.

544. Set of Hydrometers, Three Glass Spindles, each containing a Thermometer, Fig. 544, the spindles in three pasteboard cases, 15s., or each spindle, 5s.

1.	Specific gravity	·700 to 1·000 by ·005.
2.	„	1·000 to 1·400 by ·005.
3.	„	1·400 to 2·000 by ·005.



544. 545.

545. Set of Hydrometers for use when only small quantities of liquid are at command, consisting of two narrow spindles without bulb, to be used with a narrow solution tube having a funnel-shaped mouth, which prevents the adhesion of the hydrometer to the sides of the tube, Fig. 545, one spindle from ·700 to 1·000, the other from 1·000 to 2·000, per pair, 5s.

546. Nicholson's Hydrometer, consisting of Two Glass Spindles, with caps at the top, and a set of weights, for taking the specific gravity of any liquids lighter or heavier than water; with thermometer, in a case, 25s.

B.—HYDROMETERS IN SINGLE SPINDLES.

547. Specific Gravity ·700 to 1·000 by ·010, 3s.
548. „ „ ·700 to 1·000 by ·005, 3s. 6d.
549. „ „ 1·000 to 2·000 by ·010, 3s.
550. „ „ 1·000 to 1·500 by ·005, 3s.
551. „ „ 1·000 to 1·500 by ·005, open scale, 4s.

Spindles without bulbs, Fig. 545 (without the solution tube).

552. ·700 to 1·000, 2s. 6d.
553. 1·000 to 2·000, 2s. 6d.

Delicate Hydrometers, slender Spindles, wide scales, *each* 4s.

554. Specific Gravity ·800 to ·875 by ·001.
555. „ „ ·875 to 1·000 by ·001.
556. „ „ 1·000 to 1·300 by ·002.
557. „ „ 1·300 to 1·600 by ·002.
558. „ „ 1·600 to 1·900 by ·002.

559.

Large Hydrometer, stem slender and delicate, for determining the specific gravity of weak solutions, a little exceeding the density of water, such as weak bleaching liquors, milk, urine, &c., form of Fig. 559, the bulb large and stem very narrow, each 6s.

559. Specific gravity, 1·0000 to 1·0250 by ·0005.
560. „ „ 1·0000 to 1·0600 by ·0005.
561. Hydrometer, with slender stem, scale from 1·0000 to 1·0700 by ·0005, 4s.

Hydrometers with Special Scales.

TWADDELL'S HYDROMETERS, Griffin's improved form, in which the round bulb is replaced by a pear-shaped body, Fig. 562. The advantages of this form are, greater sensibility, greater durability, and the power of taking the density of a smaller quantity of liquid.

As the specific gravities of liquids are commonly denoted in books, in reference to hydrometers which indicate the direct specific gravity of liquids, in comparison with that of water, taken as a standard, and denoted by 1·000, whilst manufacturers in this country are much in the habit of speaking of specific gravities in reference to the scale adopted by the late Mr. W. Twaddell, it may be useful to show the relation of the degrees marked on *Twaddell's Hydrometers*, to those which express the direct specific gravity of a liquid. The necessary calculations are made by means of the following formulæ:—

Let a = any degree of Twaddell's Hydrometer,
x = specific gravity in relation to water taken at 1·000.

Formula 1.—To convert Twaddell's degrees into sp. gr. $x = 1 + (a \times {\cdot}005)$.

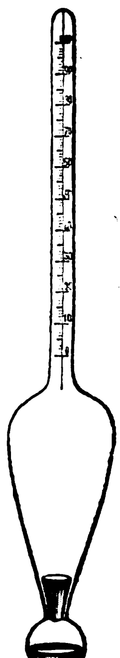
Formula 2.—To convert sp. gr. into degrees of Twaddell, $a = \frac{x - 1}{{\cdot}005}$

Example 1.—If a liquid marks 5 of Twaddell, what is its sp. gr.?
By *Formula* 1.—Sp. gr. $= 1 + (5 \times {\cdot}005) = 1{\cdot}025$.

Example 2.—If a liquid has the sp. gr. of 1·850, what degree of Twaddell's scale will that indicate?

By *Formula* 2.—Twaddell $= \frac{1{\cdot}850 - 1}{{\cdot}005} = \frac{{\cdot}850}{{\cdot}005} = 170$.

Hence 5 of Twaddell = specific gravity of 1·025. And 170 of Twaddell = specific gravity of 1·850.



562.

TABLE OF SPECIFIC GRAVITIES INDICATED BY TWADDELL'S SCLAE.

Twaddell.	Sp. Gr.	Twaddell.	Sp. Gr.	Twaddell.	Sp. Gr.	Twaddell.	Sp. Gr.
0	1000	50	1250	100	1500	150	1750
10	1050	60	1300	110	1550	160	1800
20	1100	70	1350	120	1600	170	1850
30	1150	80	1400	130	1650	180	1900
40	1200	90	1450	140	1700	190	1950

562. Twaddell's Hydrometer consists of Six Spindles, which have the following scales :—

Price of each Spindle, 1s. 6d.

No. 1.	0° to 24°	Specific Gravity	1·000 to 1·120.
2.	24 „ 48	„	1·120 „ 1·240.
3.	48 „ 74	„	1·240 „ 1·370.
4.	74 „ 102	„	1·370 „ 1·510.
5.	102 „ 138	„	1·510 „ 1·690.
6.	138 „ 170	„	1·690 „ 1·850.

With pasteboard cases, 2d. *each extra.*

563. Twaddel's Hydrometers, the set of Six Spindles, in a mahogany case, ~~21s.~~ 15s.

564. Twaddell's Hydrometers, the original form, spherical, like Fig. 559. The set of Six Spindles, without paper cases, 7s.

Single Spindles, 1s. 6d. each.

With pasteboard cases, 2d. each extra.

565. Twaddell's Hydrometers, pear shaped, with ivory scales.

Nos. 1, 2, 3, each 2s. 6d. | Nos. 4, 5, 6, each 3s.

566. Baumé's Hydrometers, for heavy liquids.

Explanation of Baumé's Scale for Heavy Liquids.—Manufacturers who employ Baumé's Hydrometer, or have occasion to know the value of the degrees on his scale, may find the following formula useful :—

Let B = Baumé's degree, and 100 = water. Then

$$\text{Specific gravity} = \frac{144}{144 - B}$$

That is to say, 144 divided by the difference between 144 and the given degree of Baumé, is the specific gravity in question, stated in reference to water assumed = 100. Thus, suppose Baumé = 66°. Then

$$\text{Specific gravity} = \frac{144}{144-66} \text{ or } \frac{144}{78} = 1.846 = \text{specific gravity.}$$—Dr. Clark.

SCALE OF BAUMÉ'S HYDROMETER FOR HEAVY LIQUIDS.

B.	Sp. Gr.	B.	Sp. Gr.	B.	Sp. Gr.	B.	Sp. Gr.
0	1·000	20	1·161	40	1·385	60	1·714
5	1·036	25	1·210	45	1·454	65	1·823
10	1·075	30	1·263	50	1·532	70	1·946
15	1·116	35	1·321	55	1·618	76	2·118

SCALE OF BAUMÉ'S HYDROMETER FOR LIGHT LIQUIDS.

10°	1·000	18°	·942	26°	·892	34°	·847
12°	·985	20°	·928	28°	·880	36°	·837
14°	·970	22°	·915	30°	·871	38°	·827
16°	·955	24°	·903	32°	·856	40°	·817

Hydrometers with Baumé's scale bear many names according to their respective applications : Alcoholometers, Saccharometers, Pèse Acides, &c.; but they are all founded on the above two scales, one for liquids heavier than water, and the other for liquids lighter than water.

567. Baumé's Hydrometer, for heavy liquids, scale 0° to 70°, with an additional scale, showing specific gravities from 1·000 to 2·000; 2s. 6d.

567A. The same, with a Thermometer, 4s.

568. Baumé's Hydrometer, for light liquids, scale 10° to 40°, with an additional scale, showing specific gravities from ·700 to 1·000; 2s. 6d.

568A. The same, with Thermometer, 4s.

569. Baumé's Hydrometer for acids, one spindle, scale 0° to 70°, weighted with lead, 1s. 3d.

569A. Ditto, ditto, weighted with mercury, 2s.

570. Baumé's Hydrometer for light liquors, one spindle, from 10° to 40°, weighted with lead, 10d.

571. Gay-Lussac's Volumeter, for determining the specific gravity of liquids, compared with water, fixed at 100° of the scale.

No. 1, for liquids lighter than water, 2s. 6d.
2, „ heavier „ 2s. 0d.

ALCOHOLOMETERS.

574. Tralles's Centesimal Alcoholometer, one glass spindle, scale 0° to 100°, each degree showing 1 per cent. by volume of pure alcohol, of sp. gr. 0·7939, in any mixture of spirit and water at the temperature of 60° F., 1s. 9d.

575. Ditto, with Thermometer enclosed, 3s.

578. Gay-Lussac's Centesimal Alcoholometer, one glass spindle, scale 0° to 100°, each degree showing 1 per cent. by volume of pure alcohol of sp. gr. 0·795, in any mixture of spirit and water, at the temperature of 15° Centigrade, or 59° F., 1s. 9d.

578A. Ditto, with Thermometer enclosed, 3s.

579. Baumé's Alcoholometer, scale to 40° or 50° graduated at 60° F., 1s. 6d.

The values of this scale are explained at No. 566.

581. Sikes's Hydrometer, in glass, one spindle, range from about 60° over proof to about 40° under proof.

With scale on paper, 2s. | With scale on ivory, 2s. 6d.

582. Sikes's Hydrometer for spirits, glass spindle, with double scale on paper, adapted to all temperatures, on the plan suggested by Stokes, with directions for use.

With thermometer in mahogany box, 12s.
The spindle alone, 5s.

583. Sikes's Hydrometer for estimating the value of spirits, according to the scale adopted by the British Board of Inland Revenue, double gilt brass instrument, in mahogany box, with ivory thermometer, a book of tables and instructions, and trial glass, complete, best make, £3, 10s.

584. Sikes's Hydrometer, brass, second quality, £2, 5s.

SPIRIT BUBBLES, OR BEADS.

585. Round Japanned Box containing 18 spirit bubbles which show degrees of Sikes's Hydrometer, according to the following scale. Adjusted at 60° Fahrenheit, 7s. 6d.

No. of Bubble.	Per cent.	No. of Bubble.	Per cent.	No. of Bubble.	Per cent.
16	45 OP	22	15 O	28	25 U
17	40 O	23	10 O	29	20 U
18	35 O	24	5 O	30	25 U
19	30 O	25	PROOF	31	30 U
20	25 O	26	5 UP	32	35 U
21	20 O	27	10 U	33	40 U

O signifies over proof; U signifies under proof.

586. Box with 12 spirit bubbles, 5s.
587. Box with 24 spirit bubbles, 10s.
588. Single spirit bubbles, of any desired number, per dozen, 4s.
589. Single spirit bubbles, of coloured glass, per dozen, 7s. 6d.

SACCHAROMETERS.

The specific gravity of solutions of sugar ranges at 62° F. from 1·000 to 1·321, at which last-named density the solution contains 67 per cent of sugar.

The specific gravity of expressed cane juice is commonly under 1·120, which can be tested with No. 1 of Twaddell's Hydrometer (see Nos. 562 and 613), or with Baumé's Hydrometer for heavy liquors having a scale from 0° to 16°.

Saccharometers for use in England are graduated at 62° F.; but for use in the West Indies at 84° F.

590. Hermbstadt's Saccharometer, one glass spindle with two scales, namely, sp. gr. from 1·000 to 1·321, and percentage of sugar from 0° to 67°, 5s.
591. Ditto, with Thermometer enclosed, 9s.
592. Hermbstadt's Saccharometer, for beer or wort, one glass spindle, scale from 1·000 to 1·100, 3s.
593. Ditto, with Thermometer enclosed, 4s. 6d.
594. Saccharometer, one glass spindle, scale showing direct specific gravity from 1·000 to 1·350, 3s.
595. Baumé's Saccharometer, one glass spindle, scale 0° to 50° weighted with mercury, 1s. 9d.
596. Ditto, weighted with lead, 1s. 3d.
597. Baumé's Saccharometer, one glass spindle, scale 0° to 25°, weighted with lead, each degree in $\frac{1}{4}$°, 1s. 9d.
598. Baumé's Saccharometer for weak syrups, scale 0° to 10°, each degree in $\frac{1}{10}$°, weighted with mercury, 2s. 6d.
599. Baumé's Saccharometer, scale 0° to 70°, each degree divided in $\frac{1}{4}$°, two spindles, weighted with mercury, the pair, 5s. Separately as follows:—

No. 1. Scale from 0° to 40°, in $\frac{1}{4}$°, 2s. 6d.
2. Scale from 40° to 70°, in $\frac{1}{4}$°, 3s.

604. Balling's Saccharometer, showing the percentage of pure sugar, one spindle, scale from 0° to 75°, 2s. 6d.
605. Balling's Saccharometer for syrups:—

No. 1. Scale from 0° to 3°, divided in $\frac{1}{10}$°, 1s. 3d.
2. Scale from 0° to 20°, divided in $\frac{1}{2}$°, 1s. 6d.
3. Scale from 0° to 60°, divided in $\frac{1}{1}$°, 1s. 9d.

607. Balling's Saccharometer for beer and wort, showing the percentage of dry extract to $\frac{1}{8}$°, 2s.
612. Buss's Saccharometer, electro-gilt brass instrument, divided on two sides of the stem, with one weight, showing to 50 lbs. per barrel. With Thermometer and book of instructions, in mahogany box, £2 5s.

HYDROMETERS FOR USE IN THE WEST INDIES.

Adjusted at 84° Fahrenheit.

613. Twaddell's Hydrometers, same scales as No. 562, but adjusted at 84° F.

No. 1. 2s.	No. 3. 2s.	No. 5. 2s. 6d.
No. 2. 2s.	No. 4. 2s. 6d.	No. 6. 2s. 6d.

614. Baumé's Saccharometer, scale from 0° to 40° or 50° at 84° Fahr., 2s.

615. Ditto, scale 0° to 75°, at 84° Fahr., 2s. 6d.

See explanation of scale at No. 566.

616. Baumé's Alcoholometer, One Glass Spindle, scale 0° to 40°, graduated at 84° Fahr., weighted with lead, 2s.

617. Spirit Bubbles of the various sorts described at No. 585, but adjusted at 84° Fahr., or any other temperature, at the same prices as those adjusted at 60°.

MISCELLANEOUS SPECIFIC GRAVITY INSTRUMENTS.

618. OIL GAUGE, or Hydrometer, for estimating the purity of fat oils, One Glass Spindle, with Thermometer enclosed, Fig. 544, 4s. 6d.

Directions for Use.—Give the instrument time to acquire the temperature of the oil, and then observe the degree of the thermometer, as well as the degree of the hydrometer. If the thermometer is at x degrees *above* zero, an equal number of degrees must be deducted from the hydrometer degree. If the thermometer is at x degrees *below* zero, an equal number of degrees must be added to the hydrometer degree. The range of the hydrometer scale is from 22 to 50, and the following table shows the degree of certain common oils:—

Purified Rape Oil, . .	38—39	Southsea Train Oil, . .	33
Common Rape Oil, . .	37—38	Nut Oil, ...	32—33
Olive Oil, ...	37—38	Hempseed Oil, . . .	30—31
Dötter Oil, ...	32—33	Linseed Oil, . . .	29—30
Poppy Oil, ...	32—33		

Mixtures of oils show a mean density. Oils that have been purified are rendered lighter, and show about 1° more on the instrument.

619. Milk Test, One Spindle, with scale 0° to 25°, to test good milk mixed with ¼, ½, and ¾ water, 1s. 6d.

620. Milk Test, One Spindle, with scale 0° to 35°; more delicate than the preceding, 3s.

621. Lacto-Densimeter of Quevenne; Spindle with two scales—one to show the density of pure milk, another for skimmed milk; both scales expressing the specific gravity of the milk, 2s. 6d.

622. Cremometer of Chevallier, the scale of which shows percentages in mixtures of water and pure milk, 3s. 6d.

The greatest density of cow's milk is 1·035, produced under favourable circumstances. The usual density of pure good milk is 1·030, water being 1·000. A scale of 35° shows, therefore, the full range between water and the best milk, and serves to register all the information which a trial of the density can elicit.

Instruments for measuring the percentage of cream in milk are described under the head of "Volumetric Analysis."

623. Griffin's Ammonia Meter, for testing liquid ammonia; one spindle, with 125°, which includes the strongest ammonia that can exist at the temperature of 62° F., and extends to all weak solutions: sp. gr. ·875 to 1·000. 4s.

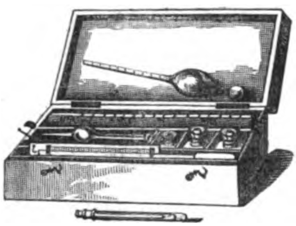
Every degree shows 17 grains of dry ammonia in a decigallon of liquor. In "Chemical Recreations," page 329, a table is given which shows every particular respecting solutions of ammonia, the strength in atoms, the percentage of ammonia, its weight per decigallon in grains, the comparative money value of different solutions per lb., &c.

624. Schatten's Hydrometer for estimating the percentage of lime in Bone Black, 2s. 6d.
625. Oechsle's Hydrometer for Wine and Must, with two scales and weight, with instructions, 4s.
626. Safety Hydrometer for Mineral Oil, 1s. 6d.
627. Hydrometer for Tannin, 2s. 6d.
629. Nicholson's Hydrometer, for taking the specific gravity of solid bodies, such as minerals, Fig. 629, japanned tinplate, 5s.
629A. Ditto, polished brass, 6s.


629.

URINOMETERS.

630. Urinometer for determining the specific gravity of urine; small glass spindle, scale 1,000° to 1,060°, 1s. 9d.
630A. Urinometer, with ivory scale, in case, 2s. 6d.
631. Urinometer, spindle with case, trial tube, and round outer leather case for the pocket, 6s.
633. Vogel's Urinometer, two glass Spindles, the pair, 3s. 6d.
634. Urinometer, spindle with case, trial tube and thermometer, in box with hinged top, Fig. 634, 12s.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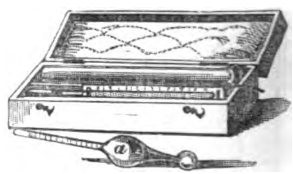
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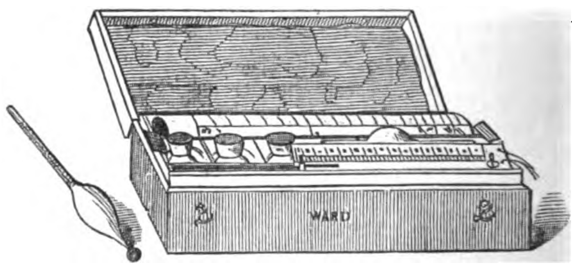


636.

635. Urinometer, with graduated solution tube, spirit lamp, thermometer, two capped acid bottles, nest of test tubes, pipette, and two books of test paper, Fig. 635, 20s.

636. Urinometer, spindle with graduated solution tube, thermometer, spirit lamp, two capped acid bottles, nest of test tubes, two books of test paper, pipette; the bottles larger than those in No. 635. In a box, Fig. 636, 31s. 6d.

Solution Tubes or Trial Jars for Urinometers, plain, 1s.; graduated, 1s. 6d.

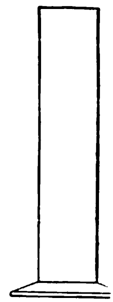
Apparatus and Tests for the CHEMICAL examination of Urine will be described in the section on VOLUMETRIC ANALYSIS.

TRIAL JARS, or SOLUTION TUBES, to contain the liquor the specific gravity of which is to be tried by a HYDROMETER.

637. Glass Jar on foot, cylindrical, with plain mouth, Fig. 637, or with flange or spout, 1½ or 1¾ inches wide.

10 inches long,	10d.
12 „ „	1s.
13 „ „	1s. 1d.
14 „ „	1s. 2d.
15 „ „	1s. 4d.
16 „ „	1s. 6d.

638. Glass Cylinders, on foot, with widened mouth, Fig. 638.
9 inches high, 1½ inches wide, 2-inch mouth, 1s. 6d.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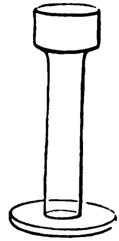
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643.

639. 13 inches high, 1½ inches wide, 2-inch mouth, 1s. 9d.

The use of the widened mouth, or cup, is to prevent the adhesion of the hydrometer to the side of the tube by capillary attraction; an accident which readily happens when the tube is without bulb, as represented in Fig. 643. The cup should be half full of liquor when the hydrometer is at rest in it.

Pneumatic Apparatus for Chemical Use.

Only such articles are cited in this list as are commonly applicable to Chemical Operations. A complete account of the apparatus proper to demonstrate the principles of the science of Pneumatics is given in a catalogue specially devoted to that subject, namely, Part I. of Griffin's *Scientific Handicraft*, price 3s. 6d.

645. SPRENGEL'S AIR PUMPS. See No. 1663.

AIR PUMPS.

AIR PUMPS of the most improved forms, and guaranteed to be in perfect action.

All the screws of Pneumatic Apparatus are made of the *same size and thread*, so that the several pieces are easily fitted to one another.

If an Air Pump is not used for a considerable time, the various parts require the addition of a little oil, which may be easily applied by pouring a teaspoonful into the centre hole in the brass plate, as shown at *c*, Fig. 646, when a few strokes of the piston up and down will convey the oil to all the internal parts, and the machine will be in good working condition. The ground edges of all receivers should be smeared with tallow prior to being fixed on the air-pump plate. Stop-cocks should be always laid aside *open;* and when a pump is put aside, the blank nut, letter *s*, Fig. 648, should always be screwed into the plate, to prevent the entry of dust.

EXHAUSTING POWER OF THE AIR PUMPS DESCRIBED IN THIS SECTION.—I have added to the description of each pump a reference to its exhausting power. It is proper to state in what manner these powers were ascertained. This was by trial with syphon gauges. The pumps were new, and therefore in good order; the joints screwed tight together; the washers, the inside of the pumps, and the leading tubes were well supplied with oil; the receivers were carefully ground on the edges and greased with tallow; and the mercury in the syphon gauges, which were of the form represented in Fig. 695, and of which several were used at once, had been recently boiled in the tubes. The temperature of the room in which the trials took place was about 55° F., and the barometer stood at 30 inches. The results are quoted in the following table:—

1 The kind of Pump tried. Under columns 2 to 5 is shown the atmospheric pressure indicated by the syphon gauges at the point of greatest exhaustion.	2. Capacity of Receiver, 960 cubic ins.; its Base, 9 inches diameter.	3. Capacity of Receiver, 280 cubic ins.; its Base, 7 inches diameter.	4. Capacity of Receiver, 86 cubic ins.; its Base, 4 inches diameter.	5. Capacity of Receiver, 25 cubic ins.; its Base, 2 inches diameter.
646. 2-barrel Pump, 8-in. plate	...	$\frac{1}{4}$ inch.	$\frac{3}{16}$ inch.	$\frac{1}{8}$ inch.
647. „ „ 10-in. „	$\frac{3}{8}$ inch.	...	$\frac{1}{4}$ „	$\frac{1}{8}$ „
648. Tate's Pump, 7-in. „	......	$\frac{1}{10}$ inch.	$\frac{1}{10}$ „	$\frac{1}{20}$ „
651. „ large 1, 10-in. „	$\frac{1}{8}$ inch.	...	$\frac{1}{10}$ „	$\frac{1}{10}$ „
652. 3-barrel Pump, 10-in. „ when the vertical barrels were used, . . .	$\frac{3}{8}$ „	...	$\frac{1}{4}$ „	...
Ditto, when the horizontal pump was used, . .	$\frac{3}{16}$ „	...	$\frac{1}{8}$ „	$\frac{1}{20}$ inch.
653. Pump with fly wheel, .	$\frac{1}{8}$ „	...	$\frac{1}{10}$ „	$\frac{1}{10}$ „

The Residues of air left in the receivers, according to these indications, are as follow:—

$\frac{1}{20}$ inch = 1 in 600.	$\frac{1}{8}$ inch = 1 in 240.	$\frac{1}{4}$ inch = 1 in 120.
$\frac{1}{10}$ „ = 1 in 300.	$\frac{3}{16}$ „ = 1 in 160.	$\frac{3}{8}$ „ = 1 in 80.

For the sake of those who may wish to try the power of their pumps in this manner, I may add to the conditions of trial above cited a caution respecting the syphon gauges. In their ordinary condition,—that is to say, after having been for some time exposed to the air,—the syphon gauges are of no use for such trials as those recorded above. For such experiments the mercury must be *recently boiled in the gauges*, and then they retain the power of giving accurate results for only a short time. If they are exposed for two or three days to the air, they lose their power. If on the day they are made they are put under a receiver, and repeatedly exhausted and refilled with air, they are thus deprived of their proper power. The air in the gauge gets among the mercury, and puts an end to its accurate indications. When the exhausting power of a pump is tested by a gauge thus deteriorated, the exhaustion appears to be much greater than it actually is, even when the quantity of air in the gauge is so small that it cannot be seen as a bubble in the mercury, either by the naked eye or with a lens; while the existence in the gauge of a very small *visible* bubble of air will enable the pump to reduce the mercury in the closed limb of the gauge lower than that in the open limb: in other words, the exhaustion will appear to take out of the receiver more air than it contained, and thus reduce the atmospheric pressure to less than nothing.

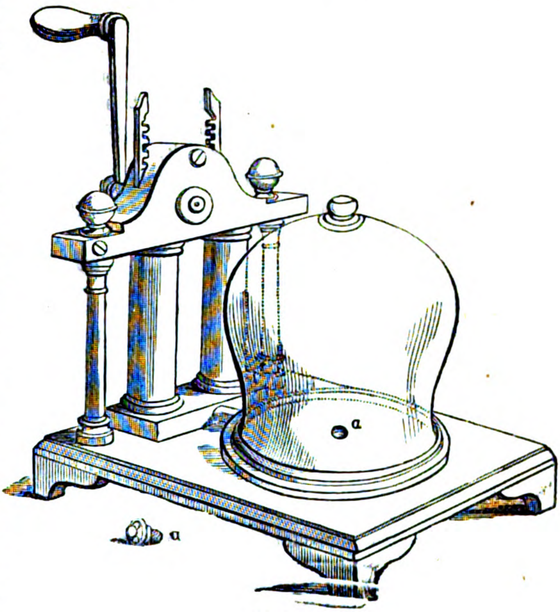
Just as it is possible to make the power of a pump appear to be better than it is by using a fallacious gauge, so it is possible to err the other way, and by neglecting to take the precautions which I have pointed out, make the power appear to be *worse* than it is. A pump cannot, indeed, be always *new*; but it is always possible to see that its pistons and valves are in good order, that the pump is clean and well oiled, that its parts are screwed tight together and fixed firmly to a table, and that the receivers are ground smooth on the edges, and are clean and properly greased. Without taking these precautions, a pump cannot be made to work well.

Notwithstanding what is said above, the syphon gauge is highly useful for comparative experiments, and to indicate results approximately.

I have not stated in the trials recorded above the number of strokes that are required to produce each effect: that indication of power is much subject to variations from accidental circumstances, such as the greater or lesser rapidity of the strokes, and the greater or lesser accuracy with which the piston of Tate's pump is driven or pulled home to the end of the barrel at each stroke.

Neither have I answered a question that is frequently asked,—How many minutes will it require with a given pump to freeze water? Generally, I may say, that any pump will freeze water over sulphuric acid, if it will produce pretty readily a vacuum indicated by $\frac{1}{4}$ inch of mercury in the syphon gauge. But one cannot fix the *quantity* of water to be frozen and the *time* to effect the freezing without knowing the power of the pump, the size of the receiver, the strength of the acid, the temperature of all parts of the apparatus, of all the materials to be used, and of the room in which the experiment is to be made. Such details cannot be entered into in this note.

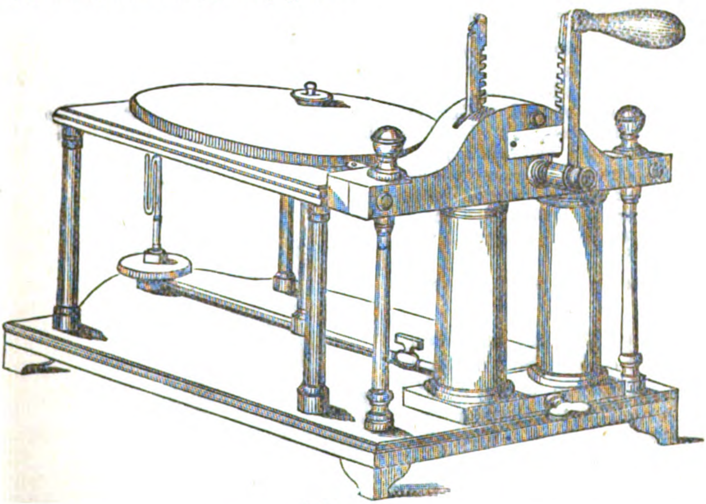
Some readers may, perhaps, consider that the exhaustions quoted in the above table do not indicate very accurate pumps; for it is very frequently stated in books, that double-barrelled pumps will exhaust to 1 in 1,000, when the mercury in the gauge will be at $\frac{1}{100}$ inch. No doubt, air pumps at three times the cost of any in this list could be made a little more accurate than these are; but I fancy that when the above statement is made as regarding ordinary working air pumps, due care has not been taken to distinguish the power of the pump from the fallacy of the gauge.



646.

646. Air Pump, double barrels, $6\frac{1}{2}$ inches long, $1\frac{1}{2}$-inch bore, $4\frac{3}{4}$-inch stroke, with 8-inch plate, on mahogany stand, and stopcock between the plate and the barrels, Fig. 646, £8, 8s.

Exhausting power of this Pump; see page 58.



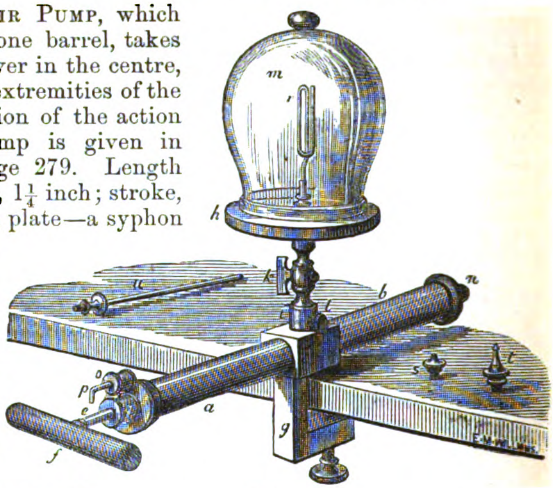
647.

647. Air Pump, double barrels, 7 inches long, $1\frac{3}{4}$-inch bore and $5\frac{1}{2}$-inch stroke, with 10-inch ground plate on mahogany stand, supported by four pillars, with small gauge plate, mercury gauge, and key, Fig. 647, £14.

Exhausting power of this Pump; see page 58.

RECEIVERS *of various forms and sizes suitable for the different Air Pumps are described between* Nos. 655 *and* 681. *The pumps are without receivers at the quoted prices.*

648. TATE'S DOUBLE-ACTION AIR PUMP, which contains two pistons in one barrel, takes in the air from the receiver in the centre, and expels it at the two extremities of the barrel. A full description of the action and power of this pump is given in *Chemical Recreations*, page 279. Length of barrel, 16 inches; bore, $1\frac{1}{4}$ inch; stroke, $8\frac{1}{2}$ inch. It has a 7-inch plate—a syphon gauge, marked *r*, and a screw, marked *n*, to enable the pump to be used as a condensing pump. It is mounted with a massive brass clamp, by which it can be securely fixed to any solid table, Fig. 648. Price £3, 13s. 6d.



Exhausting power of this Pump ; see page 58.

648.

It will freeze water over sulphuric acid in a receiver of 300 cubic inches, in 150 strokes at about 60° Fahr., and in half that number of strokes at about 40° Fahr.

649. TATE'S AIR PUMP, of the same form and dimensions as No. 648, but mounted on a solid and elegant japanned iron pedestal, represented by *a*, Fig. 649. Price of the pump on pedestal support, with syphon gauge, £3, 13s. 6d.

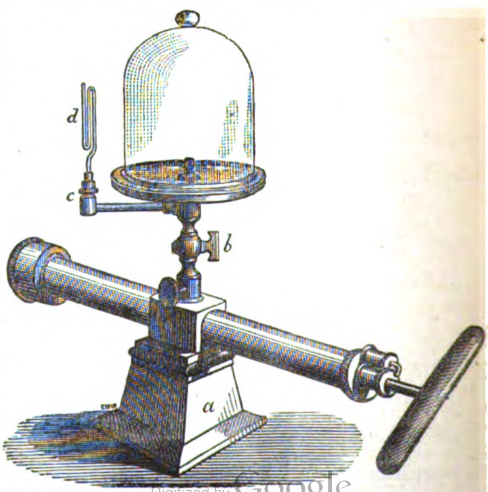
The prices of the extra pieces represented in Fig. 649 *will be found at the following numbers :—b*, at No. 684 ; *c*, at No. 686.

The pedestal requires to be screwed to the table where the pump is to be used. The pump is then perfectly solid. On the other hand, the clamp is useful when the pump has to be carried about for use in different localities.

The round box represented at the far end of the pump cylinder in Figs. 649, 650, and 652 is intended to catch the oil, of which more or less is expelled from the pump with the air at every stroke. There is a hole at the upper part of the box to let out the air. From time to time, the oil should be renewed from the box. Though not shown at Fig. 648, this oil-box is now sold with the pump, No. 648.

Exhausting power of this pump ; the same as that of 648.

650. TATE'S AIR PUMP, same form and size as No. 648, but mounted on a solid iron table, *a*, Fig. 650, which has four legs screwed to an iron plate, *b*, which plate can either be fixed permanently to the work table by four screws, or be fastened to it by the large iron clamp, *c*, which permits the removal of the pump. Price of the pump and table, *a, b*, with the syphon gauge, *d*, Fig. 649, £3, 13s. 6d.

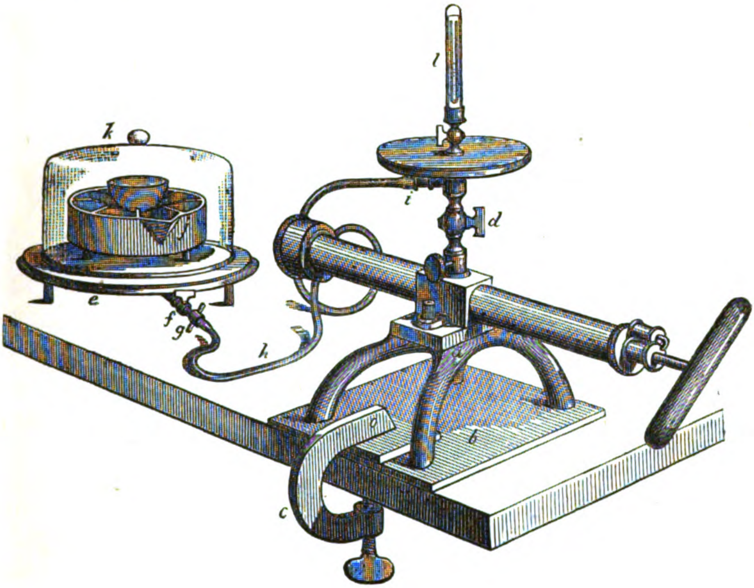


649.

For the prices of other portions of the Apparatus represented by Fig. 650

See	*c,*	*d,*	*e, f, g,*	*g, h, i,*	*j,*	*k,*	*l,*
at No.	725,	684,	687,	690.	692,	655,	695.

Exhausting Power of this Pump; the same as that of Nos. 648 and 649. The three pumps are of the same size and power, and differ only in the style of mounting.



650.

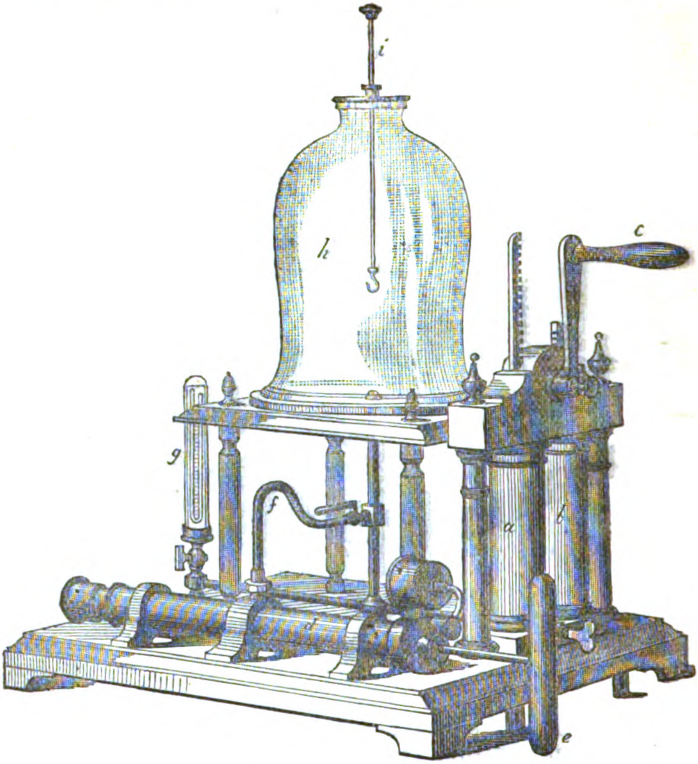
651. TATE'S AIR PUMP, of the same form as the preceding, No. 650, but of ABOVE DOUBLE THE SIZE AND POWER; namely, with a barrel of 17 inches in length, $1\frac{3}{4}$-inch bore, and $9\frac{1}{4}$-inch stroke. It is mounted on an iron table similar to *a, b,* Fig. 650, with a plate of 10 inches diameter, and supplied with the extra joint and arm marked *b, c,* in Fig. 649, and the gauge marked *l,* in Fig. 650. This is the largest and most powerful form of Tate's Air Pump which can be conveniently worked without rack-work, lever, or other machinery. It gives great power, is pretty easily worked, and is sold at a moderate price, £8.

Exhausting Power of this Pump; see page 58.

652. AIR PUMP WITH THREE BARRELS, serving either for rapid action at lectures, or for more complete exhaustion for researches, Fig. 652. Price, without the jar and rod, *h, i,* £18.

Exhausting Power of this Pump; see page 58.

This Apparatus consists of an Air Pump with two vertical barrels, marked *a, b,* in Fig. 652, which are worked as usual by the handle *c* acting on rack-work. Bore of the vertical barrels, $1\frac{3}{4}$ inch; length of barrels, 7 inches; stroke, $5\frac{1}{2}$ inches; diameter of the pump plate, 10 inches. With this arrangement, large receivers having, for example, a capacity of a thousand cubic inches, can be rapidly and easily exhausted till the mercury in the gauge falls to $\frac{3}{8}$ inch, and small receivers can be brought to a vacuum of $\frac{1}{4}$ inch. This is sufficient exhausting power for most of the experiments that are usually exhibited at lectures to illustrate the principles of pneumatics. But, as more perfect exhaustion is sometimes required, a separate pump on Tate's plan is added to the vertical pump. When the power of the latter ceases, Tate's pump is put into action, and the exhaustion then proceeds, until the mercury in the gauge descends in receivers of a thousand cubic inches to $\frac{3}{16}$ inch, and in small receivers to $\frac{1}{8}$ inch, and even to $\frac{1}{20}$ inch. See the experiments recorded at page 58. This compound Air Pump is, therefore, adapted either to give quick results when moderate exhaustion is requisite, as at lectures, or more effectual exhaustion when



652.

that is required for special experiments or for researches. The extent of the exhaustion is shown by the gauge *g*, on the plan of No. 695, fixed on the lower table of the pump.

The Apparatus is made in the most solid manner, and is mounted on a polished mahogany frame. The price quoted includes the gauge, but not the rod and receiver marked *h* and *i*.

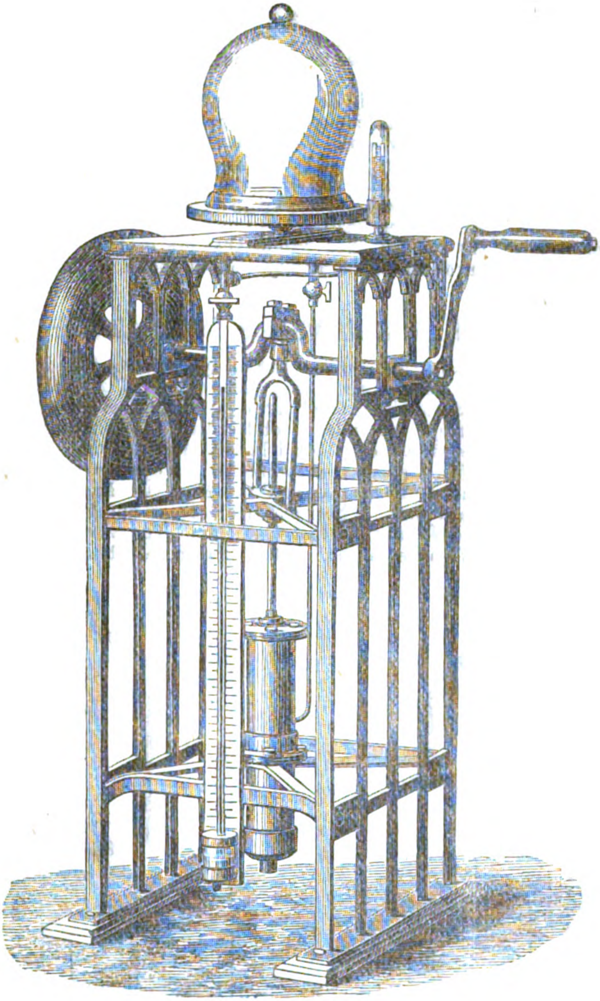
653. TATE'S AIR PUMP, of large size, arranged for easy and rapid action, worked by a winch and crank, regulated by a fly wheel, Fig. 653, £21.

Exhausting Power of this Pump ; see page 58.

The barrel is 12 inches long ; it has a bore of 2½ inches, and the stroke is 6 inches. The valves are of brass, and work in oil ; the barrel is fixed upright. The framework is of iron, and the top is of polished mahogany, bearing a brass pump plate of 10 inches diameter. Upon the mahogany top there is a screw to receive a syphon gauge similar to No. 695. There is also a descending gauge tube of 33 inches long below the pump plate, dipping into the mercury cistern, and accompanied by a scale of inches. An oil-box is adapted to each end of the barrel to receive the oil which passes out with the expelled air, and these boxes from time to time must be emptied. When the pump is set up for use the two ends of the barrel must be unscrewed, and some oil must be put into each of the boxes that contain valves, about 4 fluid ounces in the lower box, and 2 fluid ounces in the upper box. About 2 fluid ounces of oil should also be put into the pump by the hole in the centre of the plate, which, on working the handle of the pump, will be distributed throughout the interior.

An Air Pump of this description, which effects with ease in five minutes, in large vessels, a vacuum represented by ¼ inch of mercury in the gauge, can be usefully applied in many of the arts.

Remarks on the Comparative Labour that attends the Working of these Air Pumps.—



653.

I have stated at page 58, the comparative *Exhausting Power* of these six Air Pumps; and I will now say a few words on the comparative *Labour* attending their use.

The Air Pumps of the old description, with vertical barrels, such as Nos. 646, 647, and 652, are easy to work *at the beginning* of each exhaustion, and gradually become more difficult as the exhaustion approaches completion. This arises from the increasing pressure of the atmosphere upon the upper faces of the pistons in the barrels when the spaces under the pistons are nearly free from air. With Tate's pump the contrary effect is produced: at the beginning the pressure is considerable; but after two or three strokes it gradually becomes easier and easier, the atmosphere being cut off from the pistons by the valves at the ends of the barrel. Pistons of 1¼ inch diameter, such as belong to the pump No. 648, are easy to work even at the beginning of a process. But the pump No. 651, which has pistons of 1¾ inch diameter, requires for the first two or three pulls a pretty strong hand; for, besides the atmospheric pressure, there is in this case a much greater amount of friction from the pistons to be overcome: after two or three pulls it works easily enough. With a view to apply Tate's principle to large pumps the apparatus No. 653 has been made. In this case the force necessary to work the pistons is acquired mechanically, and we have an apparatus that is worked with great facility. It will be observed in the table given at page 58 that there are three pumps—Nos. 651, 652, 653—having 10-inch plates, which can be used with receivers that hold 1,000 cubic inches of air, and which exhaust these cylinders with the same degree of accuracy, while the respective cost of these pumps is £8, £18, and £21. The higher prices include the cost of the machinery for making the pumps work easily and quickly. The cheapest of these pumps will do the same work as the dearest, if you give it a little more *time* and a little more *labour*. The choice of a pump must be guided by circumstances. If you require rapid exhaustion with easy work, No. 653 is the best pump; and next to it, No. 652; but if economy is an object the pump No. 651 may be safely taken. Comparing together two pumps of the same price—namely, Nos. 646 and 651—the former is easier and quicker in action; the latter is much more effective, and without any other drawback than the two or three stiff pulls at the beginning of an exhaustion. The small Tate's Pumps, Nos. 648, 649, 650, are beyond question greatly superior to all the two-barrelled pumps that are usually sold at twice their price. These small pumps can be worked without difficulty, and, as shown in the table at page 58, they give excellent results.

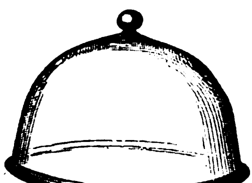
BELL-GLASS RECEIVERS FOR AIR PUMPS.

The Air-pump Receivers are all strongly welted and finely ground on the edge, the flat flange that rests upon the air-pump plate being from ¼ to ½ inch across. The width of each receiver is measured from outside to outside of the ground flange, to show what size of air-pump plate it is suitable for. The bore, of course, is ⅝ inch to 1 inch less than the described width. The height is measured inside. When there is a neck, the height is exclusive of the neck.

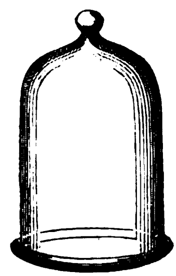
Receivers of forms suited for particular experiments in Physics are described in the article "Pneumatics," in the catalogue of Physical Apparatus.—*Scientific Handicraft.*

All these Receivers are of hard glass. Those marked B are of fine Bohemian glass, and handsomely finished. Those marked G are of hard German glass. The whole are well annealed.

The Receivers Nos. 673 to 678 have flanged mouths, ground flat, the diameter across the flange being 2 to 3½ inches.



655 to 659.



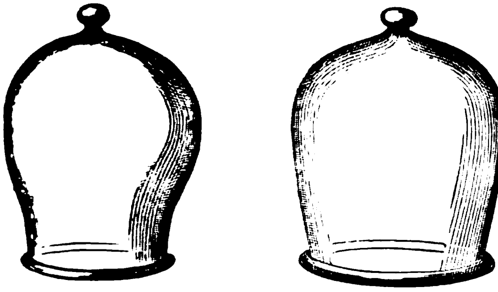
660 to 667.

Flat Receivers for Air Pumps.

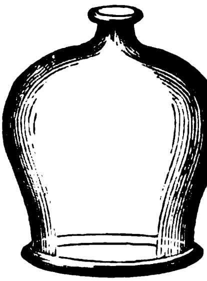
No.	Inches wide.	Inches high.	Prices. B.	Prices. G.
			s. d.	s. d.
655	6½	3½	4 0	2 6
656	7	4	4 6	2 6
657	8	6	7 0	3 6
658	10	6	11 6	4 6
659	11½	7	17 0	6 6

Cylindrical Receivers.

No.	Inches wide.	Inches high.	Prices. B.	Prices. G.
			s. d.	s. d.
660	6½	8	5 0	3 6
661	7	8	6 0	3 6
662	7	12	9 0	5 0
663	8	12	10 6	6 6
664	10	14	22 0	...
665	4	6	2 6	1 6
666	6	20	25 0	...
667	5	36	38 0	...



668 to 672.



673 to 678.

Bell-shaped Receivers. *Bell-shaped Receivers with necks.*

No.	Inches wide.	Inches high.	Prices. B.	Prices. G.	No.	Inches wide.	Inches high.	Prices. B.	Prices. G.
			s. d.	*s. d.*				*s. d.*	*s. d.*
668	4	6	3 0	2 6	673	4	6	3 6	2 6
669	6½	8	7 6	3 6	674	6½	8	8 0	3 6
670	7	8	9 0	4 0	675	7	8	10 0	4 0
671	8	10½	14 0	6 6	676	7	12	13 0	6 6
672	10	12	24 0	9 0	677	8	10½	15 0	6 6
					678	10	12	25 0	9 0

The necks of the receivers, Fig. 673, are 2 to 3 inches in bore, and 3 to 4 inches across the ground flanges.

FLINT-GLASS RECEIVERS are the same prices as those of Bohemian Glass.

EXTRA FITTINGS FOR TATE'S PUMPS.

684. Extra Screw between the Pump Plate and the Stopcock, represented at the upper part of *b* in Fig. 649, and *d* in Fig. 650, with a blank nut to close it when not required for use, 3s. 6d.

This is not a separate piece of metal, but a prolongation of the stopcock marked K in Fig. 648. It is useful for the purposes represented in Figs. 649 and 650.

685. Extra Joint with Screw. Those who already possess Tate's Pump, as figured at No. 648, can have an extra joint with this screw supplied at the cost of 5s.

686. Arm to carry a Syphon Gauge, applicable to the extra screw No. 684, represented by *c*, Fig. 649, 4s.

The Syphon Gauge, when used merely to test the power of a pump, can be screwed into the plate, as shown at *r*, Fig. 648. In that case a hole is drilled in its brass base to permit the passage of the air. But when it is desired during the progress of an experiment to know the extent of exhaustion within the receiver, the gauge can be mounted as represented by Fig. 649. The gauge *d* must then be without the extra hole in its brass base. Instead of this form of gauge, that represented by Fig. 695 can be used in this manner.

687. **Extra Pump Plate**, for use in drying chemicals in vacuo, or in freezing water, over sulphuric acid, consisting of a cast-iron table mounted on three legs, with plate-glass surface, an air-tube and stopcock, the thread of which fits a union joint, as represented by *e, f, g*, Fig. 650, three sizes.

687. 8-inch Plate, with stopcock, 14s.
688. 10 " " 18s.
689. 12 " " 25s.

690. **Connecting Tube**, flexible caoutchouc tube, 3 feet long, *h*, Fig. 650; with a screw *i*, to fit the extra joint *d*, and a union joint *g*, to fit the stopcock *f*, of the extra plate, 4s. 6d.

One connecting tube serves for any number of separate plates, Nos. 687 to 689, each of the plates having a stopcock to keep the vacuum.
During the exhaustion of a receiver placed over a separate pump plate, a gauge is fixed in the centre of the fixed pump plate, as represented by Fig. 650, to mark the progress of the exhaustion.

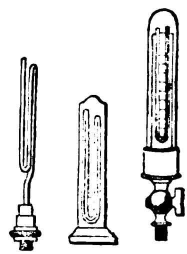
691. The Connecting Tube, with the stopcock *f, g, h, i*, Fig. 650, complete, 8s.
Flat Glass Receivers for the extra pump plates, of strong German and Bohemian glass, welded and ground on the edges, see Nos. 655 to 659.
692. Pans for containing Sulphuric Acid, represented at Fig. 650, are described in the section on "Desiccating Apparatus," No. 1285.

Syphon Gauges, for showing the extent of exhaustion effected by air pumps within their receivers. These are of three kinds :—

693. Common three-limbed Syphon Gauge, mounted on a brass foot, with male screw, Fig. 693, 3s. 6d.

This gauge may be had either with or without an air hole drilled in the brass foot: see note to No. 686. It is used as shown by *r*, Fig. 648, and *d*, Fig. 649.

694. Syphon Gauge, with scale, form of Fig. 694, mounted on a flat stand, and requiring to be placed under a receiver for trial, 5s.


693. 694. 695.

695. Syphon Gauge, with scale, form of Fig. 695, the gauge enclosed in a glass tube. Price, with stopcock, 10s. 6d.
696. Ditto, without stopcock, 7s. 6d.

Of these three syphon gauges, the one that is least trustworthy is the first, No. 693, in consequence of the difficulty of filling it with mercury quite free from air. This variety also is not graduated. The other two are graduated to show twentieths of an inch. No. 695 is represented in use by *l*, Fig. 650, and *g*, Fig. 652.
Purchasers of the Pumps Nos. 648 to 650, with which the gauge No. 693 is delivered, may have No. 695 instead, on payment of the difference in price.
The precautions to be taken to secure accurate results in the use of syphon gauges have been detailed at page 58.

STOPCOCKS AND CONNECTORS.

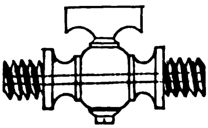
The following Stopcocks and Connectors are all London-made, of the best quality, and of Polished Brass.

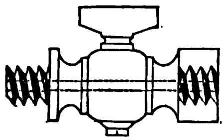
Stopcocks and Connectors of Polished Iron cost *one-half more* than those of polished brass.

Stopcocks :—

697. Stopcock, with two male screws, Fig. 697, 3s.
698. Stopcock, with one male and one female screw, Fig. 698, 3s.

699. Stopcock, with a male screw at one end, and at the other end a union joint and a brass tube for attaching a flexible tube, Fig. 699, 5s.


697.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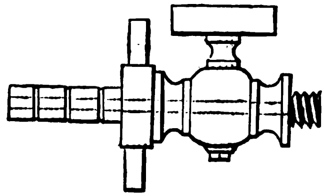
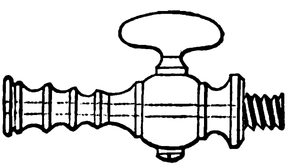

699.

700. Stopcock similar to Fig. 699, but having a female instead of a male screw at one end, and at the other end a union joint and a long brass tube for attaching a flexible tube, 5s.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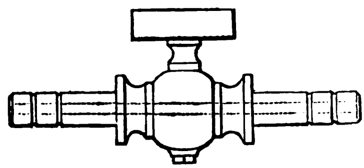
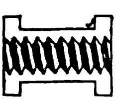

703.

701. Stopcock, with a tube at one end for connecting a caoutchouc tube, and at the other a male screw, Fig. 701, 3s.
702. A similar Stopcock and Tube, but having a female screw at one end, 3s.
703. Stopcock, having at each end a tube for connecting a caoutchouc tube, Fig. 703, 3s.

Connectors :—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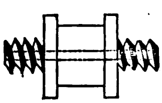
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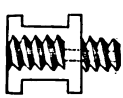
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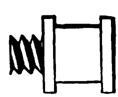
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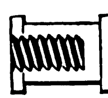
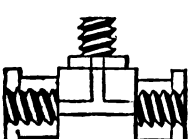

708.

704. Connector, with 2 female screws, Fig. 704, 1s.
705. Connector, with 2 male screws, Fig. 705, 1s.
706. Connector, with 1 male and 1 female screw, Fig. 706, 1s.
707. Blank Nut, with 1 male screw, Fig. 707, 1s.
708. Blank Nut, with 1 female screw, Fig. 708, 1s.

These blank nuts are used to stop openings that are not required, see No. 684.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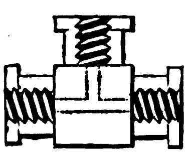
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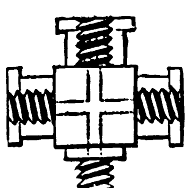
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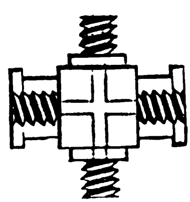
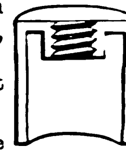

712.

THREE-WAY AND FOUR-WAY CONNECTORS; four patterns, *each* 3s.

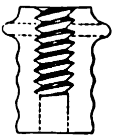
709. Connector, 2 female screws, 1 male screw, Fig. 709.
710. Connector, 3 female screws, Fig. 710.
711. Connector, 3 female screws, and 1 male screw, Fig. 711.
712. Connector, 2 female screws, and 2 male screws, Fig. 712.

713. BRASS CAPS for Bell Jar Receivers, and for Globes for gases, with female screw; diameters to suit glass necks of $\frac{3}{4}$, 1, $1\frac{1}{4}$ inch, Fig. 713, *each* 1s.
714. Similar Brass Caps, $1\frac{1}{2}$, 2, and $2\frac{1}{2}$ inches in diameter, to suit receivers such as No. 2110, *each* 2s.

The prices of Cylindrical Receivers and of Globes mounted with brass caps will be given unde the head of "Gas Receivers." Some are already stated at Nos. 678 to 681.


713.

716. Bladder Piece, or Socket to tie in the neck of a bladder or a gas bag, with female screw for receiving a stopcock, Fig. 716, 1s.
717. Connector for attaching a flexible caoutchouc tube to brass fittings, with female screw, Fig. 717, 1s.
718. Ditto, with male screw, Fig. 718, 1s.
719. Connector to join a small to a larger caoutchouc tube, without screws, Fig. 719, 1s.
720. Union Joint for connecting two flexible tubes together, Fig. 720, 1s. 6d.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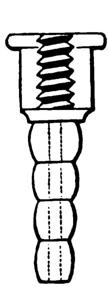
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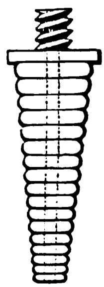
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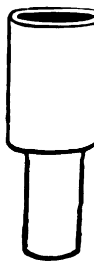
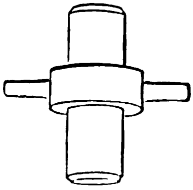

719.

721. Blocks to be screwed to a table, with female screws to receive the ends c syringes, cross pieces, or other articles that need to be fixed in an uprigh position, two kinds, Fig. 721, flat, 1s.
722. Ditto, raised, 1s.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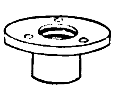
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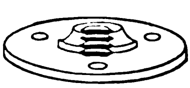
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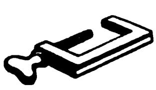
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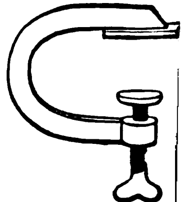
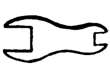

725.

723. Brass Clamp, for fastening an air pump to a table, &c., $2\frac{1}{2}$ inch, Fig. 723, 3s. 6
724. Iron Clamp, Fig. 723, $3\frac{1}{4}$ inch, 1s. 6d.
725. Iron Clamp, $4\frac{1}{4}$ inch, represented by Fig. 725 and by *c*, Fig. 650, 5s.
726. Brass Key, for screwing up the joints of air-pump apparatus, connectors to stopcocks, &c.
Single, 1s. 6d.; double, Fig. 726, 2s. 6d.
726A. Iron Key or Spanner, single, 9d.; double, 1s. 3d.


726.

AIR SYRINGES, POLISHED BRASS.

EXHAUSTING SYRINGES, Fig. 727 :—

727. Barrel 6 inches long, ¾-inch diameter outside, 8s.
728. Barrel 8 „ 1⅓-inch diameter, 16s.
729. Barrel 9 „ 1¾-inch diameter, mounted on a clamp, 35s.
730. Barrel 12 „ 2 inches diameter, mounted on a flange to screw to a table, 42s.
731. Barrel 12 „ 2¼ inches diameter, mounted on a flange, 50s.

CONDENSING SYRINGES, Fig. 727 :—

732. Barrel 6 inches long, ¾-inch diam., 8s.
733. Barrel 8 „ 1⅓ „ 16s.

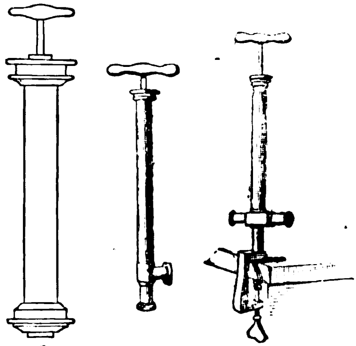
EXHAUSTING AND CONDENSING SYRINGES, form of Fig. 734.

734. Barrel 6 inches long, ⅞-inch diam., 10s. 6d.
735. Barrel 8 „ 1⅓ „ 18s. 0d.

EXHAUSTING AND CONDENSING SYRINGE, with a Cross-piece and CLAMP to fasten it to a table, Fig. 736.

736. Barrel 6 inches long, ⅞-inch diam., 18s.
737. Barrel 8 „ 1⅓ „ 27s.

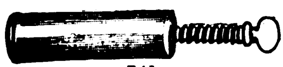
All these Syringes end with female screws.



727. 734. 736.

TALLOW-HOLDER, which consists of a mahogany tube containing a piston moved by a screw, Fig. 741.

741. Small Tallow-Holder for general use, bore ⅝-inch, 1s.
742. Large size, for use with the air pump, bore ⅞-inch, 1s. 6d.



741.

Tallow, or a mixture of tallow and wax, is convenient for greasing the edge of a glass vessel previously to decanting a liquid, in order to prevent the running of the liquid over the edge of the vessel so as to descend outside. Tallow is also required to grease the edge of air-pump receivers, to make them fit the ground plate air-tight. To fill the tallow-holder, the piston is screwed back to the top of the tube, and melted tallow is poured in till the tube is full. After cooling, the tallow is projected as required by turning the screw.

Apparatus for the Production and Application of Heat.

The selection of Apparatus for the Production and Application of Heat in chemical operations depends, in a great degree, upon the description of FUEL which can be most conveniently and economically procured in any given locality. The necessary apparatus for the production of heat may, for this reason, be arranged under three heads:—

1. Apparatus required when the fuel to be used is charcoal, coke, or coal. This comprehends Iron Furnaces, Clay Furnaces, Chauffers.
2. When the fuel is spirits or oils:—Spirit Lamps and Oil Lamps.
3. When the fuel is coal gas:—Gas Burners, Gas Furnaces.

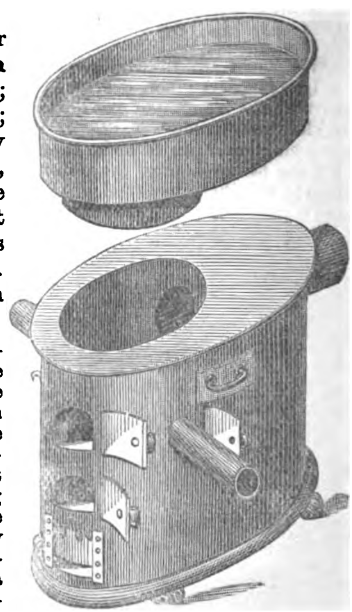
Under the head of "Application of Heat" it will be convenient to refer to Furnace and Lamp Fittings of all kinds, to Crucibles, Tubes, Baths, and other articles adapted for the special experiments that require to be made at high temperatures.

IRON FURNACES.

PORTABLE FURNACES, made of strong PLATE IRON, riveted, lined with a Refractory Fireclay Mixture, or Fire-bricks:—

745. BLACK'S PORTABLE UNIVERSAL FURNACE, for burning coal or coke, oval form, strong iron plate, lined with fire-brick, complete, on feet; fire-room, 9 inches wide and 17 inches deep; height outside, 24 inches; oval top, 21 by 16 inches; with solid cover for the fire-room, and an oval sand-bath to fit the top; the chimney is at the back; one of the front openings is suitable for a muffle of 9 inches long, 4½ inches wide, and 3 inches deep. There are side openings for a tube, as shown in the figure. £6, 6s.

746. *Additional Sand-bath Accommodation.*—When additional sand-bath accommodation is required, or when the furnace is to be used to warm the laboratory, an extra table sand-bath, of the form of Fig. 746, may be placed between the Black's furnace and the chimney of the room, a flue passing from the furnace through the sand-bath. This contrivance may be used also with other kinds of furnace. It can be very conveniently adapted to the square Cupelling Furnace described in the section on "Assaying," the dome of the furnace being removed, and the body placed below one end of the sand-bath. The free space under the sand-bath may, if required, be closed in, to form a hot chamber, a door being made in front. The price of such an extra sand-bath depends upon its size; it may be from 30s. upwards.



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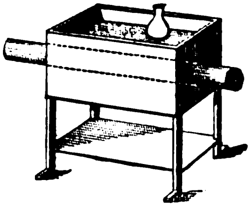
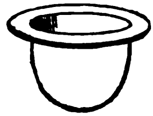
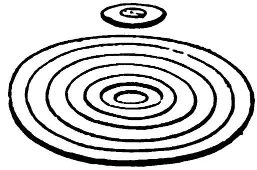




746. 748. 749.

748. Deep Cast-iron Sand-bath, to dip into the upper opening of Black's Furnace, and adapt it for distillation with retorts. Size—7 inches deep, 8 inches wide inside, 12 inches over all, Fig. 748. 8s. 6d.

749. Set of 5 Cast-iron Rings, to adapt basins of different sizes to the upper opening of Black's furnace. Sizes—3½, 5, 6½, 8, 9½, and 11½ inches diameter. Fig. 749, *per set*, 3s. 6d.

750. Muffles for the above furnace, 9 by 4½ by 3 inches, 3s. 6d.

751. Two-Gallon Still, tinplate, with movable top and iron jacket, to adapt it to this furnace, 27s.

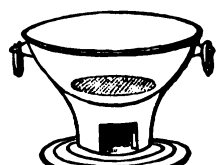
752. Condenser for this Still, Mitscherlich's form, which can be opened for cleaning, 16s.

753. Wooden Stool, to adapt the condenser to the still, 2s. 6d.

Nos. 751 to 753 will be described more particularly in the section on "Distillation," No. 1891.

754. Black's Furnace, *smaller size*, circular; the fire-room 8 inches wide, 13 inches deep; the furnace cylindrical; external diameter, 12½ inches; height, 21 inches; with solid cover, side openings for a tube, and a double-bottomed sand-bath, 12½ inches diameter. £4, 10s.

756.



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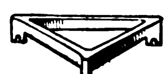


758.

756. Chauffer of Iron Trellis, for applying heat to the sides (and not the bottom) of a retort, for the safe distillation of oil of vitriol, accompanied by an iron dome; size for a three-pint retort, Fig. 756, 12s. 6d.

757. Chauffers, for evaporating and boiling, cast-iron; with iron grate, ash-pit, and base, Fig. 757.

a. 8 inches diameter, fire-room 2½ inches deep, 4s. 6d.
b. 10 „ „ 3 „ 5s. 6d.
c. 11 „ „ 3½ „ 9s. 0d.

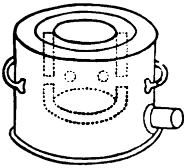
758. Trivets to support vessels over these chauffers without spoiling the draught, Fig. 758.

8 inch, 7d. 10 inch, 9d. 11 inch, 1s.

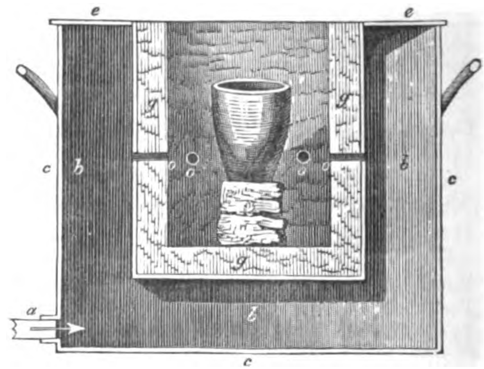
Other varieties of triangles and trivets are described at Nos. 299 to 308.

761. Fireclay, prepared for lining furnaces, supplied in powder, which requires only to be mixed with water and kneaded into a soft mass to be ready for repairing defects in the lining of furnaces. *Per cwt.*, 6s.

762. Sefstroem's Blast Furnace, for fusions at a white heat, consisting of a double furnace, of which Fig. 762*a* shows the outside, and Fig. 762*b* a section. Made of stout sheet-iron, lined with fireclay. To be used with coke, or charcoal and coke, cut into pieces of about a cubic inch in size. The blast of air to be supplied by a powerful blowing-machine. Four sizes, as follow :—



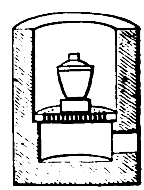
762*a*.



762*b*.

	Dimensions of Fire Room. Depth.	Width.	Outside Dimensions. Height.	Width.	Price.
762.	6½ inches,	5 inches,	9 inches,	12 inches,	30s.
763.	7¾ „	6¾ „	12 „	16 „	40s.
764.	10¼ „	7½ „	15 „	18 „	52s.
765.	12 „	9½ „	18 „	24 „	66s.

Modification of Sefstroem's Blast Furnace, not so powerful as the foregoing, but more portable, and sufficient for many purposes in pharmacy and in the assaying of metallic ores. Made of fireclay, with an iron casing and iron grate. In this furnace the blast of air passes up through the grate, as in Deville's Forge. Two sizes :—



766.

	Outside Measurement.		Size of Fire Room.		
766.	12 inches high,	9 inches wide,	8 inches high,	6 inches wide,	20s.
767.	14 „	12 „	10 „	8 „	25s.

768. Mohr's Furnace on Tripod, with Chimney below to regulate the draught; fire room, 10 inches wide, 11 inches deep; height outside, 34 inches; diameter, 13 inches (see Mohr's "Pharmaceutischen Technik," page 181); for use with charcoal and coke, with a set of ring-tops. £3.

769. Smaller size of Furnace, on the same plan as the preceding article; the fire room, 5 inches wide, 8 inches deep; height outside, 27 inches; diameter, 7½ inches; with a set of three ring-tops. 37s.

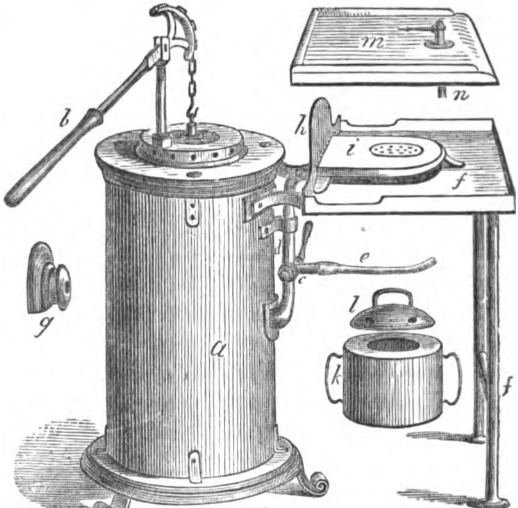
Cupelling Furnaces; see article on "Assaying."

770. **Deville's Chemical Forge,** consisting of a powerful circular blowing-machine, a forge, a blast furnace, and a glass-blowing table combined, £10, 10s.

Described in "Chemical Recreations," page 585. To be used with charcoal and coke.

771. **Deville's Chemical Forge and Blast Furnace,** larger and more powerful than the preceding, with double-action bellows, giving a continuous and uniform blast; without the glass-blowing table, £13 13s.

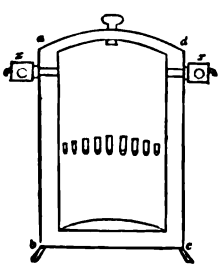
The blowing-machine of this forge is sufficiently powerful for any of the blast gas furnaces described in a following section—namely, with No. 4 Furnace it will fuse 25 lbs. of cast-iron. The price of the blowing-machine without the forge is £9.



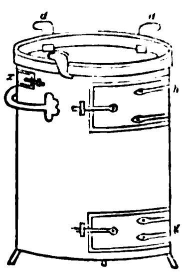
770.

772. **Luhme's Portable Furnaces.**

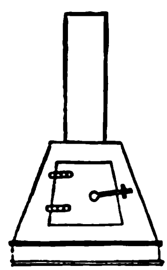
These furnaces are made of very strong iron plates, lined with fireclay; suitable for use with charcoal, but not with coal. Fig. 772*b* shows the body of the furnace in perspective. Fig. 772*a* is a section of it. *xx* are doors for closing the openings to admit of a tube. *dd* are projections for holding pans, &c., without stopping the draught. There are three projections inside for smaller vessels. The fittings represented in the other figures are all adapted to the top of the furnace, and are provided with openings to permit the escape of carbonic acid gas, and so keep up the necessary draught of air. Fig. 772*c* represents a dome for use in crucible operations. Fig. 772*f* represents



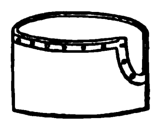
772*a*.



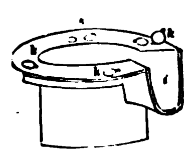
772*b*.



772*c*.



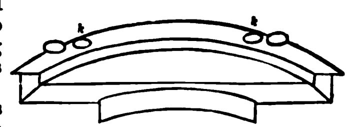
772*e*.



772.

a deep sand-bath suitable for distillations with retorts, and Fig. 772*e* is a jacket for adjusting the deep sand-bath to the furnace. Fig. 772*d* is a flat sand-bath for operating with flasks, evaporating basins, &c. The temperature is regulated by means of the valves *kk*, and ash-pit door *g*.

Several sizes of this furnace are made, and each size is supplied either with short feet, as represented by the figures, or on legs of about 17 inches in height.



772*d*.

The following are the usual sizes of Luhme's Furnaces:

Furnaces with Short Feet.	No. 1.	2.	3.	4.	5.
Diameter of fire-room,	5¼	6	7	9	11½ inch.
Depth of fire-room,	6	7½	8	9½	13 „
Height outside,	11	12	13	15	20 „
Diameter outside,	6½	7½	8½	11	14 „
Furnaces with Long Legs.	**1.**	**2.**	**3.**	**4.**	
Diameter of fire-room,	7	8	9	12 inch.	
Depth of fire-room,	8½	9½	9½	13 „	
Height outside,	30	30	30	30 „	
Diameter outside,	8½	10	11	14 „	

PRICES OF LUHME'S FURNACES.

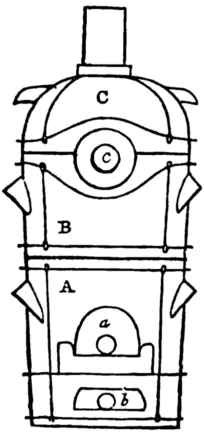
Furnaces with Short Feet.	No. 1.	2.	3.	4.	5.
773. The body and dome with side doors for tubes,	44s.	63s.	80s.	100s.	115s.
774. Deep sand-bath and jacket,	8s.	14s.	18s.	21s.	27s.
775. Flat sand-bath,	10s.	15s.	22s.	27s.	28s.
776. Complete Furnace,	62s.	92s.	120s.	148s.	170s.
Furnaces with Long Legs.	No. 1.	2.	3.	4.	
779. The body and dome with side doors,	63s.	80s.	98s.	120s.	
780. Deep sand-bath and jacket,	21s.	25s.	27s.	28s.	
781. Flat sand-bath,	16s.	22s.	27s.	28s.	
782. Complete Furnace,	100s.	127s.	152s.	176s.	

Fireclay Furnaces.

790. Universal Table Furnace, English fireclay, bound with iron wire, adapted for experiments with charcoal, or charcoal mixed with coke; consisting of the twelve articles, Nos. 791 to 802, which are supplied in a set, or separately at the prices affixed to each article. The price of the complete set is 40s.

791. The Reverberatory Furnace, in three pieces, Fig. 791, A, B, C; height 20 inches, diameter of fire-room, 7 inches, 18s.

The piece A may be used separately as an evaporating or boiling furnace. It has an iron grate. *a* is the fire-door, *b* the ashpit. When the furnace is used for crucible operations, it is built up as shown by the figure, and is surmounted by the chimney, Fig. 795. When used for distillation, the neck of the retort is passed out at the door *c*, and the body of the retort is rested on two iron bars, placed in notches on the top of the piece A.



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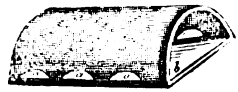

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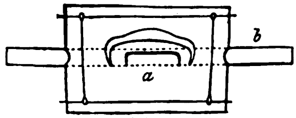

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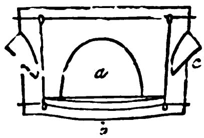

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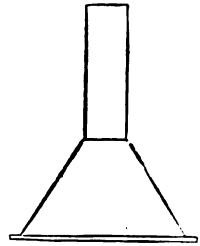

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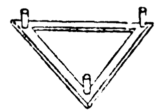

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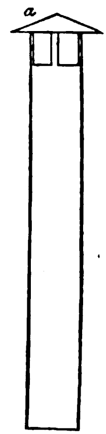

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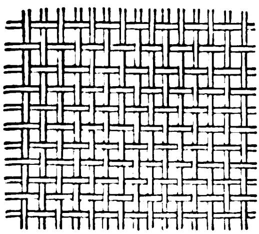

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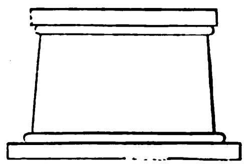

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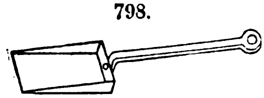

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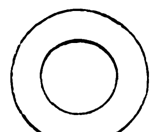
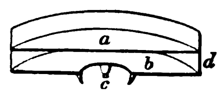




796.

792. Tube Ring for the Universal Furnace, Fig. 792, for use instead of the middle ring B, Fig. 791, when the furnace is to be used for heating tubes of iron or porcelain, 3s. 6d.

793. Muffle Ring, Fig. 793, for use when the Universal Furnace is to be used for assaying by the cupel, 3s. 9d.

794. Muffle, to fit the Muffle Ring; size, 7 by 3½ by 2½ inches, 2s.

795. Iron Chimney, Fig. 795, for use with the reverberatory furnace when a high temperature is required for crucible operations, 3 feet high, 4 inches diameter, with dome to prevent mischief from the scattering of sparks, 3s.

796. Double-bottomed Iron Sand-bath, with holes for ventilation, adapted to the piece A of the furnace, Fig. 791, 15 inches diameter, 4s. 6d.

797. Iron Blower, Fig. 797, adapted to the evaporating furnace A, used to raise the heat of the fire, 2s.

798. Furnace Base, Fireclay, Fig. 798, 8 inches high, on which to place the furnace, in order to prevent its burning the table, 4s.

799. Iron Trellis, 10 inches square, ¼-inch meshes, strong iron wire, Fig. 799, for supporting flasks and basins over the evaporating furnace, 1s.

800. Cast-Iron Trivet or Triangle, Fig. 800, for supporting basins, retorts, flasks, &c., over the evaporating furnace, 8-inch sides, 9d.

801. Pair of Flat Iron Rings, Fig. 801, for supporting basins, &c., over the evaporating furnace; size of openings, 4 and 6 inches, 1s. 4d.

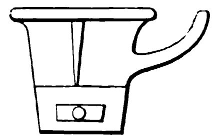
802. Iron Shovel, Fig. 802, for feeding the furnace with fuel, 1s.

803.

Fireclay Evaporating Furnaces, with ash-pit door, fire-door for inserting fuel, and grooves for ventilation cut in the top, as shown by Fig. 803; bound with iron hoops.

No.	Inside Diameter.	Price.	No.	Inside Diameter.	Price.
803.	4½ inch,	3s. 6d.	807.	10 inch,	11s. 6d.
804.	5½ „	5s. 0d.	808.	10½ „	16s. 6d.
805.	6½ „	6s. 0d.	809.	11½ „	21s. 0d.
806.	8½ „	10s. 0d.	810.	13 „	26s. 0d.

These furnaces can be conveniently heated by gas, the ring burners No. 930 to 934 being put in the place of the usual grate.



811.

811. Fireclay Evaporating Furnaces, with ash-pit door, but without fire-door, with or without a long handle, like Fig. 811, or two ears, like Fig. 803, bound with iron hoops; about 5 inch inside diameter, 4s.

817.

817. Furnace for Retorts, Evaporating Basins, or Stills, fireclay, in one piece, similar to an evaporating furnace, but having a small chimney on the side to preserve the draught when the top is closed by the vessel, Fig. 817.

No. 3. Fire-room, 7½ inches wide, 9 inches deep, 25s. 0d.
4. „ 9 „ 10 „ 31s. 6d.

This furnace can be heated by gas instead of charcoal, use being made of the rings for burners, described at No. 930.

818. Fireclay Reverberatory Furnaces, in three pieces, form of Fig. 818, page 77, but bound with iron hoops or wires.

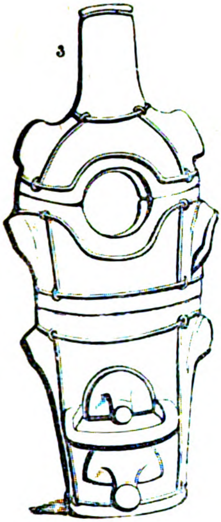
No.	Inside Diameter.	Price.	No.	Inside Diameter.	Price.
818.	4½ inch,	14s.	826.	13 inch,	50s.
820.	7 „	18s.	828.	14¼ „	70s.
822.	8¼ „	28s.	830.	17½ „	80s.
824.	11 „	40s.			

831. Melting Furnaces, fireclay, form of Fig. 831, page 77.

No.	Diameter.	Height.	Price.
831.	9¼ inch,	17½ inch,	28s.
832.	9¾ „	20 „	35s.
833.	11 „	22 „	42s.
834.	13¾ „	26 „	63s.
835.	14½ „	28 „	88s.
836.	18 „	32 „	105s.

845. Furnace for dentists or assayers, oval form, fireclay. See Nos. 4546 and 4547.

846. Reverberatory Furnace for Heating Tubes, French fireclay, form of Fig. 846; length where the tube is inserted, 13 inches inside, 44s.



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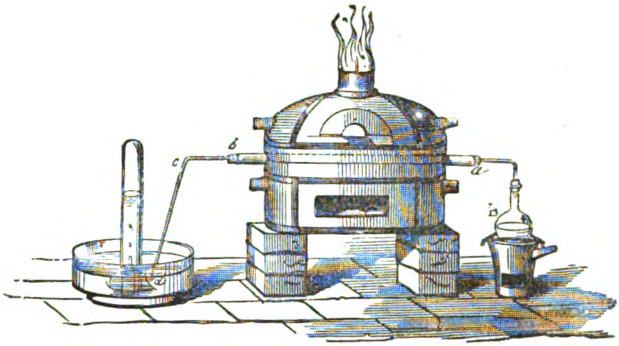
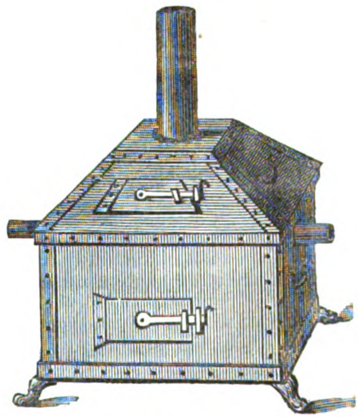


846.

847. Reverberatory Furnace, similar to No. 846, but made of iron plate, lined with fireclay, on four legs; length inside 15 inches, Fig. 847, £5, 5s.

This furnace is figured at No. 49 *in " Valentine's Inorganic Chemistry."*

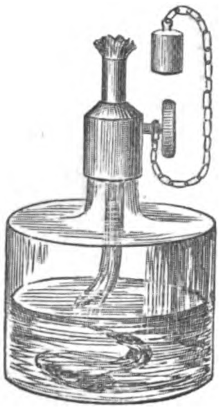
831.

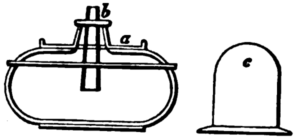


847.

Other furnaces for heating tubes will be described under the heads of "Gas Furnaces" and "Organic Analysis."

SPIRIT LAMPS.





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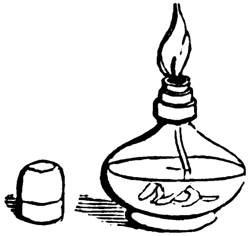
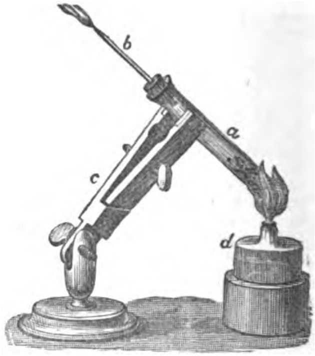


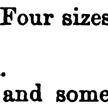


860. 854. 853.

A. SIMPLE SPIRIT LAMPS.

851. Glass Spirit Lamps, with Ground Glass Caps and Incorrodible Stoneware Wick-holders. Form of the Lamp cylindrical, like Fig. 853 *d*. Four sizes, namely, 1, 2, 3, and 4 ounces capacity, each 1s.
852. Ditto, ditto, larger sizes, 5, 6, 7, and 8 ounces capacity, each 1s. 4d.
854. Spherical-shaped Glass Spirit Lamps, with foot, form of Fig. 854, and sometimes flatter. 5-ounce size, 1s. 6d.

The Stoneware Wick-holders have, over those made of brass, the advantage of not being acted on by the acid which usually accompanies the naphtha. Consequently, they do not give a green flame, nor deposit copper upon platinum vessels placed in the flame ; neither do they convey heat to the spirit in the lamp, and cause it to boil so readily as do the brass wick-holders.



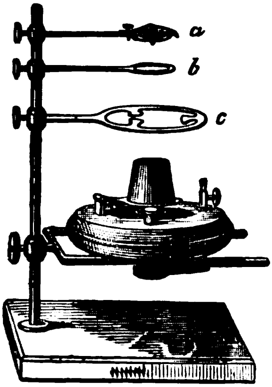
859.

857. Glass Spirit Lamps, with solid Polished Brass Screw Wick-holders and Glass Caps, 2 to 3 ounce, each 2s.
858. Ditto, larger sizes, each 2s. 6d.
859. Spirit Lamps, with an extra stoppered neck for supplying spirit when required, Fig. 859, best German glass. *a*. Cylindrical, 6-ounce ; *b*. Globular, on foot, 5-ounce ; each 2s.
860. Glass Spirit Lamps, 8-ounce size, with Brass Wick-holder, rack and pinion to raise and lower the wick as required, and brass cap., Fig. 860, 2s. 6d.
861. Round Plaited Cotton Wick, for the Spirit Lamp No. 860, per yard, 6d.
862. Embossed Stoneware Spirit Lamp, with Stoneware Wick-holder and Cap. Fig. 862, 8d.
863. Cotton Wick, flat, ½ inch wide, for Spirit Lamps, per dozen yards 1s.
864. Ditto, per single yard, 1½d.
865. Iron Chimney for Small Spirit Lamps, to steady the flame, Fig. 865, 3d.

865.

B. ARGAND SPIRIT LAMPS FOR HEATING CRUCIBLES.

Berzelius's Argand Spirit Lamp, mounted on a Stand, for supporting Crucibles, &c. Newest patterns, Berlin manufacture; polished Brass Lamps, Brass Rod and



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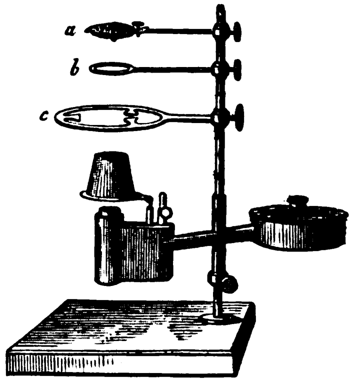

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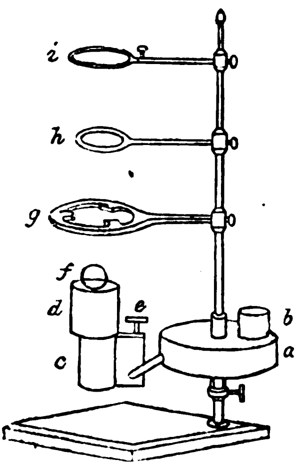

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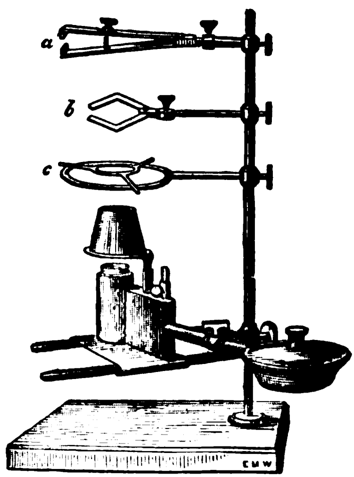


873.

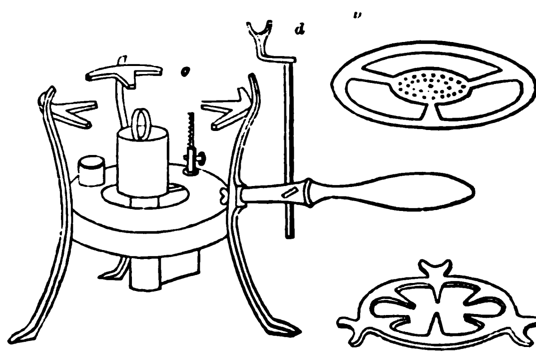
Fittings, and Mahogany Foot, as represented by Figs. 870, 871, 872, and 873, at the following prices :—

870. Spirit Lamp, with the Spirit-holder surrounding the Wick-holder, 20s.

871. Spirit Lamp, with the Spirit-holder separated from the Wick-holder, 20s.
872. Spirit Lamp, with the Spirit-holder separated from the Wick-holder, but surrounding the Brass Rod, 20s.
873. Spirit Lamp, with the Spirit-holder separated from the Wick-holder, and having a Stopcock and extra fittings, as represented in Fig. 873, 23s.
876. Lamps of the above patterns, if mounted on a porcelain foot, cost 4s. extra.
880. Wicks for the Argand Spirit Lamps, per dozen, 8d.

C. ARGAND SPIRIT LAMPS ON TRIPOD STANDS.

For the ignition of crucibles it is usual to mount the lamp on a slender support that will not carry away so much of the heat as to lessen its intensity too greatly; but for boiling and evaporating, it is convenient to have the lamp on a lower and more solid support, such as is represented in Fig. 889, a brass tripod with wooden handle.



889

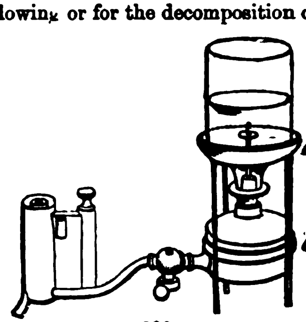
885. Brass Lamps, lacquered brown colour, with one iron ring, 8s. 6d.
886. Ditto, larger size, with one iron ring, 10s. 6d.
887. Brass Lamps, polished, larger and stronger than the lacquered lamps, with one brass ring, *a*, and one iron ring, *b*, as shown in Fig. 889, 18s. 6d.
888. Ditto, larger size, 20s.
889. Massive Brass Spirit Lamp, with the fittings represented by Fig. 889, 27s.

D. BLAST SPIRIT LAMPS.

Apparatus for the Continuous Action of Argand Spirit Lamps.

When a spirit lamp acts with a blast of air, either for glass-blowing or for the decomposition of siliceous minerals, the quantity of spirit held in a lamp of the usual size is soon exhausted, and it is convenient to have the means of renewing the supply without suspending the operation. Either of the following plans may be adopted.

Fig. 890 represents a lamp to which the frame *a b* is attached. The ring *b* sits on the spirit-holder of the lamp. The ring *a* supports an inverted spirit flask, in the neck of which a valve is fixed. From this flask the spirit runs into the lamp when the rod of the valve touches the bottom of the lamp, and the spirit is so low there as to permit air to pass up into the flask.



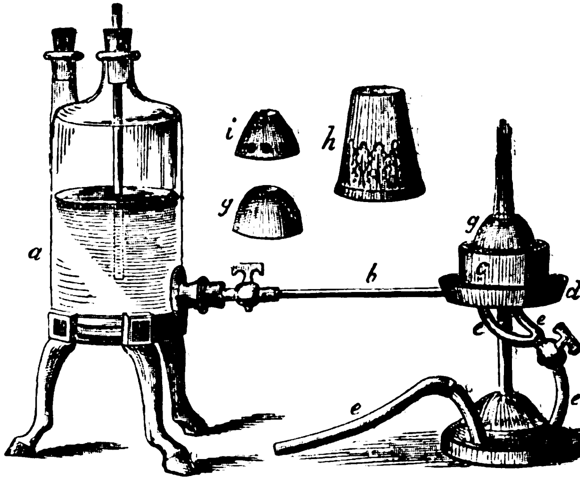
890.

890. Price of the frame and a pint bottle, fitted, 6s.
892. Spirit Reservoir, consisting of a metal can, mounted on three legs, and provided with a stopcock and a long delivery pipe, by which spirit can be delivered continuously, in drops or in a stream, either to feed Argand lamps, or such as are represented at No. 859, quart size, 6s.

This apparatus is represented by *a* in the woodcut of Charles Griffin's Oil-Lamp Furnace, No. 912.

893. **Deville's Blast Lamp,** for producing a very high degree of heat by burning turpentine vapour mixed with a current of atmospheric air supplied by a blowing apparatus. Price 42s.

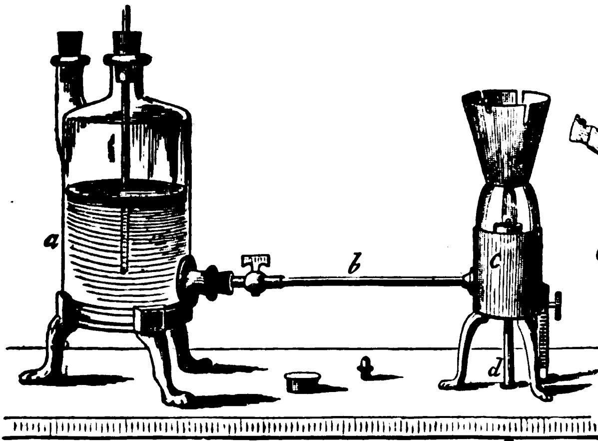
The apparatus is represented by Fig. 893 at about one-fifth of the actual size. It is described in detail in *Chemical Recreations*, page 583. The turpentine is contained in the vessel *a*. The blast is conveyed by the pipe *e*. The copper pieces *g*, *h*, *i*, are used to modify the flame. The largest piece, *h*, is that on which crucibles are to be supported by means of a triangle of platinum wire. This lamp acts without a wick.



893.

894. Blast Spirit Lamp, for burning a mixture of alcohol and turpentine with a blast of atmospheric air, Fig. 894. Price 28s.

Described in *Chemical Recreations*, page 585. The vessel *a* contains the mixed spirits. The cylinder *c* contains an Argand wick. The blast of air is supplied by the pipe *d*, which comes up through the table. This blast pipe can be fixed at different heights, and be supplied with jets of different sizes, to suit the regulated supply of spirit, and the height of the exposed portion of wick.



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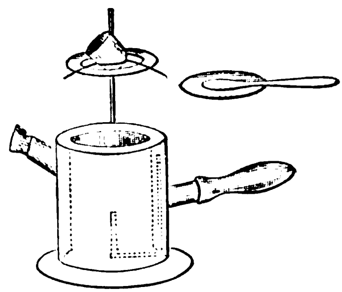

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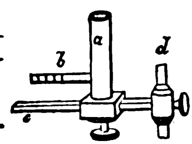

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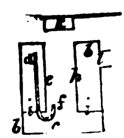


896.

895. Multiple Blowpipe, for use with any of the Argand Spirit Lamps, to enable them to raise heat sufficient to fuse several hundred grains of carbonate of soda, or a few ounces of copper, Fig. 895. Price 5s. 6d.

This blowpipe belongs to Charles Griffin's Thermogenic Oil Lamp, described in No. 912, in a subsequent section. It is represented here as mounted on the support of a spirit lamp. *a* is the multiple blowpipe, which can be passed up inside the wick-holder of a lamp to a height depending upon the height of the wick and the degree of heat required. The blast of air enters by the tube *b*; *d* is the rod of the spirit lamp support, and *c* a square bar upon which the position of the blowpipe can be adjusted. The air is supplied by a glass-blower's bellows, or any other blowing machine. This form of blowpipe is easily managed, and very effective; more so than Plattner's apparatus, which consists of five blowpipes, arranged in a circle within the wick, for it is difficult to get the separate five blowpipes to act uniformly. By a sufficient exposure of cotton wick, a good supply of spirit, and a regular blast of air, a powerful heat can be obtained with the use of this blowpipe. But, in point of fact, a brass Argand spirit lamp is not a suitable instrument for producing very high temperatures; for when you succeed in heating a crucible by means of it to whiteness, the crucible in its turn heats the lamp and the spirit. The lamp melts or burns, and the spirit boils, takes fire, and produces a larger flame than you wish for. These difficulties are avoided by the use of a lamp constructed on the principle of Charles Griffin's Oil Lamp, which is described in the following section. Argand spirit lamps answer well for producing a good red heat; but when a white heat is required, they are neither handy nor economical.

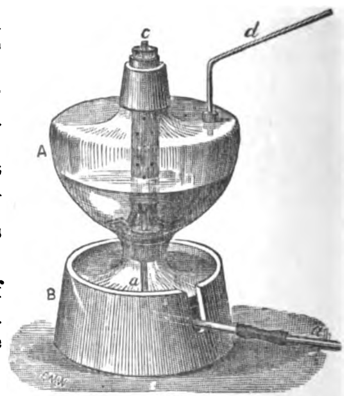
896. Russian Spirit Lamp, well adapted for all purposes where a powerful heat is required for a short time, as in igniting platinum or porcelain crucibles, bending glass tubes, &c. Size, 2½ inches high, and 2½ inches diameter, Figs. 896 and 897. 12s. 6d.

897. Large Russian Spirit Lamp, 5 inches high and 5 inches diameter. 21s.

This lamp consists of a body, *b*, *b*, having a false side, *e*, *h*, and partial false bottom, *i*, *i*, as seen in Fig. 896, so fixed as to enclose a space *b*, *d*, which has no communication with the inner space *c*, except by the bent tube *d*, which terminates in a fine orifice at *f*. The cover, *k*, serves as a measure, and being filled with either alcohol or pyroxylic spirit, is emptied into the inner space *b*, *d*, by aid of a funnel, through the opening *l*, which is then securely closed by a good cork. The same measure of spirit is introduced into the space *c*, and kindled. The spirit in *c* by burning soon boils that in the space *b*, *d*, and the vapour is forced with considerable violence through the tube *d*, becomes ignited at *f*, and produces a continuous column of burning vapour 6 inches high, which will last from twelve to sixteen minutes. The cover, *k*, will serve as an extinguisher when required, by merely placing it over the space *c*.

A ring or triangle, kept in its situation by the screw at the side, may be adjusted to any height, and serves to hold crucibles while being heated. During a process the neck, *l*, with its cork, should be so placed, that if the cork is violently expelled it can strike nothing to harm it.

901. Mitscherlich's Ether Lamp, fed with a blast of oxygen gas, by the flame of which platinum and quartz can be melted, Fig. 901. See *Chemical Recreations*, page 189. 6s.



901.

OIL LAMPS.

A. Oil Lamps for Boiling and Evaporating.

905. Small Oil Lamp, of saltglazed stoneware, with stoneware wick-holder, cover, and cup to catch overflowing oil, Fig. 905, suitable for slow evaporations, 8d.

906. Similar Lamp, of white glazed Berlin porcelain, 1s. 6d.

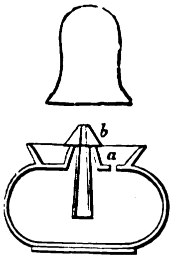
907. Argand Oil Lamp, japanned tin-plate, on tripod stand, Fig. 907, with copper chimney:

No. 1, 7s. | No. 2, 8s. 6d. | No. 3, 10s. 6d.

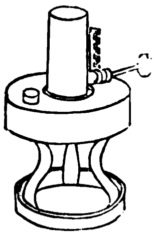
908. Large Lamp Furnace, for boiling or distilling, or the evaporation of bulky solutions. Copper solar oil lamp, iron stool, tin-plate cylinder, sand-bath, and 3 tops, *g*, *h*, *i*, as represented in Fig. 908, 30s.

909. The Solar Oil Lamp separately, 20s.

910. Cylinder of Saltglazed Stoneware, for use with the solar lamp instead of the tin-plate cylinder depicted in Fig. 908, 10 inches high, 9 inches in diameter, 3s.



905.



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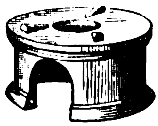
910.



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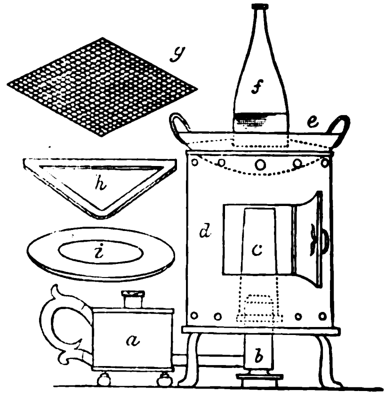


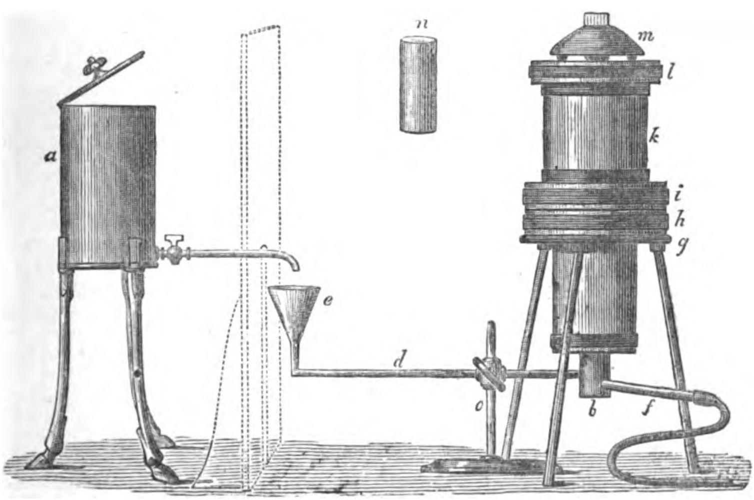
908.

911. Foot of Saltglazed Stoneware, size 9 inches diameter, 4½ inches high, adapted to adjust the cylinder No. 910 properly over the Solar Lamp, No. 908, 2s.

The slit represented in Fig. 910 is to admit a gas-pipe, when gas instead of oil is employed with this evaporating furnace.

B. Griffin's Oil-lamp Furnace, for Melting Metals at a White Heat.

The Oil-lamp Furnace rivals a spirit lamp in handiness and cleanliness, and a blast gas furnace in economy and power. It produces neither smoke, nor soot, nor ill odours. It is so compact, that it may stand on a tea-tray while melting 80 ounces of iron; and it requires no chimney. The first cost of the apparatus and the current expense for oil are mere trifles.



912.

912. The Guinea Furnace.—This furnace serves for all chemical operations in platinum and porcelain crucibles, and for all metallurgic fusions in small fireclay or plumbago crucibles. It will melt a pound of cast iron in twenty-five minutes at a cost of 3d. for oil. It comprises all the articles shown in the above figure.

913. The Guinea-and-a-Half Furnace.—This furnace does all the work of the

Guinea Furnace, and, in addition, is provided with furnace bodies and crucibles for operating on larger quantities of metal. It will melt 5 lbs. of cast iron in 60 minutes, at a cost of 9d. for oil.

914. Extra Grates for the Oil-Lamp Furnaces, each 1s. 6d.

915. Cotton Wicks for the Lamp; per dozen sets of three wicks, 2s. 6d.

The Price of extra Clay Cylinders will be found at No. 1035.

Blowing Machines suitable for this furnace are described in the section on "Blowing Machines."

Account of an Oil-Lamp Furnace, for Melting Metals at a White Heat.

By Charles Griffin.

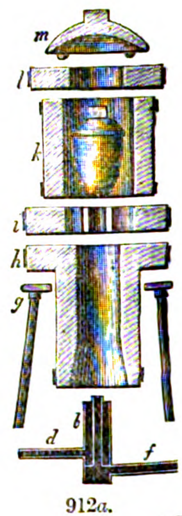
(*From the* "Chemical News" *of* January 2, 1864.)

I have been for some time engaged in experiments on the construction of chemical lamps. My object was to discover a method by which chemists and metallurgists, who have occasion to melt metals at a white heat, but who happen to have no command of coal gas, may be enabled to accomplish their purpose by other agents. After many trials, I have contrived an oil-lamp which is not only as powerful in action as the best gas furnaces, but almost rivals them in handiness and economy.

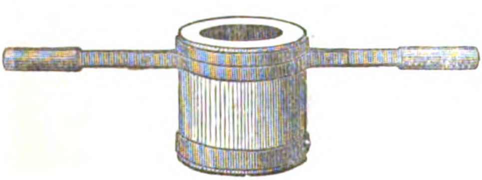
Description of the Apparatus.—The Oil-Lamp Furnace is represented in perspective by Fig. 912, and in section by Fig. 912*a*. It consists of a wick-holder, an oil-reservoir, and a fireclay furnace. To these must be added a blowing-machine for the supply of atmospheric air.

The oil-reservoir is represented at letter *a*. It is made of japanned tin-plate, mounted on iron legs, and fitted with a brass stopcock and delivery-tube. Its capacity is a little more than a quart. The wick-holder is represented at letter *b*, and the upper surface of it by the separate figure *c*. The wick-holder and the oil-reservoir are consequently detached. *d* is a tube which brings oil from the funnel *e*, and *f* is a tube to be placed in connection with the blowing apparatus. The wick-holder contains three concentric wicks, placed round the multiple blowpipe *c*, which is in communication with the blowing-tube *f*.

The crucible furnace consists of the following parts:—*g* is an iron tripod; *h* is a flue for collecting and directing the flame. This flue is of such a width, that when the wick-holder *b* is pushed up into it until the top of the wick is level with the top of the clay cone, there remains a clear air-space of about ⅛ inch all round between the wick-holder and the cylindrical walls of the flue.—*i* represents a fireclay grate, having three tongues, shown by *i*, the separate figure of its upper surface. These tongues support the crucible, without stopping the rising flame.—*k* is a fireclay cylinder, which rests upon the grate *i*, and encloses the crucible, forming, in fact, the body of the furnace. Of this piece there are three sizes; the smallest is of 3 inches bore, and works with crucibles that do not exceed 2¼ inches diameter; a middle size, 4 inches bore, for crucibles not exceeding 3½



912*a*.



p.

c.

i.

inches diameter; the largest size, 5 inches bore, for crucibles not exceeding 4¾ inches diameter. This piece being heavy, is provided with handles, as represented in figure *p*. The walls of these cylinders are from 1 inch to 1½ inch thick.—*l* is a flat plate of fireclay, with a hole in the centre, used to cover the cylinder *k*, so as to act like a reverberatory dome.—*m* is a cover which prevents loss of heat from the crucible by radiation, but gives egress to the gaseous products of the combustion of the oil.—*n* is an extinguisher to put over the wick-holder when an operation is ended; and *o* is a support for the wick-holder.

No chimney is required.

Management of the Oil-Lamp Furnace.—The apparatus is to be arranged for use as it is represented by Fig. 912. The cylinder *k* is to be selected to fit the crucibles, and the crucible of a size to suit the quantity of metal that is to be melted. 1 lb. of iron requires the smallest of the three cylinders described above; 1½ lb. the middle size; 5 lbs. the largest size. The air-way between the crucible and the inner walls of the cylinder should never exceed ¼ inch, nor be less than ⅛ inch.

The cotton wicks must be clean, and be trimmed a little below the level of the blowpipe *c*. If properly managed, they do not readily burn away, but can be used for several fusions. The reservoir should be filled with oil for each operation. The proper sort of oil for use is the more volatile kind of mineral oil, of the specific gravity of ·750, which is now easily procurable at about 3s. per gallon. The variety known by the commercial name of turpenzine answers well. The combustion of a quart of this oil, costing 9d., gives heat sufficient to melt 5 lbs. of cast iron Liquids of the alcohol class, spirits of wine, and pyroxylic spirit can be used; but they are less effective and more expensive than turpenzine. Care must be taken not to spill the oil on the table or floor, and not to decant it carelessly in the neighbourhood of a light; because atmospheric air strongly charged with the vapour of these light oils is explosive. When the oil is burnt in the furnace in the manner described below there is no danger. During an operation a wooden screen, as represented by the dotted lines in Fig. 912, should be placed between the oil-reservoir and the furnace, to prevent the vaporisation of the oil by radiant heat.

As the wick-holder *b* and supply-pipe *d* contain only about one fluid ounce of oil, the oil must be run continuously during a fusion from the reservoir *a* into the funnel *e*, in order that the cotton may be always flooded. The success of the fusion depends upon the due supply of oil, to which point the operator must pay attention. At the commencement of a fusion the oil must be run from the reservoir until the surface of the oil in the funnel has a diameter of about an inch. The wicks will then be flooded, and a light may be applied, and a gentle blast of air then set on. The oil immediately sinks in the funnel; and the stopcock must be opened, and so regulated as to keep the oil barely visible at the bottom of the funnel. If too much oil is supplied it immediately rises in the funnel, and simultaneously overflows the wick-holder. Too much vapour is then thrown into the furnace, and the heat is immediately lowered, especially at the beginning of an operation, before the fireclay portions of the furnace are well heated. If, on the contrary, too little oil is supplied, the wicks burn, and the operation is spoilt. The demand of the wick-holder for oil depends upon the condition of the furnace and the character of the fusion in progress. When the lamp is newly lighted and the furnace cold, the oil should be passed slowly, in distinct drops; but as the furnace becomes hot the rapidity of the supply of drops should be increased; and, finally, when the furnace is at a white heat, the oil should be supplied in a thin continuous stream. When the fusion to be effected is that of only a small quantity of metal, such as 1 lb. of iron, a rapid supply of drops of oil is sufficient even to the close of the operation. At that rate, the burner consumes about 1¼ pint of oil in an hour. When the fusion to be effected is that of 4 lbs. or 5 lbs. of iron, and the large furnace is in action and has been brought to a white heat, the supply of oil must, as stated above, be in a thin continuous stream, and the operation will then consume 2 pints of oil in the hour. And here it requires remark that, with that continuous supply, when the furnace is large and is at a white heat, the oil does not rise in the funnel, being instantaneously converted into gas at the mouth of the burner, and thrown up in that state into the furnace for combustion. The operation, indeed, consists, at that point, of a rapid distillation of oil-gas, which is immediately burnt, in the presence of air supplied at a suitable pressure by a dozen blowpipes, in effective contact with the crucible to be heated.

The contents of a crucible under ignition in this furnace can at any moment be readily examined, it being only necessary to remove the pieces *l* and *m* with tongs, and to lift the cover of the crucible, during which the action of the furnace is not to be interrupted.

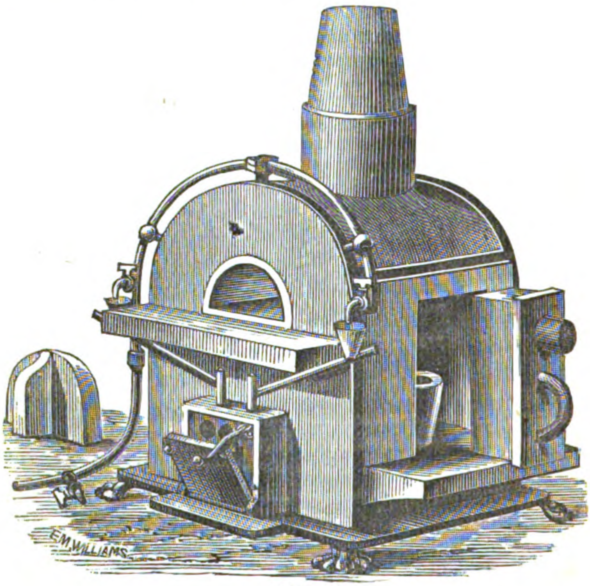
When the operation is finished the blast is stopped, the stopcock is turned off, the oil-reservoir is removed, the wick-holder is lowered on the support *o*, withdrawn from the furnace, and covered with the extinguisher *n*. The quantity of oil which then remains in the lamp is about one fluid ounce.

Power of the Oil-Lamp Furnace.—The furnace being cold when an operation is commenced, it will melt 1 lb. of cast iron in 25 minutes, 1½ lb. in 30 minutes, 4 lbs. in 45 minutes, and 5 lbs. in 60 minutes. These results have been obtained in my experiments. When the furnace is hot, such fusions can be effected in much less time; for example, 1 lb. of iron in 15 minutes. It need scarcely be added that small quantities of gold, silver, copper, brass, German silver, &c., can be melted with great ease, and that all the chemical processes that are commonly effected in platinum and porcelain crucibles can be promptly accomplished in the smallest cylinder of this furnace; and, in the case of platinum vessels, with this special advantage, that the oil-gas is free from those sulphurous compounds, the presence of which in coal-gas frequently causes damage to the crucibles.

Requisite Blowing Power.—The size of the blowing machine required to develop the fusing power of this Oil-Lamp Furnace depends upon the amount of heat required, or the weight of metal that is to be fused. For ordinary chemical operations with platinum and porcelain crucibles, and even for the fusion of 1 lb. of cast-iron in clay or plumbago crucibles, a blowing power equal to that of a glass-blower's table is sufficient, provided the blast it gives is uniform and constant. But the fusion of masses of iron weighing 4 or 5 lbs. demands a more powerful blower, such as is commonly used in chemical laboratories for the supply of air to blast furnaces when fed by gas or coke. The highest power of the Oil-Lamp Furnace depends, indeed, upon the power of the blowing machine that is to be used with it. Much more than 5 lbs. of iron can be melted by the gas which this oil-lamp is capable of supplying, provided a sufficiently powerful blowing machine supplies the requisite quantity of air. When more than a quart of oil is to be rapidly distilled into gas, and the whole of that gas is to be instantly burned with oxygen, it is evident that effective work demands a large and prompt supply of air.

918. Sainte Claire Deville's Universal Furnace for heavy oils, heating simultaneously a muffle 7½ inches long, 4¾ inches wide, and 3 inches high, and several crucibles; it is supplied with openings for tubes. This powerful furnace requires no blowing machine, but has to be attached to a 20 foot chimney. It readily melts cast iron, Fig. 918, £7, 10s.

919. The Burner alone, Fig. 919, 30s.



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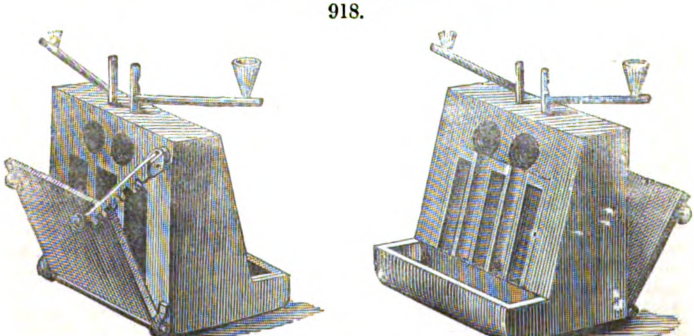


919.

GAS BURNERS AND GAS FURNACES.

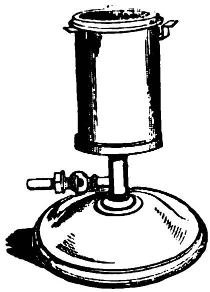
920. GAUZE-TOP CYLINDER GAS BURNER, 4 inch brass cylinder, with 2 inch gauze-top, iron foot, fish-tail jet, extra blowpipe jet, and wooden support for the hand, Fig. 920, but without stopcock, 6s.

921. Gas Burner, which can be used as an Argand burner, with metal chimney; as a gauze-top burner, and as a blowpipe jet; brass cylinder, 5½ inches by 2½ inches, iron foot, and Argand burner, 8s.

922. Stopcock to either of the above, 1s. 6d. extra.

923. Hoffman's Gas Burner, 5½ inch brass cylinder, with 2 inch gauze-top, Argand burner and blowpipe burner, with 3-way cock and iron foot, 12s. 6d.

924. Gas Burner, cylinder with gauze-top and stopcock, on a large retort stand, with rings and iron crucible jacket, Fig. 924, 27s.



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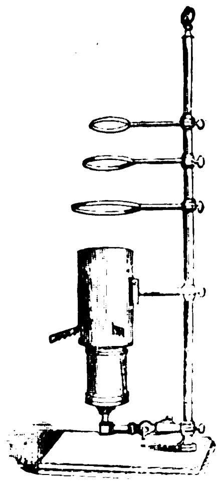
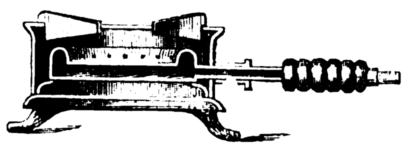


924.

925. Gas Boiling Apparatus, broad gauze-top, with regulator and basin support, Fig. 925, 20s.

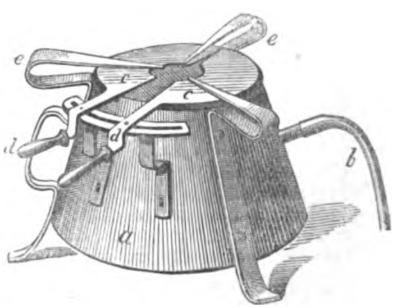
927. Depose Gas Boiler, made very flat, of cast iron, so that it can be readily placed under a low support. Very useful in evaporations.

No.	Diam. about	Price.
0.	4½ inches,	3s. 6d.
1.	5½ ,,	4s. 0d.
2.	6½ ,,	5s. 0d.
3.	7½ ,,	6s. 0d.



927.

RING GAS BURNERS, for producing diffused flames, suitable for boiling, evaporating, and the application of heat to large surfaces; consisting of bent iron pipes pierced with numerous holes, each of which supplies gas for a special flame. Several forms, as represented by Figs. 930 to 934. The pipes have a bore of $\frac{3}{16}$ inch, and the rings have the diameters quoted in the table.



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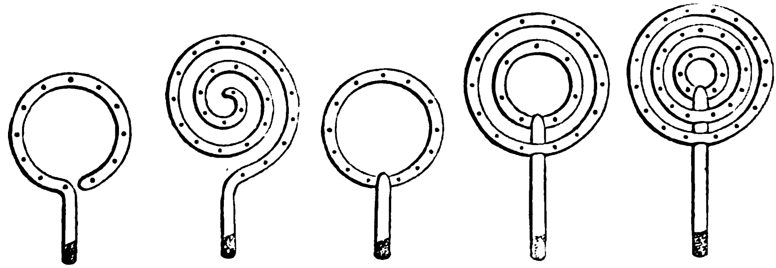
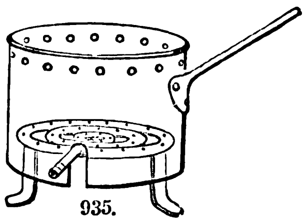


Diameter of Ring.	930. Plain Ring.	931. Coil.	932. Brazed Ring.	933. Double Ring.	934. Triple Ring.
2 inch,	1s. 0d.	—	1s. 6d.	3s. 0d.	—
3 "	1s. 2d.	2s. 0d.	1s. 9d.	3s. 6d.	—
4 "	1s. 3d.	2s. 3d.	2s. 0d.	3s. 9d.	6s. 0d.
5 "	1s. 5d.	2s. 8d.	2s. 3d.	4s. 3d.	6s. 6d.
6 "	1s. 6d.	3s. 0d.	2s. 6d.	4s. 6d.	7s. 0d.
7 "	1s. 8d.	3s. 6d.	2s. 9d.	5s. 0d.	7s. 6d.
8 "	1s. 9d.	—	3s. 0d.	5s. 6d.	8s. 0d.

935. CYLINDRICAL IRON FURNACES FOR SUPPORTING BASINS AND OTHER VESSELS OVER THE RING GAS BURNERS, made of stout iron plate, of the form represented by Fig. 935, consisting of a cylinder, the top of which is 10 inches above the table. It stands on three legs, is open at the bottom, and is furnished with a handle. The three strips of metal that form the feet are continued upwards within the cylinder, and bent towards the middle, so as to form a tripod, upon which the ring burner rests, the leading tube passing out through a slit in the cylinder, to be put into connection with the caoutchouc tube that brings the gas. The space between the ring burner and the top of the furnace is about 6 inches.



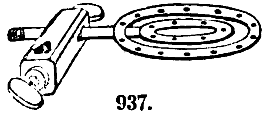
935.

Two sizes af this cylinder:—

935. Six inches diameter, serves for rings of any pattern from 2 inches up to 5 inches diameter, 4s.

936. Nine inches diameter, serves for all the sizes of the rings, so that by changing the ring any requisite degree of heat can be supplied, 5s.

937. Block for attaching the Ring Gas Burners to a retort stand. See Nos. 277, 286*a*.



937.

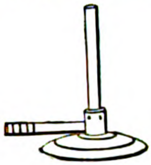
a. Price of a suitable iron retort stand, the base rectangular, 9½ inches long, 6 inches wide, the rod 28 inches long and ⅝-inch diameter, and a block adapted to such a rod and to the diameter of the arm of the burners, 5s. *b.* If a stand with rings or other fittings is required, the price will be found between No. 260 and No. 280.

Triangles for supporting small vessels over these cylinders are described at Nos. 299 to 308; sand-baths in a subsequent section.

The Clay Furnace for Stills, &c., No. 817, or the furnaces Nos. 803 to 810, can also be heated by these ring gas burners, instead of being fed with charcoal.

938. Deville's Collection of Gas Burners for various chemical operations, comprehending all the pieces shown in Fig. 938, £4, 10s.

Description.—*a*, supply pipe with stopcock; *b.* jet with circle of holes; *c*, single jet; *d.* flat jet for blowpipe; *e*, Argand, with gallery for chimney; *f*, Herapath's gas blowpipe; *g.* cylinder with gauze top, and with extra tube for a blast of air to give an intense heat; *h*, a brass cone for collecting a mixture of air and gas; and *i*, *j*, *k*, are three burners adapted to this cone, *i* and *f* having gauze tops, and *k* being provided with a blowpipe; *l* is a pipe coming from the blowing machine, or, in certain cases, from a gasometer containing oxygen gas. When *h* is supplied with coal gas and air, and *k l* with oxygen gas, an intense heat is produced by the jet. *m* is a crucible jacket, which fits the top of the cylinder *g*. The retort stand belongs to the set, and all the pieces fit properly to one another.



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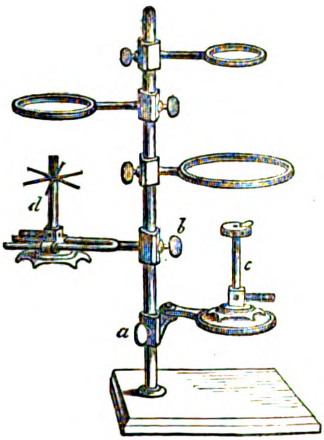
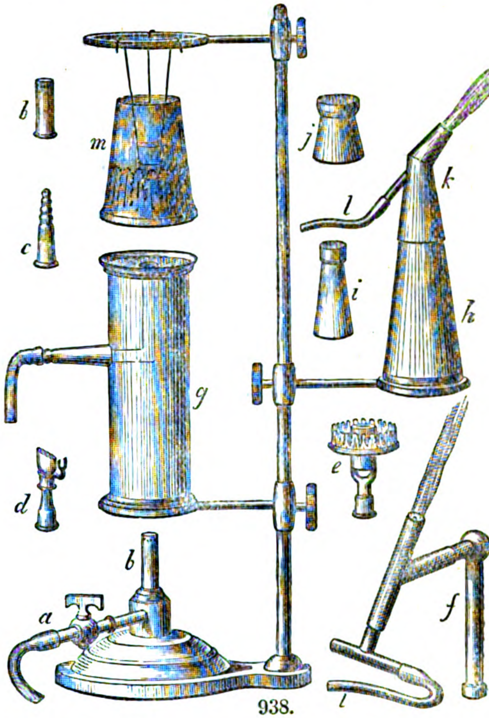


946.



938.

BUNSEN'S GAS BURNERS, which give a blue smokeless flame on burning a mixture of gas and air.

946*a*.

949.

The due performance of Bunsen's burner depends upon the proper admixture of gas and air. If gas is in excess, the flame gives light and smoke, and little heat. If air is in excess, the mixture explodes, and the gas takes fire within the tube, at the bottom. The proper management of such apparatus is explained at article No. 1013.

945. Bunsen's Single Jet, namely, brass tube and iron foot, plain, Fig. 945, 1s.

946. Single Jet with fork holes, by which it can be mounted on a retort stand, as represented by *d*, Fig. 946, 2s. 6d.

The other articles shown in Fig. 946 are as follows:—

Iron Retort Stand, with rectangular foot, $9\frac{1}{2}$ by 6 inches, and rod 28 inches by $\frac{5}{8}$ inch; three malleable iron rings, 3, 5, and $6\frac{1}{4}$ inches diameter, with triangular collars and screws, No. 262, 7s. 6d.

a. An Iron Table, No. 273, 3s.; *b*, Fork, No. 948, 1s. 9d.; *c*, Griffin's Rose Burner, No. 973, 1s. 6d.; *d*, Bunsen's Burner, with star and fork holes, No. 950, 3s. 6d.

946A. Curved Bunsen's Jet, similar to Fig. 946*a*, for saving space in height, 3s.

947. Fork for Bunsen's Burner, with collar to fit $\frac{1}{2}$-inch or $\frac{5}{8}$-inch iron rod, and brass thumbscrew, *b*, Fig. 262, 1s. 9d.

949. Single Jet Burner, with star support, without fork holes, Fig. 949, 2s.

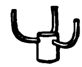
950. Ditto, with fork holes, *d*, 946, 3s. 6d.

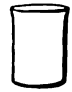
951. Porcelain Plate to put over the star support, No. 949, to catch the ashes of a filter when burnt over the blue flame, Fig. 951, 1s. 3d.

951.

952. Iron Tripod Support to hold capsules, &c., over a Bunsen's Gas Burner, Fig. 952, 6d.

953. Small Cylindrical Iron Chimney, to put on a star support to steady the flame, Fig. 953, 3d.





952. 953.

954. Blowpipe Jet, which acts when dropped into the Bunsen's Jet, &c., so as to cut off the atmospheric air and give a luminous gas flame, 4d.

955. Griffin's Rose Burner, the smallest size, to adapt the Bunsen's Jet for evaporations, *d*, Fig. 975, *the head only*, 6d.

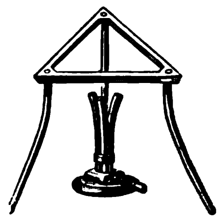
956. Gas Burner and Fittings, comprising single jet with star support, filter plate, blowpipe jet, tripod support, chimney, and rose burner, 5s.

957. The same set when the burner has fork holes, 6s. 6d.

958. Two Jet Burner, with fork holes, 3s.

959. Three Jet Burner, with fork holes, Fig. 959, but with upright jets, 4s.

960. Four Jet Burner, with fork holes, 5s.

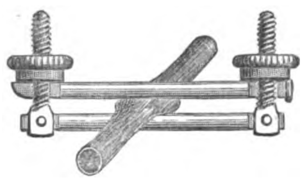


959.

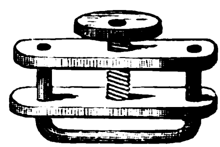
971. Lever Regulator for a current of gas passing through a caoutchouc tube, Fig. 971, 1s.

972. The same, another pattern, Fig. 971*a*, 1s.

972a. The same pattern, of much larger size, for 1 inch tubes, 1s. 6d.



971.



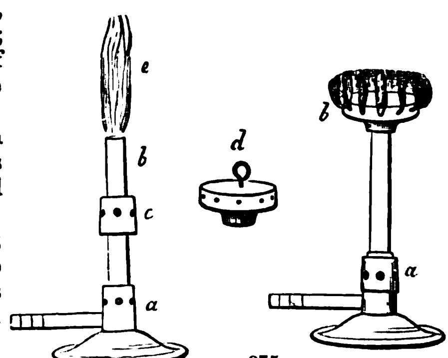
971*a*.

The addition of a Stopcock to any gas burner increases the price 1s. 6d.

GRIFFIN'S ROSE GAS BURNERS.

The Rose Gas Burners give a single flame when crucibles are to be ignited, and a rose or circle of small flames when liquids are to be heated in vessels of glass or porcelain. It is represented by Fig. 975, where *a*, *b*, is a burner similar to Bunsen's; *c*, a regulator to control the entrance of air into the box *a*, and thus prevent the flame from blowing down; *d*, the rose, which divides and spreads the flame when put on the top of the tube *b*; *e* shows the single or igniting flame; *b*, the spread or evaporating flame.

Three sizes of this burner are made; and to accompany each size, a furnace adapted to secure the most advantageous use of the heat which the burner furnishes. The smallest size of these burners, No. 1, is made without the regulator *c*.



975.

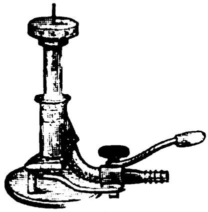
Prices of the Rose Gas Burners.

973. No. 1, Bore of the single burner, $\frac{3}{8}$-inch, 1s. 6d.

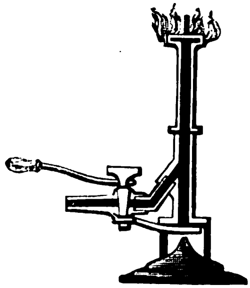
973a. No. 1, ditto, without the rose top, 1s.

974. No. 2, ditto, $\frac{5}{8}$-inch, 3s.

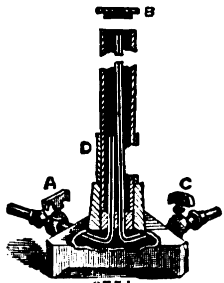
975. No. 3, ditto, $\frac{9}{8}$-inch, 7s.



975*a*.



975*aa*.

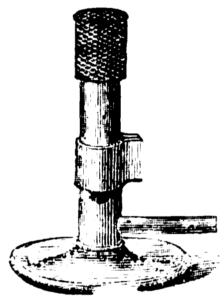


975*b*.

975A. Rose Gas Burner with simultaneous adjustment of air and gas, see Fig. 975*a* and 975*aa*, price 8s.

975B. BUNSEN BURNER for high temperatures.

This arrangement is now well-known to most of the leading chemists. It is a combined Bunsen with a powerful blowpipe, and is one of the most generally useful arrangements known for the chemical laboratory. The blowpipe flame obtained with the blast tube, when confined by the loose cap B, is compact—a good form and extremely powerful, owing to the fact that the air mixture is partially made before the blast begins to act. When the object to be heated is fragile it can be warmed by the Bunsen flame, and the blast slowly turned on by the tap C. The convenience of having a powerful flame at command under an ordinary retort stand without the necessity of re adjusting the height or position will be fully appreciated. Price 8s. A special pattern is made with double blast tube, designed as a powerful upright blowpipe, but not giving a good Bunsen flame, price 8s.

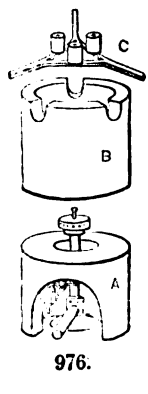


975c

975C. Bunsen's Burner, with solid flame, will burn any description of coal gas, at all pressures down to $\frac{3}{8}$-inch. It burns $4\frac{6}{10}$ cubic feet of air to every foot of gas. The amount of air drawn in at the base of the burner is adjusted by raising or lowering the copper cap. Fig. 975.

No. 0.	diameter	$\frac{3}{4}$	inch, gas per hour	8	feet,	5s.
,, 1.	,,	1	,, ,,	16	,,	6s.
,, 2.	,,	$1\frac{1}{2}$	,, ,,	25	,,	8s.
,, 3.	,,	2	,, ,,	35	,,	10s.

FURNACE FITTINGS FOR ROSE BURNER No. 1.



976.

FURNACE FOR EVAPORATIONS.—Clay furnace, consisting of two pieces, A and B, Fig. 976, which, when put together and the burner supplied with the rose top, produces a convenient furnace for evaporations. The three notches on the upper part of B are intended to receive the branches of a triangular support, such as C, Fig. 976, or Nos. 299 to 308. They serve also to keep up the draught when basins, sand-baths, pans, &c., are placed directly upon the furnace. Height 9 inches, diameter 5 inches.

976. Furnace alone, 5s.

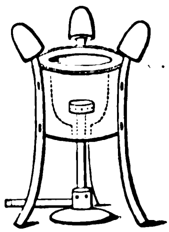
977. Furnace, with No. 1 Burner, 6s. 6d.

FURNACE FOR IGNITIONS.

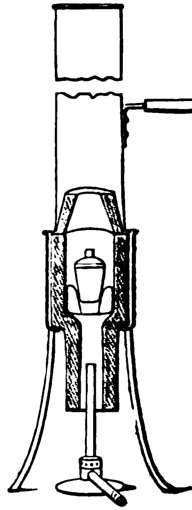
The power of the burner No. 1 is better suited for boiling and evaporating than for crucible operations, and therefore no furnace for ignitions has been provided for it. Nevertheless, for operations that are performed on small quantities of materials in porcelain or platinum crucibles and cups, extemporaneous furnaces can be readily built up with the clay cylinders described at No. 1018.

FURNACE FITTINGS FOR ROSE BURNER No. 2.

FURNACE FOR EVAPORATIONS.—Fig. 981 represents a furnace for evaporations. It consists of a fireclay pan open at the top, and with a hole in the bottom, through which the burner passes, and which admits air to the flame. It is fitted in an iron case, which has three legs to support it, and at the top has three iron pegs to support clay knobs, which keep the evaporating basins from contact with hot iron, and so lessen the chances of fracture. These knobs support basins of all sizes from 6 inches diameter upwards. The heat applied to a metal vessel will boil three gallons of water, and, of course, serve for the evaporation of large quantities. Small basins are to be supported over this furnace by triangles laid across the pan.



981.



983.

981. Price of the Evaporating Furnace, without the burner, 7s.

982. Price of the Furnace, with the Burner No. 2, 10s.

FURNACE FOR IGNITIONS.—Fig. 983 represents a furnace suitable for heating crucibles, the Burner No. 2 being used without the rose. It consists of a furnace body, with a descending flue made of fireclay. This is supported in an iron case with three legs. The crucible rests within the furnace on an iron ring of the form shown by *h*, *i*, Fig. 999. The body of the furnace is covered by a small clay cone, and that by an iron chimney 2 feet long. The power of this furnace is sufficient to fuse, in 15 minutes, 1000 grains of anhydrous carbonate of soda, contained in a platinum crucible. It will also fuse metallic silver.

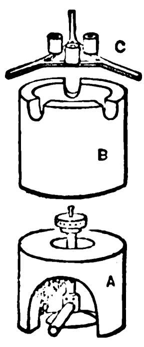
983. Price of the Furnace for Ignitions, without the Burner, 8s.

984. Price of the Furnace with the Burner No. 2, 11s.

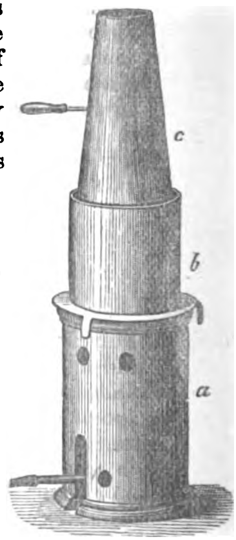
985. PRICE OF THE COMPLETE FURNACE :—
Burner, 3s.; Evaporating Furnace, 7s. Crucible Furnace, 8s.; together, 18s.

986. CLAY EVAPORATING FURNACE FOR No. 2 BURNER. In two pieces, similar in form to Fig. 986. Height 12 inches, diameter 6½ inches. Price, without the Burner, 7s.

987. The Clay Furnace, with the Burner No. 2, 10s.



986.



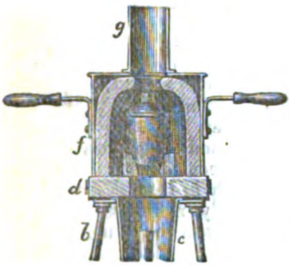
988.

988. Gas Crucible Furnace, consisting of a saltglazed stoneware Cylinder, 8 inches high; a Bunsen's Burner, similar to No. 2, but without the rose-head; a Crucible Furnace, body and trivet similar to *k*, Fig. 995; an iron top to support the crucible furnace on the cylinder, and a chimney; the whole resembling Fig. 1010, 10s. 6d.

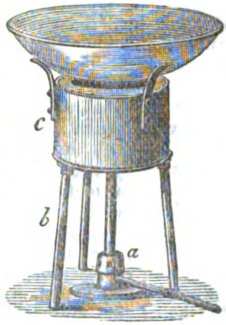
In article No. 1018, it is shown in what manner the lower part of this furnace, A, Fig. 976, can be used as part of a temporary furnace for the ignition of small crucibles.

FITTINGS FOR ROSE BURNER No. 3.

991. The Fittings for the Rose Burner No. 3 are represented by Figs. 993 to 999, with the exception that the evaporating furnace, Fig. 993, in lieu of having flat iron ears to support evaporating basins, is now made with round rods and clay caps, as represented by Fig. 993*a*. The burner, with these fittings, can be used as a convenient source of heat for most operations of the chemical laboratory and lecture table. It will boil a quantity of liquid, exceeding 4 gallons, at once; it will raise a $4\frac{3}{4}$-inch fireclay crucible to full redness; it will fuse anhydrous carbonate of soda in greater quantity than is required for the analysis of a siliceous mineral; and it will melt sterling silver. This amount of power is sufficient for most chemical operations that are not metallurgic.



994*a*.



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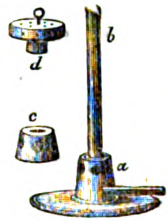

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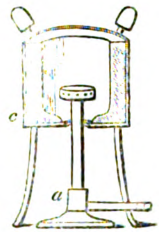


993*a*.

Price of the Fittings for No. 3 Rose Burner.

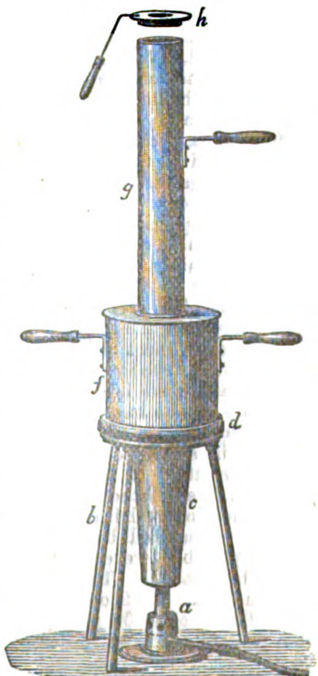
992. The Furnace complete, comprehending what is represented by Figs. 993, 994, and 995, with the burner 997, 42s.

993. The Furnace for boiling and evaporating, Figs. 993 and 993*a*, with the burner, 20s.

994. The Furnace for heating large crucibles (up to $4\frac{3}{4}$ inches high), Fig. 994, with burner and trivet, 25s.

995. The Furnace for heating small crucibles, Fig. 995, with the burner and trivet, 20s.

996. One Set of the Fittings, both for large and small crucibles, represented by Figs. 994 and 995, with one burner, 30s.



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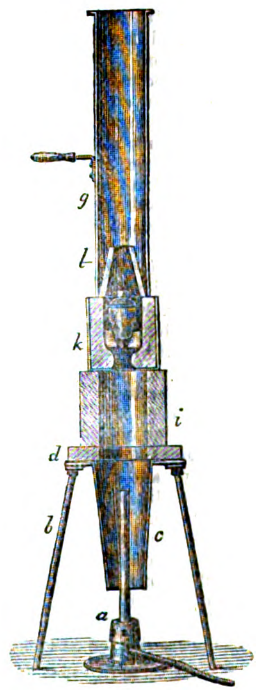
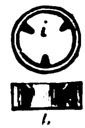


995.

997. The Rose Burner No. 3 alone, 7s.

998. Extra Iron Trivet, Fig. 999, 2-inch, for supporting small crucibles in the furnace, Fig. 995, 6d.

999. Extra Iron Trivet, Fig. 999, 4-inch, for supporting large crucibles in the furnace, Fig. 994, 8d.



999.

1005. *Description.*—Fig. 993 represents the evaporating furnace, a section of which is given by Fig. 993*a*. When liquids are to be boiled or evaporated in glass or porcelain vessels, the rose burner is to be used; but when a metal vessel is to hold the liquid, the flame from the single jet may be allowed to play on the bottom of the vessel. Small vessels are to be supported on triangles, No. 299. With this arrangement, and with gas supplied by ¼-inch pipe, under a pressure which gives about 30 cubic feet of gas per hour, the heat produced, acting upon water contained in a porcelain evaporating basin, will heat from 60° to 212° F. 1 quart in 5 minutes, 1 gallon in 15 minutes, 2 gallons in 30 minutes; and when the water boils it is driven off in steam at the rate of more than a gallon of water per hour. The method is consequently applicable to distillation on a small scale, and to numerous operations in pharmacy.

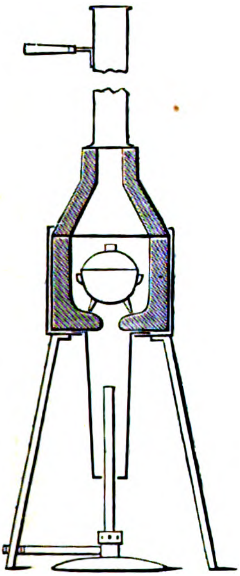
1006. *Arrangement for Heating to Redness a Large Fireclay Crucible.*—When a large crucible is to be heated to redness—as, for example, when oxide of copper is to be dried for use in an organic analysis—the gas burner is to be used without the rose, and is to be arranged with the furnace fittings that are represented in perspective by Fig 994, and in section by Fig. 994*a*, and the lower part of Fig. 995, *a*, *b*, *e*, *d*. Letter *a* represents the gas burner, Fig. 997; *b* is a tall iron stool; *c*, a chimney which collects atmospheric air to feed the flame, and leads it up close to the vertical tube *b*, by which contrivance the air is warmed and the tube cooled; *d* is a furnace-sole or plate of fireclay; *f* is a reverberatory dome, the interior of which is best shown in the section, Fig. 994*a*; *e* is a cast-iron ring or trivet, represented more clearly in Fig. 999; *g* is an iron chimney, 24 inches long, and 3½ inches wide; and *h*, a damper, to lessen the draught when small crucibles are to be heated. The height of this apparatus, from *a* to the top of *f*, is 24 inches; and the external diameter of the dome *f* is about 8 inches. The crucible, which may be from 4¼ to 4¾ inches in height, is placed on the iron ring *e*, Fig. 994 *a*, or Fig. 999, and that on the clay-sole *d*, and it is then covered by the dome *f*. The gas should be lighted after the crucible is placed in its position, and before the dome is put on. The dome and the chimney are then to be added, and the operation allowed to proceed. With a crucible of the above size, the damper *h* is not required; but it must be used when the crucible is under 4 inches in height, otherwise the draught, occasioned by extra space within the dome, causes the flame to blow down. The damper must be put on the chimney before the chimney is put on the dome. The iron ring, Fig 999, or *e*, Fig. 994*a*, suits crucibles of different sizes, according to the side of it which is turned uppermost.

The figures show that a crucible mounted in this furnace can lose very little heat by radiation or conduction, and hence it is that a small gas flame produces a powerful effect. In half-an-hour, a 4¾-inch clay crucible, filled and covered, can be heated to full redness. The progress of the ignition can be easily examined by lifting up the chimney *g* and the dome *f* by their respective wooden handles. But the action of the furnace can also be judged of by a peculiar roaring noise which it produces. If the gas and air are mixed in due proportions, the roar is regular and continuous. If there is too much gas, the roar is lessened. If too much air, the roar is increased, but is rendered irregular and intermittent. The greater the noise, the greater the heat in the furnace; but when the roar becomes spasmodic, the flame is on the point of blowing down. To prevent that occurrence, the proportion of air must be lessened or that of gas increased.

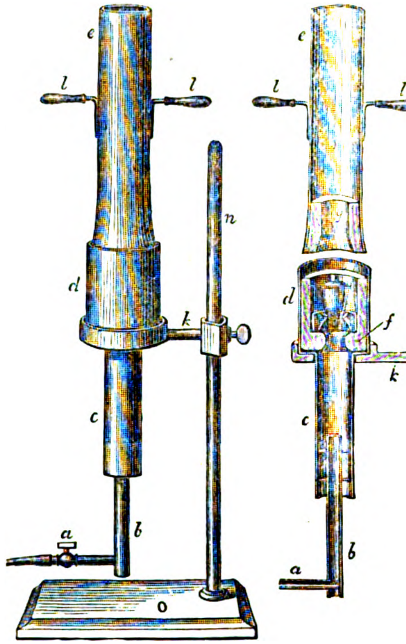
1007. *Arrangement for Heating Platinum Crucibles, as in the Fusion of Silicates with Anhydrous Carbonate of Soda.*—The following arrangement is convenient when small crucibles are to be strongly heated:—Anhydrous carbonate of soda in quantities exceeding 1,000 grains can be thus readily fused in a platinum crucible, and sterling silver can be melted in a clay crucible. It is also available for ignitions or fusions in small porcelain crucibles. Fig. 995 represents the arrangement of apparatus as seen in section. *a* is the gas burner; *b*, the stool; *c*, the air-chimney; and *d*, the furnace sole, as already explained. *i* is a cylinder of fireclay, 4 inches high, and 4½ inches diameter; *k* is a fireclay furnace, in which is placed a small cast-iron ring, about 2 inches in diameter, similar in form to that represented by Fig. 999, and on this ring the platinum crucible is adjusted; *l* is a fireclay or plumbago reverberatory dome; and *g* is the chimney that forms part of the furnace represented by Fig. 994. The crucible being adjusted, the gas lighted, and the dome and chimney put on, the lapse of 12 or 15 minutes, according to the quality and pressure of the gas, suffices for the fusion of 1,000 grains of carbonate of soda in a platinum crucible. At the heat which this furnace produces the cast-iron ring does not melt, nor alloy with the platinum crucible placed upon it.

1008. Gas Melting Furnace, for Quantities of Lead, Zinc, Antimony, &c. with Gas Burner and Iron Crucible, complete, as represented by Fig. 1008, 30s.

The iron crucible will contain nearly 30 lbs. of lead, and about 24 lbs. of zinc. The burner readily melts these quantities, and then, with a diminished quantity of gas, will keep the metals fluid. The metals being protected from the air, suffer little loss by oxidation. Such operations as the granulation of zinc are performed with this apparatus with great facility. It serves also for baths of fused metal. In a larger furnace of this kind, made for a special operation, I have with the burner No. 3 melted 60 lbs. of zinc with ease ; and I believe that, used in this manner, the burner is powerful enough to melt a hundredweight of zinc.



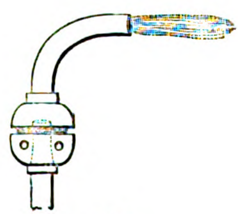
1008.



1009.

1009. Gas Crucible Furnace, suitable for analytical operations with platinum crucibles. Figures 1009 show it in perspective and in section. The power is sufficient to fuse 1000 grains of anhydrous carbonate of soda in ten minutes. It will take in a crucible measuring nearly 2½ by 2½ inches. Price of the Furnace, complete, with support but without stopcock, 14s.; price with the stopcock, 15s. 6d.

1011. Gas Burner, for burning a mixture of gas and air, to heat flues, for boiling water in fixed coppers, &c.; stout iron pipe, 1 inch bore, with regulator for the atmospheric air, Fig. 1011, 8s.



1011.

1012. *The Principles of Heating by Gas*, which have led to the construction of these gas furnaces, may be summed up as follows :—When a crucible or other solid body is to be heated, it is to be wrapped in a single flame at the point of maximum heat, and loss of heat by radiation and conduction is to be prevented by the interposition of non-conducting materials (plumbago or fireclay) ; and when liquids are to be boiled or evaporated, particularly when they are contained in vessels of glass or porcelain, the flame is to be broken up into numerous horizontal jets, and these are to be made to supply a large and regular current of highly-heated air, by which alone, and not by the direct application of the flame, the vessel that contains the liquid is to be heated. In both cases provision must be made to secure a sufficient draught of air through the furnace, because every cubic foot of gas requires for combustion 10 or 12 cubic feet of air, and the gases which have done their duty must be rapidly carried away from the focus of heat. If the steam, the carbonic acid gas, and the free nitrogen, which constitute the used-up gases, are not promptly expelled, fresh gaseous mixture, in the act of producing additional heat by combustion, cannot get near the object that is to be heated, and the heat so produced out of place is wasted.

1013. *Remedy for the common Defects of Bunsen's Burner.*—Bunsen's gas-burner, whatever its size, is subject to two defects: sometimes the flame burns white and smoky, and sometimes it blows down, the gaseous mixture explodes, and the gas then burns with a smoky flame in the tube. The remedies for these defects are as follows:—If the flame is white only when the gas is turned on very full, the remedy is to lessen the supply of gas; but if the flame continues to burn white at the top when the gas is gradually turned off, and the mass of flame slowly sinks, then the holes which deliver the gas from the supply pipe into the air-box *a*, Fig. 997, are too large, and are placed too directly under the centre of the vertical tube *b*, Fig. 997, and these defects must be corrected in the instrument. Finally, when the flame blows down, it is because the supply of atmospheric air is too large in proportion to the supply of gas, and their relative proportions must be altered. To effect this alteration, the cap *c* is to be turned round on the air-box *a*, so as partially to close the holes, and thus lessen the supply of air. If, when the gas is alight, the flame needs to be lowered, first the supply of air is to be lessened, and then the supply of gas. If the flame is to be enlarged, first the supply of gas must be increased, and then the supply of air. In short, to prevent the flame blowing down, the gas must always be first placed in excess, and then have the proper quantity of air adjusted to suit it by means of the regulator *c*. When gas burners of this description have to be used in a locality where the pressure of the gas is slight, especially in the daytime, there is a constant tendency in the flame to blow down. The best way to prevent that occurrence is to supply the gas by a pretty wide tube, and to see that the current of gas is not checked by a very narrow bore in the plug of an intervening stopcock, which I have frequently observed to be the unsuspected cause of want of pressure in the supply of gas. If this does not suffice to prevent the blowing down of the gas, the holes which admit the gas from the supply pipe into the box *a* of the burner should be enlarged, more or less according to necessity. A large supply of gas compensates, to some extent, for want of pressure.

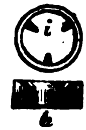
When a steady and long-continued heat is desired from a Bunsen's burner, it is proper to use two stopcocks and a length of caoutchouc tube between them. One of these stopcocks is to be affixed to the burner, and the other to the supply pipe. The latter is to be opened *wider* than is necessary to supply the required quantity of gas, and the former is to be used to regulate the supply to the burner exactly. Under these circumstances, if another stopcock is opened and gas burnt in the immediate neighbourhood, the flame does not so readily blow down in the regulated burner as it does when only the stopcock on the supply pipe is used.

EXTEMPORANEOUS CRUCIBLE FURNACES, WHICH CAN BE BUILT UP OF FIRECLAY CYLINDERS TO FIT CRUCIBLES OF ANY GIVEN SIZE.

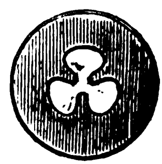
1018. When a crucible is suspended by wires or by a ring over the flame of a spirit lamp or gas burner, the flame and the hot air supplied by the flame strike the crucible for an instant, and then pass away to do no more good. At the same time, the effect of the heating power on the crucible is lessened by other circumstances; namely, by radiation on all sides, by a mass of cold air which constantly rises around and in contact with it, and by the conducting power of the metallic apparatus which supports both the crucible and the lamp. These losses are avoided if the crucible is enclosed in a furnace made of a non-conducting material, such as fireclay, which can absorb and retain heat. I have shown in the descriptions of the gas furnaces, and in that of Charles Griffin's Oil-Lamp Furnace, several methods of mounting crucibles in fireclay jackets, and I have now to describe some furnace fittings that may be used to construct temporary table furnaces for crucibles that are to be exposed to the flame produced by gas, oil, or spirits, up to a temperature close upon, but not quite up to, a white heat; that is to say, up to a heat that will readily melt anhydrous carbonate of soda and small quantities of silver, and so be fit for most analytical operations; but which will not melt copper nor cast iron, and therefore not be fit for metallurgic operations, the heat for which, generally speaking, requires for its production either the aid of a very tall chimney or a blowing machine, and necessarily the aid of furnaces and fittings suitable to sustain the required high temperature. There is no economy in making the same gas furnace serve for operations both at a red heat and a white heat.

Figs. 1024 to 1050 represent sections of cylinders of fireclay, which are drawn on a scale of 1 inch to 8 inches, and have the relative heights and bores represented in the figures. The clay pieces, that is to say, as many of them as are necessary for a given purpose can be adjusted over a gas flame by means of a tripod, Fig. 959 or 994, or a ring such as *k*, Fig. 1009, or a clay support such as A, Fig. 976.

1019. Grates.—The crucible to be operated upon is to be supported on a toothed ring, made either of cast iron or fireclay, such as are represented by Figs. 999 and 1019. Fig. 999 is a ring of cast iron, *h* representing it in section, and *i* as seen from above. It is about 2 inches in diameter, and has three teeth projecting towards the middle of the ring. This ring can be supported by any of the clay cylinders whose bore does not exceed 2 inches. Fig. 1019 is a ring of fireclay of 4 inches external diameter and 1 inch in thickness, provided with three teeth that project inwards, and upon which a crucible can be supported without injuring the draught of the gas furnace. Both these grates will support crucibles at the highest temperature which can be produced by spirit, oil, or gas, without a blast of air; but at a white heat produced by any of these fuels with a blast of air, the iron ring melts, and if the heat is long continued, those of fireclay soften and partially give way. When the fireclay grate, Fig. 1019, is required to sustain a very high temperature for a considerable time, it is proper to have it made of 6 inches diameter, as represented by Fig. 1042, the air-way in which is the same as that of the small grate, but the clay ring is much stronger.



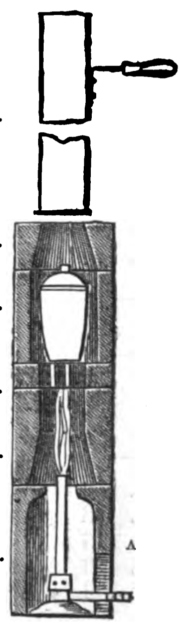
999.


1019.

1020. *Action.*—The grate is fixed above the flame at a distance which is found by trial to place the crucible in the point of greatest heat. Commonly, a 4-inch cylinder, No. 1027 or No. 1034, placed upon a suitable support, serves the purpose. The bore of the cylinders at the bottom must be wider than the burner, to allow of a considerable influx of atmospheric air around the flame. The grate is placed on this cylinder, the crucible on the grate, and then another cylinder around the crucible. The choice of this upper cylinder depends entirely upon the size of the crucible that is to be heated. Whatever the size of the crucible, the cylinder must be so chosen as to fit the crucible as accurately as possible, leaving between it and the furnace walls an open space of not less than $\frac{1}{8}$ inch, nor more than $\frac{1}{4}$ inch, all round. If the upper cylinder is not contracted at top, like Nos. 1032, 1033, 1034, then a cylinder of narrow bore, such as Nos. 1024 or 1025, must be put upon it, in order to deflect the flame and the rising current of hot air upon the top of the crucible, and thus produce a reverberatory furnace. Finally, an iron chimney, 2 or 3 feet long, must be put upon the furnace, to draw up a draught of air sufficient to feed the flame.

1021. *Example.*—Suppose the Rose Gas Burner No. 2 is to be arranged for an ignition, with the use of the fireclay support, A, Fig. 986. The combination of pieces necessary for the purpose may be those represented by Fig. 1021, where A is the fire-clay support, No. 986; and the rest of the pieces are those which are figured and described at the numbers placed against each of them in this figure. It is evident that the application of this furnace to crucibles of different sizes depends upon the proper choice of the cylinders, here marked 1031 and 1032. Of course there is only a limited choice of crucibles suitable for such operations. Three inches is the extreme width between the furnace walls of any of the pieces from No. 1024 to No. 1034; and though larger cylinders could be used, such as those from No. 1035 to No. 1040, it must be remembered that the flame of a lamp without blast has only a limited power, and that although a given flame will fuse 1000 grains of carbonate of soda in a platinum crucible, it may only heat to a moderate redness a large clay crucible. Yet, considering that low degrees of heat are suitable for many chemical purposes, it is convenient to have the power of readily adjusting a temporary furnace to the bulk of any crucible which it is desired to heat.

1022. The clay pieces Nos. 1035 to 1042 are those that have been expressly designed for the blast oil furnace described at No. 912; but these can also be used for spirit and gas furnaces, the respective sizes being chosen in each case according to the size of the crucible that is to be ignited. In respect to the *means of supporting* a crucible, it has been shown in the description of No. 912, that clay trivets with a wide flange, namely, the 6-inch trivets No. 1042, will support a crucible containing 5 lbs. of iron until that quantity of iron is melted, even under the operations of a blast: so that it is evident that this method of supporting a crucible in a gas flame may be always depended upon when no blowing-machine is employed.



1021.

But the discovery of the fact, that a trivet of fireclay of the form of Fig. 1019, could sustain a crucible bearing 5 lbs. of cast iron, until that quantity of iron was melted under the action of a blast, induced me to make some experiments on the joint use of a small blast gas burner and the small fireclay cylinders that are described in this section, and these experiments have led to the construction of the MINIATURE BLAST GAS FURNACE, described in No. 1155, an apparatus that justifies the recommendation that I have given of the use of these cylinders; for in the Miniature Blast Gas Furnace, the chemist has an instrument which possesses great power, in a small compass, and convenient form, the cost of which is a trifle, and which, by the addition or exchange of a few fireclay cylinders, can be modified to suit a great variety of operations at high temperatures.

1023. PRICES OF FIRECLAY FURNACE CYLINDERS, all bound with Iron.

A. PLAIN CYLINDERS.

No.	Outside Diameter.	Height.	Bore.	Thickness of Walls.	Price.
1024.	4 inch.	1 inch.	2 inch.	1 inch.	1s. 0d.
1025.	4 „	1½ „	2 „	1 „	1s. 0d.
1026.	4 „	3 „	2 „	1 „	1s. 6d.
1027.	4 „	4 „	2 „	1 „	1s. 6d.
1028.	4 „	1 „	3 „	½ „	1s. 0d.
1029.	4 „	1½ „	3 „	½ „	1s. 0d.
1030.	4 „	3 „	3 „	½ „	1s. 6d.
1031.	4 „	4 „	3 „	½ „	1s 6d.

B. CYLINDERS WITH CONICAL BORE.

No.	Outside Diameter.	Height.	Bore, Wide end.	Bore, Narrow end.	Price.
1032.	4 inch.	2 inch.	3 inch.	2 inch.	1s. 4d.
1033.	4 „	4 „	3 „	2 „	1s. 9d.
1034.	4 „	4 „	3 „	2 „	1s. 9d.

C. CYLINDERS OF THE OIL FURNACE, No. 912.

No.	Outside Diameter.	Height.	Bore.	Thickness of Walls.	Price.
1035.	5 inch.	4 inch.	3 inch.	1 inch.	1s. 9d.
1036.	6 „	5 „	4 „	1 „	2s. 3d.
1037.	6 „	1 „	2 „	2 „	1s. 3d.
1038.	8 „	6 „	5 „	1½ „	3s. 6d.
1039.	8 „	2 „	2 „	3 „	2s. 0d.

1040. Flanged Cylinder, 6 inches across the flange, 2 inches bore, 6 inches high, 4 inches across the funnel-shaped mouth, 2s.

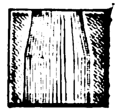
1024. 

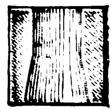
1028. 

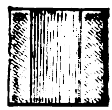
1025. 

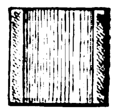
1029. 

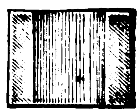
1032. 

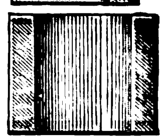
1033. 

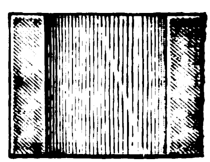
1034. 

1027. 

1031. 

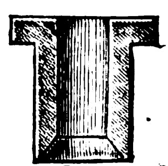
1035. 

1036. 

1038. 

1039. 

1037. 

1040. 

1042. 

1041. **Fireclay Grate**, small size, outside diameter, 4 inches, Figs. 1019 and 1042, 1s. 3d.
1042. **Fireclay Grate**, large size, outside diameter, 6 inches, Figs. 1019 and 1042, 1s. 8d.
1043. Iron Grate, Fig. 999, 2 inches diameter, 6d.
1044. Iron Grate, Fig. 999, 4 inches diameter, 9d.
1045. Iron Chimney, with handle, but not lined with fireclay, 2 feet long, 2s. 6d.
1046. Ditto, 3 feet long, 3s.

D. CYLINDERS OF THE MINIATURE BLAST GAS FURNACE, No. 1155.

1047.

1047. Cylinder, 4 inches diameter, 1½ inch thick, 1¼ inch bore, 1s.

1048.

1048. Cylinder, 6 inches diameter, 1½ inch thick, 1½ inch bore, 1s. 6d.

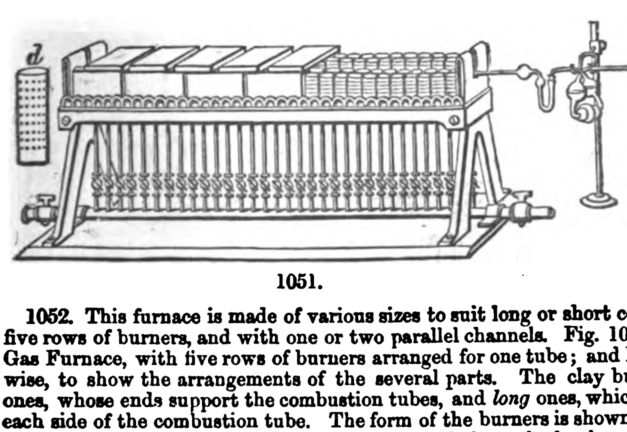
1049.

1049. Cylinder, 6 inches diameter, 2 inches thick, bore 3 inches at the wide end, 2 inches at the narrow end, 2s.
1050. Cover on three feet, *m*, Fig. 912, and 1050 in Fig. 1155, 4d.

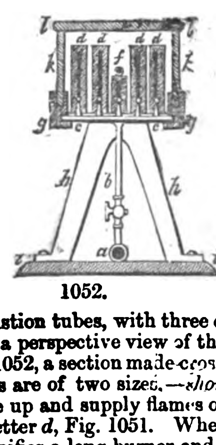
Gas Furnaces for Heating Tubes.

HOFMANN'S GAS COMBUSTION FURNACE.

1051. In this apparatus the combustion of the gas, supplied by a series of vertical gas jets, is effected by means of a number of perforated clay burners, in which the gas is mixed with air. These burners are so grouped as to form a channel for the combustion tube, a system of stopcocks serving to regulate the heat, or to confine it within any desired limits. A full description of the apparatus by Professor Hofmann will be found in the "Quarterly Journal of the Chemical Society," vol. xi., page 30.



1051.



1052.

1052. This furnace is made of various sizes to suit long or short combustion tubes, with three or five rows of burners, and with one or two parallel channels. Fig. 1051 is a perspective view of this Gas Furnace, with five rows of burners arranged for one tube; and Fig. 1052, a section made cross-wise, to show the arrangements of the several parts. The clay burners are of two sizes,—*short* ones, whose ends support the combustion tubes, and *long* ones, which rise up and supply flames on each side of the combustion tube. The form of the burners is shown at letter *d*, Fig. 1051. When there are three rows of burners they are arranged thus: *l s l*, where *l* signifies a long burner and *s* a short one, the combustion tube lying upon *s*. With five rows of burners the arrangement for *one* combustion tube is this: *l l s l l*, as shown in the figures: and for *two* combustion tubes it is *l s l s l*. The furnace is supplied with a stopcock at each end of the main gas-pipe.

Description of Fig. 1052.—*a* is the main gas-pipe; *b* is one of the vertical gas-pipes, with its stopcock; *c c*, a cross pipe armed with jets to throw the gas into the clay burners; *d d d d*, the long clay gas burners; *f*, the short burners upon which the combustion tube rests; *g g*, iron side-frames to fix the apparatus together; *h*, iron framework to support the furnace; *i i*, iron vase; *k k*, side-plates of fireclay to prevent loss of heat from the burners by radiation; *l l*, flat plates of fireclay laid on the top to prevent loss of heat by too free radiation upwards; which plates, however, are not to be set so close together as to injure the draught.

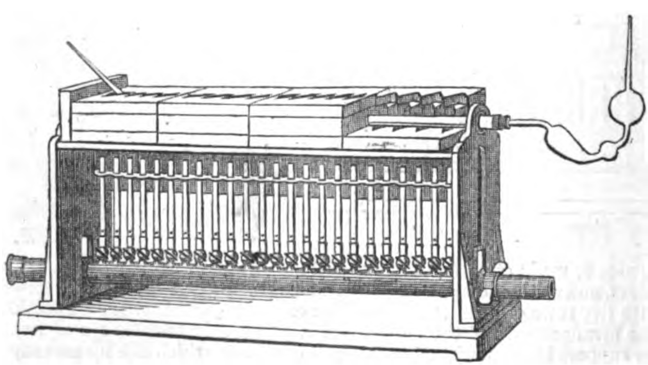
LIST OF PRICES OF HOFMANN'S FURNACES.

No.	Length of Combustion Tube, for which the Furnace is used.	Number of Stopcocks.	Rows of Burners.	Total Number of Burners.	Price.
1053	34-inch tube.	34 stopcocks.	5 rows.	170 burners.	£7, 7s.
1054	26 ,,	26 ,,	3 ,,	78 ,,	£5, 5s.
1055	10 ,,	10 ,,	3 ,,	30 ,,	£3.

1060. Clay Burners, short or long, per dozen, 2s.
1061. Flat Clay Plates, per dozen, 3s.
1062. Hofmann's Gas Combustion Furnace, for use when oxygen gas is required to effect the complete combustion of some organic substances, as described in the "Quarterly Journal of the Chemical Society," vol. vi., p. 209, and in Liebig's "Handbook of Organic Analysis." Price £3, 10s.
1063. Pair of Gas-Holders to contain oxygen gas, for use with this furnace. Copper, £6.

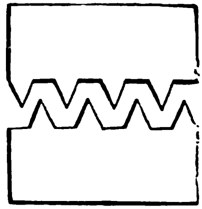
GRIFFIN'S GAS FURNACE FOR HEATING TUBES, AND FOR COMBUSTIONS IN ORGANIC ANALYSIS.

1064. This apparatus is represented by Fig. 1064. It consists of a series of Bunsen's gas burners, arranged in a line so close together as to give almost a continuous blue flame. Above this flame is placed a double row of fire-bricks, so formed as to make a longitudinal reverberatory furnace, in which a tube of any material—glass, porcelain, iron, or platinum—can be easily heated to redness, and kept at a red heat. The different parts of this furnace are firmly connected together by a substantial iron framework. The bricks are supported by two stout flat iron plates, which pass from end to end of the furnace, and are screwed to the upright supports. At the back of each row of bricks there is an arrangement to keep the bricks from falling outwards.



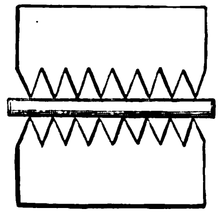
1064.

Upon the two iron plates above the gas flame are placed two rows of fire-bricks with zigzag edges, each brick being 4 inches long, 2 inches wide, and ½ inch thick; these rows extending the whole length of the furnace. The form of the bricks is represented in Fig. 1087. The toothed or vandyked edges of these bricks can be put at any desired distance from each other, and the bricks therefore permit more or less draught through the furnace. The points of the zigzags form the furnace-grate, upon which the glass combustion tube lies solidly and evenly.



1087.

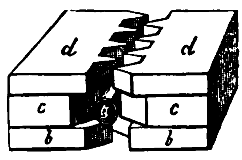
Upon this zigzag grate another tier of fire-bricks is placed of the form shown by Fig. 1088. These bricks are 4 inches long, 2 inches wide, and 1 inch thick. The combustion tube is placed between them, as represented in the figure, and the flame rises through the zigzags on each side of the tube. The bricks in general require to be pushed close to the tube, but they can be withdrawn to any distance which the due regulation of the draught and heat may require.



1088.

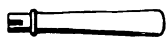
Finally, a third tier of bricks, similar to those that constitute the grate, is put on the top, and these bricks are pushed to a certain degree of closeness to form a sort of reverberatory dome, which makes the gas flame bend upon and heat the upper surface of the glass tube before it leaves the furnace.

Fig. 1090 represents a cross section of these bricks as arranged in connection with a combustion tube: *a* is the combustion tube; *b b* the flat bricks of the form of Fig. 1087, pushed pretty close together to form a grate for the support of the tube; *c c* are bricks of the form of Fig. 1088, constituting the side walls of the furnace; and *d d* are flat bricks similar in form to those of the grate, but constituting, as here placed, the dome of the longitudinal furnace. At each end of the furnace a slotted clay plate, similar to Fig. 1076, is placed to cut off the heat from the iron end plate of the furnace. Of course, after the gas has been lighted a little while all the points of these zigzags acquire a bright red heat, so that the glass tube is exposed on all sides either to a blue gas flame or to contact with red-hot fireclay. If *additional* heat is required it may be produced by putting on the top of the furnace two rows of bricks or two plates of iron facing each other.



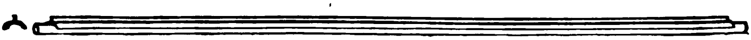
1090.

1071. *Description.*—The horizontal main pipe can have gas applied at either end, or at both; there is a screw cap to close one end when not required, which is usually the case, as a supply of gas at one end is sufficient at ordinary pressure to give a flame that will fuse the most refractory glass that can be procured. The form of the bricks used for the furnace is shown in perspective in Fig. 1064, and in Figs. 1087 and 1088. The draught of the furnace is regulated by the distance at which these bricks are placed from one another. Fig. 1072 represents a clamp for turning the stopcocks of the gas burners, which are set too close together to be conveniently moved by the fingers.

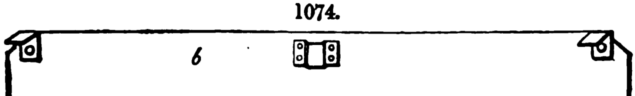


1072.

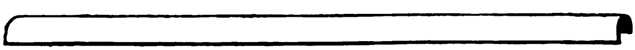
Support of Tubes in the Furnace.—Metallic or porcelain tubes, that are not subject to bend when hot, are supported in this furnace by the end supports of the furnace. Short lengths of tube can be supported on the teeth of the bricks. But glass tubes, such as are used in organic combustions, fuse too readily in the heat of this furnace, and require a support. This consists of an iron tray with a keel, such as represented by Fig. 1074. A cross section of this tray is shown at the right hand end of Fig. 1074. The keel prevents the warping of the tray. This tray is only supplied when specially ordered.



1074.



1075.



1077.

1075. *Regulation of the Heat.*—1. By attention to the main supply pipe, of course, more or less gas can be given to the whole series of burners. 2. Each burner being provided with a stopcock can be individually regulated. 3. The regulation of the space between the bricks is another means of changing the degree of heat. 4. When the bricks become red-hot, a great quantity of heat is radiated downwards, which is not only a loss, but one that acts injuriously on the row of burners. To prevent this action, two iron plates of the form represented by *b*, Fig. 1075, are fixed, one on each side of the furnace. Those plates force the current of air that is required to feed the flames to pass close by the burners, and keep them cool. With these plates a given heat is produced by a smaller quantity of gas than is necessary without them. 5. Finally, the entire row of burners can be raised 3 inches nearer to the tube when a strong heat is required, by merely loosening the thumbscrews at the two ends of the furnace, lifting up the main gas tube with the burners, and again fixing the thumbscrews. The following experiment shows the importance of this movement:—

Trial with a Furnace (No. 1080) *with* 36 *Jets.*—Gas supply pipe, ½-inch bore. Object, to keep a cast iron pipe of an inch diameter continuously at the same apparent degree of red heat.

1. The top of the gas burners being 3 inches from the iron pipe, and the pressure of the gas $\frac{4}{10}$-inch of water, the consumption of gas was 12 cubic feet in 15 minutes.

2. The top of the gas burners being 1 inch from the iron pipe, and the pressure of the gas reduced to $\frac{2}{10}$-inch of water, the consumption of gas was 6 cubic feet in 15 minutes.

That is to say,—to keep up the same degree of heat, twice as much gas was necessary in the one case as in the other. Thus, while this arrangement gives the power of raising the heat when necessary, it at the same time enables the operator to practise economy in the consumption of gas.


1076.

1076. Fig. 1076 represents a clay plate put at each end of the furnace, when it is employed for combustions, to keep the heat from passing from the body of the furnace outwards to the corks, &c., which it may be desirable to keep cool. It is now made with a slot instead of a hole, to facilitate removal of tube.

1077. The jets are protected by an iron cover of the form of Fig. 1077, which should be put over the jets as soon as an operation is ended.

Prices of the Combustion Furnaces.

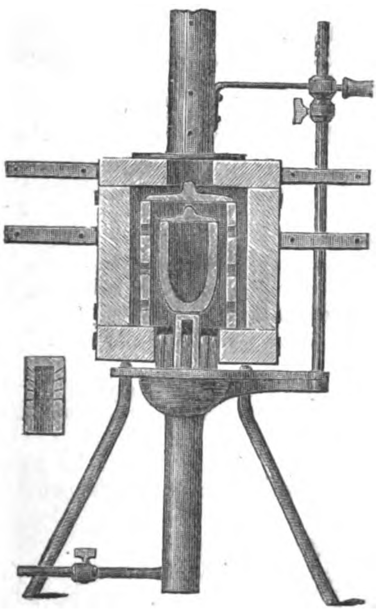
1078.	Inside length, 35 inches,	50 burners,	price £7,	7s. 0d.
1079.	„ „ 30 „	42 „	„ £6,	6s. 0d.
1080.	„ „ 25 „	36 „	„ £5,	5s. 0d.
1081.	„ „ 21 „	30 „	„ £4,	14s. 6d.
1082.	„ „ 17 „	24 „	„ £4,	4s. 0d.
1083.	„ „ 13 „	18 „	„ £3,	3s. 0d.

GRIFFIN'S GAS CRUCIBLE AND MUFFLE FURNACES.

1090. Account of a Gas Furnace for Chemical Operations at a white heat, without the aid of a blowing machine, and a new method of supporting crucibles in gas furnaces, by Charles Griffin.

(*Extracted from the "Journal of the Chemical Society."*)

"On a former occasion I introduced to the notice of the Chemical Society a gas furnace for operations at a white heat in crucibles, or a copper-melting heat in muffles. A detailed description of that furnace is given in the Journal of the Society, for August 1870. The crucibles are either suspended in a pierced plumbago cylinder, or supported on a trivet grate, both of which are liable to break when white hot, and therefore a cause of trouble and expense. Crucibles vary so much in form and size that they are often not suspended from these cylinders exactly in the focus of the heating power. Trivet grates have the disadvantage that they interfere with the direct action of the flame upon the crucible, and if made slightly they break when heated to whiteness. I desire now to place before you a new form of burner by which these defects are remedied. In the new burner the circle of gas jets are enlarged so as to leave a space round the central jet. An atmopyre similar to those used in Hofmann's Combustion Furnace, but of greater bulk and strength, is dropped over this central jet, and forms a solid support for the crucible. This support does not readily break, but should an accident happen, it can be replaced at the cost of a few pence. It brings the bottom of the crucible exactly into the focus of heat, and itself supplies a portion of the heating power of the burner. It also enables one to use any crucible at hand independent of its form or size. A strong lateral arm cast on the body of the burner, supports an upright iron rod, which carries the chimney of the furnace. By prolonging the legs of the burner upwards they are made to carry the clay furnace, and thus, by doing away with a stool or other support, the construction is simplified and the cost lessened. A plumbago cylinder, to deflect the flame and entrap the heat, is placed round the crucible, and is covered with an ordinary crucible cover, by removing which the crucible can be inspected. These fittings, however, present nothing new, being adapted from Griffin's Blast Gas Furnace, which was introduced sixteen years ago. Access to the crucible in the furnace is gained by turning aside the chimney and lifting the top plate of the furnace, which is provided with handles for this purpose. These handles do not become very hot, even when the furnace is at a white heat. The power of these new burners is very remarkable, one of small size consuming only 20 feet of gas per hour, and having a chimney 4 feet high, being capable of fusing half a pound of cast iron in 35 minutes from the time of lighting the gas; or of melting gold, silver, or copper in crucibles placed within a muffle measuring 5 inches long by 3 inches wide. If a chimney 6 feet high be employed, cast iron can be melted in crucibles placed within the muffle. A burner of larger size, consuming 40 feet of gas per hour, will melt cast iron in crucibles placed within a large muffle measuring 8 inches long by 4 inches wide. In the crucible furnace it will melt 1 lb. of cast-iron in 35 minutes, 2 lbs. in 45 minutes, 3 lbs. in 55 minutes, and 4 lbs. in 65 minutes, from the time of lighting the gas. It is thus seen that when a white heat has been once obtained, 10 minutes' time is required for the fusion of every additional pound of iron. These results, attainable with certainty and rapidity, are, I believe, the highest that have hitherto been placed at the command of the



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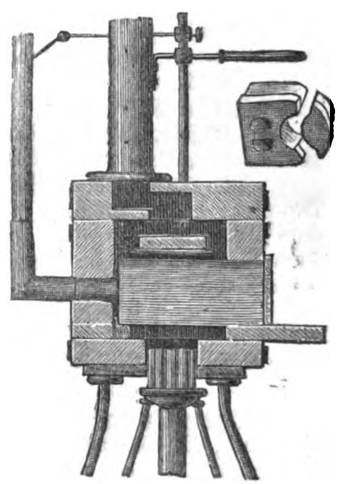


1093.

chemist. As in my former furnace, the proper admixture of gas and air is judged of from the colour and quantity of flame which passes up the chimney. To enable the operator to see this flame, three small holes are bored in the chimney. The flame is not seen at the upper hole, unless the supply of gas is too large, but it is always visible at both the lower holes."

In the above figure the muffle is provided with a small draught flue, having a regulating cap on its upper end. In the small furnaces this is omitted, and the muffle is slotted in the usual manner. The cover of the furnace is now made without the zigzag opening in the roof. The burner of the muffle furnace is the same as that used in the crucible furnace, Fig. 1090.

Skittle pots up to 8 inches can be used for collecting, burning waste with fluxes, &c., and in much less time than is required by a coke fire. An 8-inch pot can be worked in half an hour from lighting the gas. Two of the outer cylinders are used, placed on the top of one another.

1091. The *Distillation of Pure Zinc, per descensum*, can be performed in one of these gas furnaces by passing a tube from the top of the crucible downwards through the burner to the table. Price £5.

1092. **Gas Crucible Furnace.** Price £2, 12s. 6d.

Burner, 26 jets, one clay atmopyre, $2\frac{5}{8}$ inch × $1\frac{1}{4}$ inch, no stopcock, 18s. 0d.
Sole plate, $8\frac{1}{2}$ inch × $1\frac{3}{4}$ inch, hole $3\frac{3}{8}$ inch, ... 2s. 0d.
Top plate, $8\frac{1}{2}$ „ × $1\frac{1}{4}$ „ hole 2 „ handled, . . . 4s. 0d.
Cylinder, $8\frac{1}{2}$ „ × $6\frac{1}{4}$ „ bore $5\frac{3}{8}$ „ „ . . . . . . 5s. 0d.
Flue, 6 feet × 2 inch, with 6 inch iron base, two arms and a handle, 9s. 0d.
One P.P. cylinder, with 44 $\frac{1}{2}$-inch holes. Size, $5\frac{3}{4}$ high × $4\frac{3}{8}$ wide × $3\frac{5}{8}$ bore. To cover P.P. pot No. 2 and clay pots Nos. 3 and 4, 4s. 6d.
One P.P. cylinder, as above, bore $3\frac{7}{8}$ inch, diameter $4\frac{5}{8}$ inch. To cover P.P. pots Nos. 3 and 4, and clay pots No. $4\frac{1}{2}$, ... 5s. 0d.
Two clay covers No. 5 for the cylinders, ... 0s. 5d.
One each, clay covers and crucibles, Nos. 3, 4, and $4\frac{1}{2}$, ... 1s. 0d.
One each, P.P. pots, Nos, 2, 3, and 4, ... 5s. 0d.
Three clay covers for ditto, No. $4\frac{1}{2}$, ... 0s. 6d.

Power.—Melts 1 lb. of cast iron in 35, 2 lbs. in 45, 3 lbs. in 55, and 4 lbs. in 65 minutes.
Consumption of Gas.—40 cubic feet per hour.

Clay atmopyres, $2\frac{5}{8}$ inch × $1\frac{1}{4}$ inch, each 4d.
Clay crucibles, No. 3, 1s. 9d., No. 4, 2s. 2d., No. $4\frac{1}{2}$, 3s. 3d. per doz.
Do. covers, „ 3, 1s. 3d., „ 4, 1s. 9d., „ $4\frac{1}{2}$, 2s. 0d. „
P.P. crucibles, „ 2, 10s. 0d., „ 3, 15s. 0d., „ 4, 20s. 0d. „
P.P. crucible No. 2 contains $1\frac{1}{2}$ lb.; No. 3, 2 lbs.; No. 4, 3 lbs. cast iron before melting.
Crucible tongs, 25 inches, bow form, No. 124, 3s. 6d.; 16 inches, straight, No. 127, 5s. 6d.

1093. **Gas Muffle Furnace.** Price £3, 3s.

Burner, 26 jets, one clay atmopyre, $2\frac{5}{8}$ inch × $1\frac{1}{4}$ inch, no stopcock, 18s. 0d.
Muffle body, 21s.; one muffle, $8\frac{1}{4}$ „ × $4\frac{1}{4}$ „ × $3\frac{1}{2}$ inch, 6s., 27s. 0d.
The muffle has a tube at back end, $3\frac{1}{2}$ inch × 1 inch.
Top plate, hole 2 inch, ... 4s. 6d.
Sole plate, „ $3\frac{3}{8}$ „ . . . . 4s. 6d.
Flue, 6 feet × 2 inch, 6 inch iron base, two arms and a handle, . 9s. 0d.

Power.—Gold, silver, and cast-iron melt readily in crucibles placed within this muffle.
Consumption of Gas.—40 cubic feet per hour.

Muffles, $8\frac{1}{4}$ × $4\frac{1}{4}$ × $3\frac{1}{2}$, each 6s.

1094. If the Combined Crucible and Muffle Furnaces are ordered, the price is 88s., with one burner and flue.

1095. **Miniature Crucible Furnace.** Price £1, 1s.

Burner, 20 jets, one clay atmopyre, $2\frac{3}{4}$ inch × 1 inch, no stopcock, 7s. 6d.
Sole plate, 6 inch × $1\frac{1}{4}$ inch, hole $2\frac{3}{8}$ inch, ... 1s. 0d.
Top plate, 6 „ × 1 „ hole 2 „ handled, ... 1s. 9d.
Cylinder, 6 „ × 5 „ bore 4 „ „ . . . . 2s. 6d.
Flue, 4 feet × 2 inches, 6 inch iron base, one handle, . . . 5s. 0d.
One P.P. cylinder, $4\frac{1}{8}$ high × $3\frac{1}{4}$ wide × $2\frac{3}{4}$ bore, 14 holes $\frac{1}{2}$ inch, 1s. 4d.
One clay cover for ditto, flat form, No. 4, ... 0s. 1d.
One each, clay crucibles and covers, Nos. 1, 2, and 3, . . . 0s. 7d.
Two P.P. pots, No. 0, $2\frac{1}{4}$ inch × $2\frac{1}{2}$ inch, ... 1s. 0d.
Two „ „ 00, 2 „ × $2\frac{1}{4}$ „ . . . . 0s. 8d.

Power—Melts $\frac{1}{4}$ lb. of cast iron in 35 minutes, and copper, silver, and gold in a proportionately shorter time.
Consumption of Gas.—20 cubic feet per hour.

Clay atmopyres, $2\frac{3}{4}$ inch × 1 inch, each 4d.
Clay crucibles, No. 1, 10d., No. 2, 1s. 3d., No. 3, 1s. 9d. per doz.
Do. covers, „ 1, 10d., „ 2, 0s. 10d., „ 3, 1s. 3d. „
Plumbago crucibles, No. 0, 3s.; No. 00, 3s. per doz.

P.P. crucible, No. 0, contains 9 oz.; No. 00, 5 oz. cast iron before melting.
Crucible tongs, 16 inches, straight (No. 127), 5s. 6d.

1096. **Miniature Muffle Furnace.** Price £1, 11s. 6d.

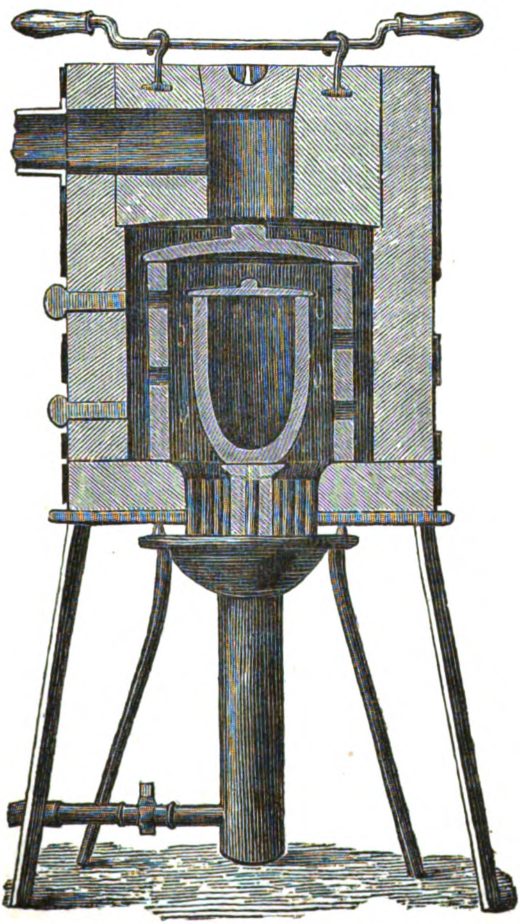
Burner, 20 jets, no cock, atmopyre 1 inch × $2\frac{3}{4}$ inch, . . .	7s. 6d.
Muffle body, 12s. 6d., 1 muffle, $5\frac{1}{2}$ in. × 3 in. × $2\frac{1}{2}$ in., 2s. 6d.,	15s. 0d.
Top plate, hole 2 inch, ...	2s. 4d.
Sole plate, hole $2\frac{3}{8}$,, ...	2s. 4d.
Flue, 4 feet × 2 inch, 6 inch iron base, one handle, . . .	5s. 0d.

Power.—With a 4-foot flue melts gold, silver, and copper; with a 6-foot flue melts cast iron, placed in crucibles within the muffle.

Consumption of Gas.—20 cubic feet per hour.

Muffles, $5\frac{1}{2}$ inch × 3 inch × $2\frac{1}{2}$ inch, each 2s. 6d.

1097. If the Combined Crucible and Muffle Furnaces are ordered, the price is 40s., with one burner and flue.



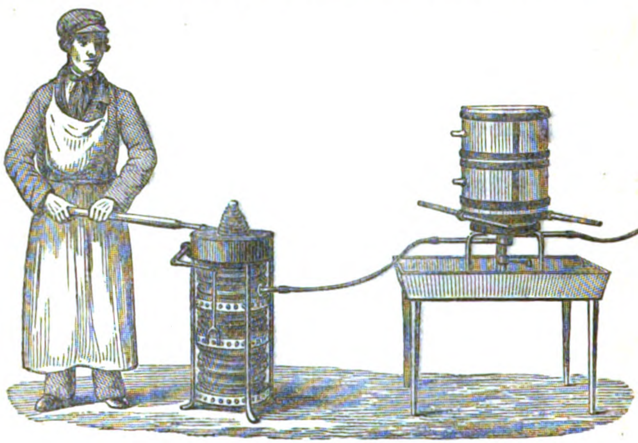
1098.

1098. Extra Large Gas Furnace, capable of raising a No. 12 plumbago pot, measuring 8 inches high by 6 inches wide, to a white heat, including three pots, three pierced cylinders, iron tongs, three atmopyres, &c., &c., Fig. 1098, £15.

The cover of such a furnace is let into the body, which rises higher than in the smaller patterns, and from which the flue passes off laterally to a standing flue or other house chimney, Fig. 1098.

GRIFFIN'S BLAST GAS FURNACE.

1100. This furnace is suitable for the fusion of refractory metals, and for all purposes of ignition, combustion, fusion, or dry distillation at a red heat or a white heat, where it is desirable to produce those temperatures and effects promptly, certainly, steadily, conveniently, and cheaply.

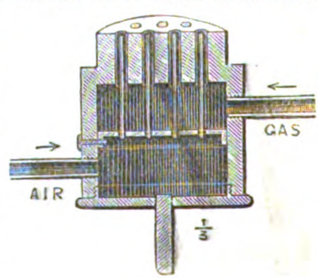


1100.

The Blast Gas Furnace consists of two parts, namely, of a particular form of gas burner, which is supplied with gas at the usual pressure, and with a blast of common air, supplied by bellows or a blowing machine, at about ten times the pressure at which the gas is supplied.

Secondly, of a furnace which is built up round the flame that is produced by the gas burner, and the crucible that is exposed to ignition. The object of the peculiar construction of this furnace is to accumulate and concentrate in a focus the heat produced by the gas flame, and to make it expend its entire power upon any object placed in that focus.

1101. The Gas Burner is a cylindrical iron reservoir, constructed as shown in section in Fig. 1101, which is drawn on a scale of one-third the full size. It contains two chambers, which are not in communication with one another. Into the upper chamber, gas at ordinary pressure is allowed to pass by the tube marked gas. Into the lower chamber, air is forced by the tube marked air. The upper part of the burner is an inch thick in the metal. Through this solid roof holes are bored for the escape of the gas. The quantity of gas used in an hour is about 100 cubic feet. The stopcock which supplied it had a bore of half an inch. The round rod, which is represented at the bottom of the burner, Fig. 1101, is intended to fit it to the support, shown by *b*, in Figs. 1115 and 1118.



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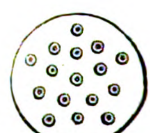


1101*a*.

Gas Furnace, arranged for Heating at the Top.

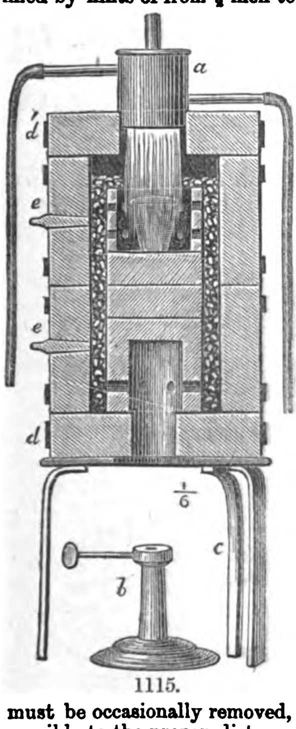
1115. This gas furnace is exhibited in section by Fig. 1115. *a* is the gas burner; *b* is the support for it, when used below the furnace; *c* is the iron tripod support for the furnace; *d d*, are two perforated clay plates, adapted to the gas burner *a*; *e e* are two clay cylinders. These pieces, *a* to *e*, are similar in all the furnaces, and will not require description in each example.

The interior of the furnace, as represented by Fig. 1115, is built up as follows:—The clay plate, *d* is put upon the tripod *c*. Over the central hole in *d*, the clay cylinder or ventilator is placed, and upon that cylinder two or three of the clay plates. Upon these a porcelain or platinum crucible is placed. If it is of platinum, a piece of platinum foil may be put between the crucible and the uppermost clay plate, to protect the crucible from contact with particles of iron, or against fusion with the clay. The crucible is to be surrounded by the plumbago jacket. The space between this pile in the centre of the furnace and the two cylinders *e e*, which form the walls of the furnace, is to be filled with flint-stones or gravel, washed clean and dried. The stones which answer best are rounded, water-worn pebbles, of half an inch to one inch diameter. These may be piled up to the top edge of the jacket.

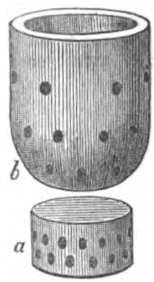
1116. It has been found convenient to give the crucible jacket a conical form, the better to adapt it to the usual shape of the crucible. The four figures 1116 *a*, *b*, *c*, *d*, show the method of using it, so as to make crucibles of different sizes fit the furnace properly.

In these figures, *a* represents a ventilator or hollow support, the sides of which are pierced full of holes. This is placed over the hole in the lower nozzle plate, to permit of the descent and escape of the carbonic acid gas and steam produced by the combustion of the gas in the furnace: *b* represents a cone open at both ends and pierced full of holes. Its use is to contain the crucible that is to be exposed to heat, as represented by *d* in Figs. 1116 *b*, *c*, *d*.

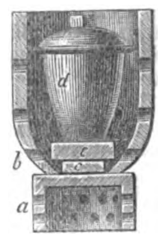
The ventilator and cone together should be equal, or nearly equal, to the height of the body of the furnance. The top of the crucible should be *about* $2\frac{1}{2}$ inches from the flat iron face of the gas burner, that being in general the place of greatest heat, but subject to a variation of half an inch, more or less, according to the supply of gas. The space between the crucible and cone should be about $\frac{1}{4}$ inch; if much wider the heating power of the furnace is diminished. The space between the ventilator and cone, *a*, *b*, and the sides of the furnace, must be completely filled by flints of from $\frac{1}{2}$ inch to 1 inch diameter. When the flints split up, the powder produced



1115.



1116*a*.



1116*c*.

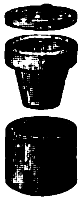
1116*b*.

1116*d*.

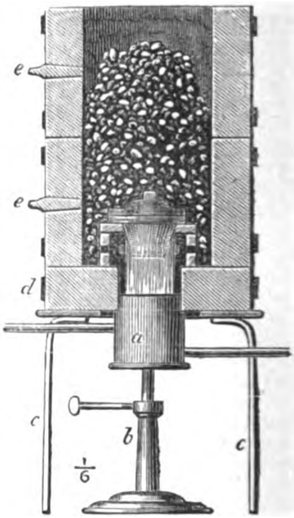
must be occasionally removed, as it stops the draught of the furnace. In order to raise the crucible to the proper distance from the face of the burner, round clay plates are used: thus, *c*, Fig. 1116*c*, shows how to raise a crucible within a cone; and *c*, Fig. 1116*d*, shows how a small cone can be raised above the ventilator to the proper height. Different sizes of cones may be used in the same furnace, the cone being chosen in each operation to fit the crucible, the quantity of surrounding pebbles being of no consequence, provided the furnace is filled up to the edge of the cone.

Gas Furnace Heated at the Bottom. Exhibited in Section by Fig. 1118.

1118. In this furnace the parts marked *a*, *b*, *c*, *d*, *e*, *e*, are the same as those similarly marked in Fig. 1115; but the gas burner is in this case put into the bottom of the furnace instead of the top, and the arrangement of the crucible and its support is altered in the manner shown by the figure. Upon the centre of the clay plate *d*, the perforated plumbago cylinder is placed; and upon that, a plumbago crucible. This arrangement is represented by Fig. 1118*a*, where *a* is the cylinder, *b* the flanged crucible, and *c* the crucible cover. These are placed together in position in Fig. 1118. The size of the crucible and the height of the perforated cylinder are to be so adjusted that the bottom of the crucible shall be struck by the hottest part of the gas flame; that is to say, the space left between the face of the gas burner and the bottom of the crucible must not exceed 2¼ inches. The crucible is provided with a closely-fitting cover, and pebbles are then filled in between the crucible jacket and the furnace cylinder, *e*, and are covered over the crucible until both the pieces of the furnace, *e*, *e*, are nearly filled. The gas is then lighted, the blast of air is set on, the gas burner is forced up into the hole in the clay plate *d*, and the operation proceeds. In from ten to twenty minutes after the gas is lighted—this difference of time depending upon the size of the furnace and the weight of metal contained in the crucible—the interior of the lower cylinder, *e*, acquires a white heat.

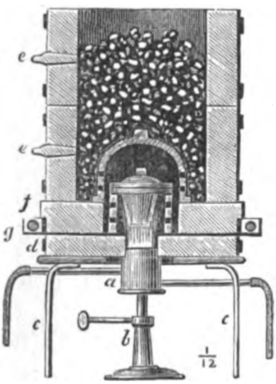


1118A.

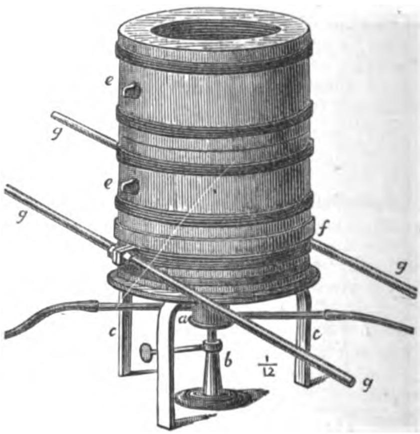


1118.

Gas Furnace heated from below, and provided with a Lifting Apparatus, to afford access to the Crucible. Exhibited in section and in perspective by Figs. 1119 and 1120.



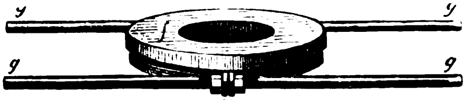
1119.



1120.

1119. This modification of the furnace is contrived to afford the means of inspecting the contents of the crucible without serious interruption to the process of ignition. The apparatus is shown in section by Fig. 1119, and in perspective by Fig. 1120. Besides the pieces that are similar to those which form the other furnaces, this furnace has two additions, a *lifter* and a *dome*.

The packing of this variety of furnace is performed as follows :—The clay plate *d*, and the lifter *f*, are placed upon the tripod-stand. The crucible jacket, or one similar, but of larger size, is placed upon the plate *d*. The crucible and its cover is then put into its place, and is covered with the dome, which must rest upon the lifter *f*, and must be of such a width as to clear the crucible easily when lifted. The internal height of the dome should be such as just to clear the top of the crucible cover. Consequently, where crucibles of different sizes are used, domes of different sizes are also necessary. Observe, distinctly, that the crucible and its support are to rest upon the plate *d*, and the dome upon the lifter *f*. The furnace cylinders *e*, *e*, are now to be superposed, and the space between the dome and the cylinders, and that above the dome, are to be filled with small pebbles, as already directed, and as represented by Fig. 1119. The gas may then be lighted, the blast of air set on, and the operation be allowed to proceed.



1121.

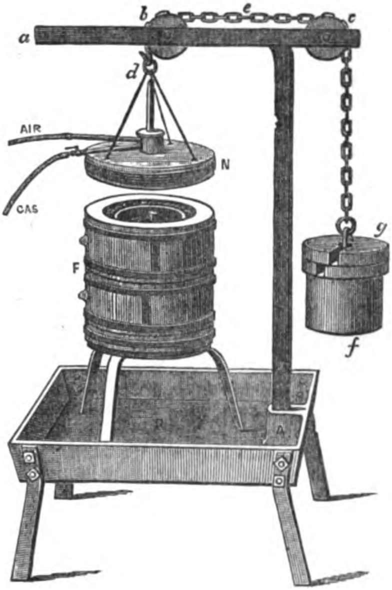
Crane Lifting Apparatus.

1122. For all sizes of furnaces the methods of Lifting represented by Figs. 1122 and 1123 are to be preferred to that described above.

Fig. 1122 represents a contrivance for lifting the nozzle plate and gas burner when the heat is applied at the top of the furnace. Fig. 1123 represents a method of lifting the entire furnace from the crucible when the heat is applied below. In both cases the crane and all its supports can be swung round on the point A, by the hand applied at *a*, to give free access to the crucible. The weights *f*, *g*, acting together, cause the furnace F, or the nozzle-plate N, to rise. When the weight *g* is removed, the furnace *f*, or the nozzle-plate N, descends. *e* represents an iron chain that runs over the pulleys *b*, *c*.

The same pan and crane answer for both operations ; but in one case the weights *f*, *g* counterbalance only the nozzle-plate and burner, *d*, N. Fig. 1122 ; and in the other case, they are much heavier, in order to counterbalance the loaded furnace, *d*, F, Fig. 1123.

These two figures exhibit the furnace in its complete state : Fig. 1122, arranged for heating at the top ; and 1123, arranged for heating at the bottom. Both figures show the iron pan which has been found useful with this furnace.

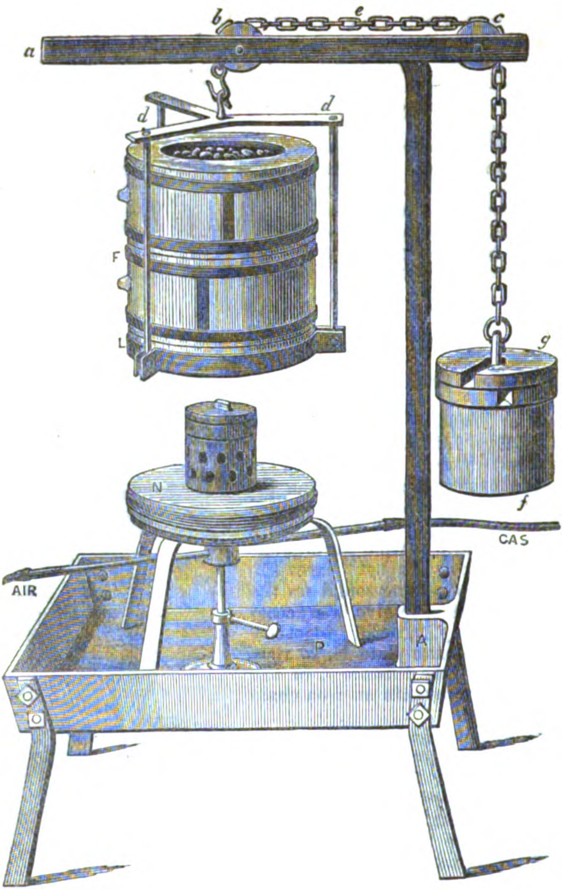


1122.

1125. *Miscellaneous Uses of the Blast Gas Furnace.*—1. The preparation of chemical substances by the projection of mixtures into a crucible kept at a red or white heat. 2. For melting silver, gold, copper, cast iron, brass, bronze, nickel-silver, &c., either for making small castings or ingots. 3. For experiments on glass, every description of which it is able to fuse. 4. For experiments on enamels, coloured glasses, and artificial gems. 5. For experiments on metallic alloys. 6. For the fusion of steel. 7. For the use of dentists. 8. For the assay of ores of silver, copper, lead, tin, iron, and other metals. 9. For all purposes of ignition, combustion, fusion, or dry distillation, at a red heat, or a white heat, where it is desirable to produce those temperatures promptly, certainly, steadily, conveniently, and cheaply.

Distillation per descensum.—Suppose a stoneware bottle with a long neck to be fitted with a stoneware tube, passing nearly to the bottom of the bottle, and projecting some inches beyond its mouth. Suppose this bottle to be half filled with metallic zinc, and then to be fixed upside down in the furnace, Fig. 1115, with the tube projecting downwards through the hole in the plate *d*, and nearly dipping into a vessel of water. The furnace being packed with pebbles, and the heat applied at the top, the distillation of zinc *per descensum* then takes place.

Exhibition of coloured flames.—When the gas burner, Fig. 1101, is supplied with gas and air, and is inflamed in the open air, so as to produce a clear blue flame of 3 inches long, and beyond it a flickering, nearly colourless flame of 12 inches long, brilliant colours may be given to this flame



1123.

by the introduction of concentrated solutions of certain salts. A ball of pumice-stone, an inch in diameter, fastened to a stout iron wire, is dipped into the saline solution, and while wet is plunged into the flame, upon which the whole flame becomes coloured. An iron crook is used to give an oblique direction to the flame of the gas burner, in order that powders and liquids put into the flame may not fall into the holes of the burner. Fig. 1126 represents the crook, and Fig. 1127 the manner of its adaptation to the burner and stool.

1127.

1126.

Brilliant flames are produced by throwing iron turnings into the flame; also by finely-pounded charcoal, resin, lycopodium, &c.

To produce *Coloured flames* the following solutions are used:—

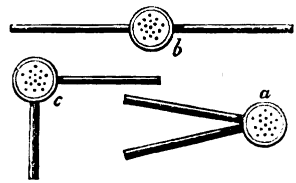
1. *Chloride of Strontium*, gives a brilliant crimson flame; 2. *Chloride of Calcium*, a reddish orange flame; 3. *Chloride of Sodium*, brilliant yellow; 4. *Chloride of Copper*, bluish green. For No. 4, the pumice-stone must be mounted on a copper wire. If the flame is touched on one side with the copper solution, and on the other

with the strontium solution, half the flame is green and half crimson. The colours and reflections of these flames are necessarily most brilliant in a dark room. A remarkable effect is produced by the yellow soda flame. It is reflected from the human countenance with a ghastly blackness, and the light is so powerful as to give the appearance of bronze to an assembly of several hundred people; while all the bright colours of dress, scarlets, mauves, magentas, and the like, disappear instantly.

1127. *Repair of the Gas Furnace.*—When the clay cylinders become warped or chipped, so as to allow the gases to escape at the joints laterally, they must be luted for each operation by applying a little wet fireclay by means of a spatula. When only a moderate heat is required, this luting is unnecessary.

PRICES OF BLAST GAS BURNERS AND FURNACES, AND THEIR SEPARATE PIECES.

1128. Blast Gas Burners, each with an iron support, Fig. 1101, and *b*, Fig. 1115. 6 jets, 10s.; 16 jets, 16s.; 26 jets, 30s.



1129.

1129. The burner with 16 jets is suitable for the furnaces Nos. 1, 2, and 3. The burner with 26 jets is suitable for the furnace No. 4. The burner with 6 jets is only suitable for small crucible work. The gas supply-pipe for the burner with 16 jets must have a bore of ½-inch, and that for the larger burner a bore of ¾ to 1 inch.

In Fig. 1101, the gas and air are represented as being supplied to the burner on two opposite sides; but it is sometimes convenient to have the supply-pipes placed at right angles to one another, as shown at *c*, Fig. 1129, and sometimes nearly parallel, as at *a*, Fig. 1129. It depends upon the locality where the furnace is to be used.

COMPLETE GAS FURNACES.

These estimates include *specimens* of the Interior Fittings, and a few Crucibles of the sizes suitable for each furnace, Nos. 1 to 4.

When purchasers wish to have *quantities* of crucibles, or additional pieces of such articles as most readily burn away, they are requested to give orders accordingly.

Blowing Machines are not included in the estimates. See section on "Blowing Machines" at No. 1162.

1147. Furnace No. 1 includes the following articles. Price £2, 5s.

Fireclay Furnace, 4 pieces, iron bound, 9s.
Gas Burner, 16 jets, with support, 16s.
Iron Crook, 1s.
Tripod Support for the furnace, 8s.

Interior Fittings.

No. 1. Ventilator, 3 inches high, 3 inches wide, 1s. 2d.
1A. Plumbago Cylinder, 2½ by 2½ inches, 1s.
1B. " " 3 by 3 inches, 1s. 9d.
This cylinder will take in a crucible measuring 2¼ inches wide by 2¾ inches high, the largest suitable for this size of furnace.
1B. Flanged Crucible and Cover, plumbago, 1s. 8d.
1B. " " " fireclay, 2 sets, 1s. 4d.
Clay Plates, 2 inches by ½ inch and 1 inch, 2 each, 10d.
" " 3 " ½ " 1 " " 10d.
Round Fireclay Crucible, six, with covers, 1s. 1d.
Plumbago Crucible, No. 1, two, with covers, 1s. 6d.
Round Flints, ½ cubic foot, in packing case, 2s. 6d.

1148. Furnace No. 2. Price £7, 17s. 6d.

Fireclay Furnace, 4 pieces, iron bound, 15s.
Gas Burner, 16 jets, with support, 16s.

Iron Crook, 1s.
Tripod Support for the furnace, 10s.
Crane Lifting Apparatus, Figs. 1122, 1123, £4, 4s.

INTERIOR FITTINGS.

No. 2. Ventilator, 3½ inches wide, 2 inches high, 1s. 2d.
2. Cone, 6 inches high, 5¾ inches upper diameter, 2s. 6d.
2. Dome, 5½ inches diameter, 4s.
2A. Flanged Crucible and Cover, plumbago, 2s.
2A. „ „ „ clay, 2 sets, 2s.
2B. „ „ „ plumbago, 3s. 3d.
2B. „ „ „ clay, 2 sets, 2s.

1A.	Plumbago Cylinder,	2½ inches high,	2½ inches wide,	1s.
1B.	„ „	3 „ „	3 „	1s. 9d.
2A.	„ „	3½ „ „	4 „	2s. 6d.
2B.	„ „	5 „ „	4 „	3s. 0d.

Clay Plates, 2 inches by ½ inch and 1 inch, 2 each, 10d.
„ 3 „ ½ „ 1 „ „ 10d.
Plumbago Plate, 3 inch, 2 copies, 1s.
Round Fireclay Crucibles, for Cone No. 2, all with covers, 3 each of 4¾ inches high, 4¼ inches high, 3½ inches high, 3s.
Round Flints, ½ cubic foot, in packing case, 2s. 6d.

1149. FURNACE No. 2, without the Crane Lifter and Pan, Fig. 1123, but with the Lifter, Figs. 1121 and 1120, £4, 10s.

1150. Furnace No. 3. Price £11.
Fireclay Furnace, 4 pieces, iron bound, £1, 1s.
Gas Burner, 16 jets, with support, 16s.
Iron Crook, 1s.
Tripod Support for the furnace, 15s.
Crane-Lifting Apparatus, Figs. 1122 and 1123, £5, 5s.

INTERIOR FITTINGS.

No. 3. Ventilator, 4½ inches wide, 2½ inches high, 1s. 6d.
3. Perforated Cone, 7½ inches high, 6½ inches upper diameter, 4s.
2. Ventilator, 3½ inches wide, 2 inches high, 1s. 2d.
2. Perforated Cone, 6 inches high, 5¾ inches upper diameter, 2s. 6d.
3. Dome, 7½ inches diameter, two copies, 12s.

1A.	Perforated Cylinder,	2½ inches high,	2½ inches diameter,	1s. 0d.
1B.	„ „	3 „	3 „	1s. 9d.
3A.	„ „	3½ „	5 „	3s. 0d.
3B.	„ „	5 „	5 „	3s. 6d.

Perforated Plumbago Plates, 3 inch, 2 copies, 1s.
„ „ „ 4 „ 1s. 4d.
3A. Flanged Crucible and Cover, plumbago, 4s. 6d.
3A. „ „ „ fireclay, 2 sets, 2s. 4d.
3B. „ „ „ plumbago, 6s.
3B. „ „ „ fireclay, 2 sets, 3s. 8d.
Clay Plates, 2 by ½ inch, and 2 by 1 inch, 2 each, 10d.
„ 3 by ½ „ 3 by 1 „ 10d.
„ 4 by ½ „ 4 by 1 „ 1s. 2d.
Round Fireclay Crucibles to fit Cone No. 3, all with covers, 3 of 5¼ inches, 1s. 4d.; 3 of 6¼ inches, 1s. 9d.
Round Fireclay Crucibles to fit Cone No. 2, all with covers, 3 of 4¾ inches, 1s. 2d.; 3 of 4¼ inches, 10d.
Round Pebbles, 1 cubic foot, in packing case, 4s. 6d.

1151. FURNACE No. 3, without the Crane Lifter and Pan, Figs. 1122 and 1123, but with the Lifter, Figs. 1120 and 1121, £6, 12s.

1152. Furnace No. 4. Price £16.

Fireclay Furnace, 4 pieces, iron bound, £2, 10s.
Gas Burner, 26 jets, with support, 30s.
Iron Crook, 1s.
Tripod Stand for the furnace, 18s.
Crane-Lifting Apparatus, Figs. 1122 and 1123, £6, 6s.

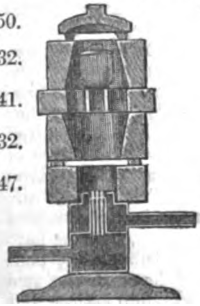
INTERIOR FITTINGS.

No. 4. Ventilator, 6 inches wide, 2½ inches high, 2s. 6d.
4. Perforated Cone, 9½ inches high, 9 inches upper diameter, 6s.
3. „ „ 7½ „ 6½ „ „ 4s.
4A. Dome, 9½ inches diameter, 2 copies, 16s.
4B. „ 11 „ 14s.
1B. Perforated Cylinder, 3 inches high, 3 inches wide, 1s. 9d.
4A. „ „ 5 „ 6¾ „ 5s.
4B. „ „ 7½ „ 8½ „ 10s.
Perforated Plumbago Plate, 4 inches, 2 copies, 1s. 4d.
4A. Flanged Crucible and Cover, plumbago, 8s.
4A. „ „ „ fireclay, 2s. 6d.
4B. „ „ „ plumbago, 12s. 6d.
4B. „ „ „ fireclay, 3s. 8d.
Clay Plates, 3 by ½ inch, and 3 by 1 inch, 3 each, 1s. 3d.
„ 4 by ½ „ 4 by 1 „ 3 „ 1s. 9d.
Round Fireclay Crucibles to fit Cone No. 4, all with covers: 3 of 7¼ inches, 2s. 6d.; 3 of 8¼ inches, 3s. 4d.
Round Fireclay Crucibles to fit Cone No. 3, all with covers: 3 of 5¼ inches, 1s. 4d.; 3 of 6½ inches, 1s. 8d.
Round Flints, 1 cubic foot, in packing case, 4s. 6d.

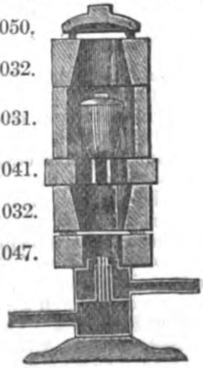
1153. FURNACE No. 4, without the Crane Lifter and Pan, Figs. 1122 and 1123, but with the Lifter, Figs. 1120 and 1121, £11.

Miniature Blast Gas Furnaces.

1155. Many chemical ignitions, performed on small quantities of substances in analytical processes, demand a degree of heat greater than that afforded by gas burners with draught, but not so much as is supplied by the powerful blast furnaces described in the preceding section. The apparatus now to be described is intended to meet this requirement. It will readily raise to a white heat all the sizes of platinum and porcelain crucibles that are commonly in use, and such sizes of clay or plumbago crucibles as will contain 1 lb. of cast iron, which quantity of metal this furnace will melt.



1155.



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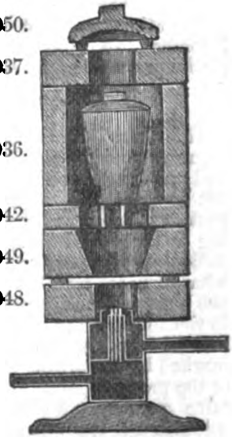


1157.

Figs. 1155, 1156, and 1157 represent three examples of the MINIATURE BLAST FURNACE. This consists, in the main, of a blast gas burner, similar in construction to that represented by Fig. 1101, but smaller in size, and having only three jets. It is fixed upon, and forms part of, the furnace support, as represented in the figures. Upon the iron nozzle of the burner there is fixed a fireclay nozzle plate, or furnace-sole, similar to *d*, Fig. 1115, and upon this plate the little furnace is built up of loose clay cylinders, such as are described in articles 1018 to 1050, and which are in all cases selected to suit the size of the crucible that is to be operated upon. The entire furnace rests on the solid shoulder of the gas burner. No pebbles are used, the degree of heat that is intended to be raised not requiring their aid. Gas supplied at common pressure by a ½-inch pipe is sufficient.

In mounting this furnace, it is necessary to place between the nozzle plate, or sole, and the conical flue placed upon it, three small feet, to separate the two pieces and give room for the influx of atmospheric air around the flame, without which the proper heat of the furnace is not obtained. Three bronze halfpenny pieces answer the purpose exactly.

Upon comparing the three figures, 1155, 1156, 1157, it will be perceived that the interior of the furnace is exactly alike up to the grate or trivet, and differ above that only in having cylinders that suit the different sizes of crucibles that are to be heated.

It is in the power of the operator, when working with platinum crucibles, to dispense with the grate, and to hang his crucible in the hottest part of the furnace by a sling of platinum wire suspended from an iron bar laid across the top of the furnace. The piece marked 1041, in Fig. 1155, being omitted, the two pieces, 1032 and 1032, come together and form a cavity, in the centre of which the crucible is to be suspended. If it then appears to be too low in the flame the height can be raised by putting such pieces as 1024 or 1025 between the lower piece, 1032, and the sole, 1047.

PRICES OF THE MINIATURE FURNACES.

1155. Gas Burner and Furnace for crucibles not exceeding 2 inches by 2 inches. The fireclay pieces are 4 inches in external diameter. Price 12s.

1156. Gas Burner and Furnace for crucibles not exceeding 2¾ inches by 2¾ inches. This includes the same pieces as No. 1155, with the addition of a cylinder 4 by 4 inches, to make room for the larger crucible. Price 14s.

1157. Gas Burner and Furnace for crucibles not exceeding 3½ inches by 3½ inches. All the pieces are 6 inches in external diameter. Price 16s.

1158. The Three Furnaces combined—that is to say, one burner, one of each size of nozzle plate, and one set of the other fittings, both of the 4-inch and 6-inch diameter, so as to fit up any one of the furnaces represented in the three figures. Price 21s.

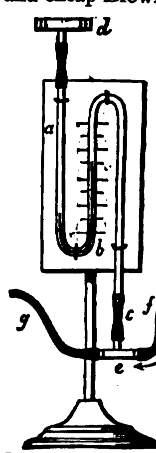
1159. The Three-jet Gas Burner, mounted on the iron stand, without the fireclay furnaces, price 7s. 6d.

The prices of all the clay cylinders are given at Nos. 1023 to 1050, being the Nos. referred to at the side of the above figures. Duplicates of the grates or other pieces are supplied at these prices.

The Miniature Blast Gas Furnaces can all be efficiently worked by the new and cheap Blowing Machines, No. 1166, price 55s., and No. 1167, price 75s. The former, when platinum crucibles are to be used; the latter, when iron is to be fused.

BLOWING MACHINES.

The Blast Gas Furnaces, the Gas Blowpipes, and the Oil-lamp Furnaces require the aid of blowing machines sufficiently powerful to supply a constant and uniform blast of air, without which the true power of the furnaces cannot be developed. It is convenient to have these blowing machines as compact as possible, and desirable to have them at moderate prices. The following articles fulfil these conditions more or less completely. It is rather difficult to state explicitly what is the power of each machine. I have stated what furnaces each is best suited for, and a comparative view of the force of the blast supplied by several when used under the same circumstances is given in the following table. The trials were made as follows:—The blast of air, passing from a blowing machine to a six-jet blast gas burner in the direction marked by the arrow, was made to pass through the tube *f e g*, forming part of the pressure-gauge represented by Fig. 1162. The glass tube, *a b c*, contains mercury, which, when at rest, settles at the same level in the two columns *a b*, but when *f* is connected with a blowing machine in action, and *g* with a gas burner, the mercury descends in the tube *b* and rises in *a*; and the difference of level, indicated by the scale drawn on the board in inches, shows the comparative force of the blast.



1162.

Catalogue No. of the Machine.	Pressure of Mercury.	Catalogue No. of the Machine.	Pressure of Mercury.
1163	2 inch.	1166	1 inch.
1164	2 "	1168	½ "
1165	1 "	1169	½ "

Any blowing machine which is intended to supply a blast of air that will melt more than 2 lbs. of cast iron in a gas or oil furnace must, when tried in this manner, show a pressure *exceeding* 1 inch of mercury, and must have a *steady* blast; that is to say, the mercury in the gauge must not vibrate violently.

1162. Pressure Gauge, with a scale on silvered brass finely divided, on support with junction T-pieces, Fig. 1162, 8s.

When this gauge is supplied with water coloured blue by sulphate of indigo, instead of with mercury, it serves to indicate the pressure of ordinary coal-gas, which is commonly from ½ inch to 1 inch of water. The T-piece *d* is ¼ inch diameter, and the T-piece *e* is ¼ inch diameter, the former to suit caoutchouc gas-tubes, and the latter to suit air-tubes. Wherever the pressure of gas varies considerably, it is convenient to have a gauge of this sort always at hand; and when a fusion that demands a very high temperature is to be effected, the trial should be deferred till the gauge shows the gas to be at a sufficient pressure.

1163.

1163. Circular Blowing Machine, 12 inch diameter, with spring and weights, height of wire frame 42 inches, as represented in Fig. 1163, £5.

It serves for the blast furnaces, the gas blowpipes, and the miniature blast furnaces.

1164. Circular Blowing Machine, of a larger and powerful description, being a portion of Deville's Chemical Forge, No. 771. It is cased in iron, £9.

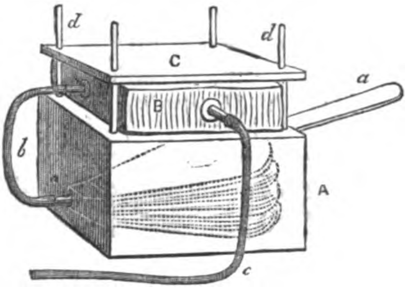
1165. Double Bellows on Frame, form of Fig. 1165. Diameter of bellows, 14 inches, with strong wooden stool and iron fittings, £3, 13s. 6d.

This machine is very easy to work, but not so powerful as No. 1163. It can be used with any of the smaller furnaces, but not for Nos. 3 and 4 of the blast furnaces.

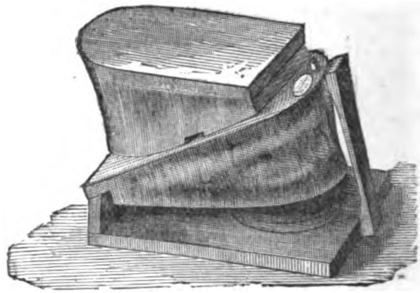
1165.

1166. Blowing Machine, consisting of a single bellows, 12 inches diameter, connected with a regulator made of india-rubber cloth, which is pressed by an iron weight, Fig. 1166, £2, 15s.

The bellows is contained in the box A, and is worked by a long lever *a*. B is the waterproof cloth regulator, which measures 15 inches square by 5 inches deep when distended. C is a plate of cast iron weighing 30 lbs., which slides freely down the round iron rods *d*, and presses uniformly on the bag. The air passes from the bellows into the bag by the tube *b*, in which there is a valve to prevent the return of the air. The air is conveyed to the furnace by the pipe *c*. The power of this apparatus is sufficient to work the miniature blast gas furnaces, No. 1155, and the two smaller sizes of oil-lamp furnaces. The supply of air from this machine is extremely uniform, and well adapted for analytical blowpipe experiments, such as those of Plattner, for a perfectly uniform blowpipe jet can be kept up by it for any length of time by giving an occasional stroke to the bellows, once or twice in five minutes.



1166.



1167A.

1167. Adaptation of the last-named Blowing Machine for high temperatures, £3, 15s.

When the Blowing Machine No. 1166 is often required to produce high temperatures, such as is necessary to fuse cast iron, it is expedient to increase the pressure by using an additional iron plate c, Fig. 1166. In that case, the pressure is so much increased on the bellows, that it is necessary to exchange it for one of stronger make, No. 1167. This machine will give air enough to melt 2 lbs. of cast iron.

1167A. Patent Continuous Blast Foot Bellows, very strongly made, also very compact and requiring small space, Fig. 1167A, india-rubber bellows.

No. 1, ...	25s. 0d.
No. 2, ...	31s. 6d.

1168. Modification of Toft's Blowpipe. Zinc reservoir, japanned, measuring 12 inches wide, 18 inches long, 26 inches deep; inclosed in a wooden box, and surmounted with a 12-inch bellows, £3, 3s.

1169. Blowing Machine, consisting of bellows, with a convenient treadle, fixed in case, with handle; useful for small operations, Fig. 1169, £2, 2s.

1170. Fanner, with 9-inch fan, and 29-inch fly-wheel, with treadle, mounted on a frame to screw to the floor, £6, 6s.

This apparatus gives a great mass of air, but the blast has little intensity. It can be used with Sefstroem's furnace, but is not effective with gas furnaces.

1169.

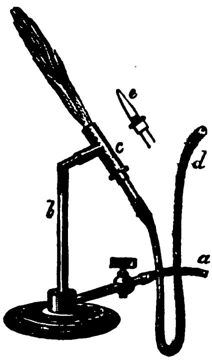
1172. Foot Blower, with caoutchouc reservoir, Fig. 1189, price 16s.
1173. A similar blower of larger size, 25s.
1174. Vulcanised caoutchouc blower, with caoutchouc regulator and connecting pipes, Figs. 4220 and 1182, 10s. 6d.
1175. A similar machine, but of larger size. See Fig. *c* and *d*, 1182, 21s.

GAS BLOWPIPES.

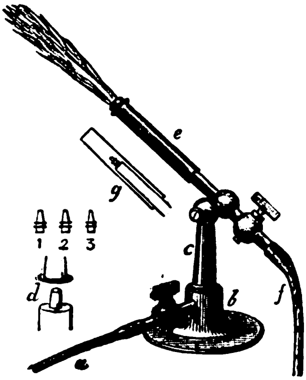
1176. Herapath's Gas Blowpipe, with a tube, through which air is blown by the mouth into the flame, Fig. 1180, 6s.

This blowpipe, invented by Mr. Herapath, Sen., of Bristol, was the original gas blowpipe, upon which so great a variety of modifications have been founded. *a* is the gas supply pipe, *d* the air tube, *c* a tube in which the gas and air are mixed, *e* the blowpipe jet of the air tube, *b* the support about which the tubes are movable.

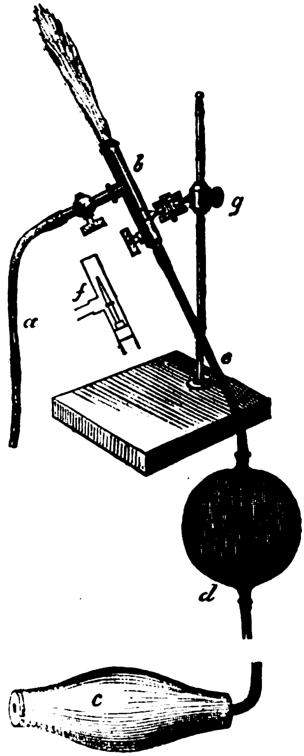
1177. Similar Gas Blowpipe, without foot and stopcock, suitable for affixing inside a Bunsen's jet, price 2s. 6d.



1180.



1181.



1182.

1181. Bunsen's Modification of Herapath's Gas Blowpipe, with two stopcocks and three brass nozzles with different orifices, Fig. 1181 (without the caoutchouc tubes), 15s.

For "Blowing Machines," see 1175.

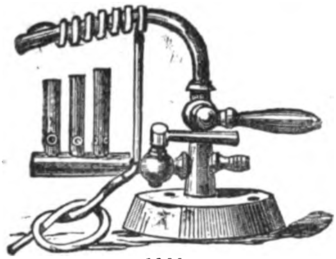
a, b, c, are pipes for the supply of gas; *f* is the tube for the blast of air—for small operations the mouth may be used, but for heating crucibles a blowing machine is necessary; *e* is the tube in which the gas and air mix; the relation of the air tube to the external gas tube is shown at *g*; *d* shows the manner of putting on the blowpipe jets, of which there are three sizes, marked 1, 2, 3. At *e* there is an outer sliding tube, by which the form and volume of the flame can be regulated.

1181A. Hot Blast Blowpipe, for temperatures above the power of ordinary gas and air blowpipes. As will be seen from the engraving, Fig. 1181*a*, the air jet is coiled round the gas pipe in a spiral form, and both are heated by three small Bunsen burners underneath, which are controlled by a separate tap. The power of this arrangement is about double that of an ordinary blowpipe; and when the jet is turned down to a small point of flame it will readily fuse a moderately thick platinum wire. In power it is nearly equal to the oxy-hydrogen jet, and it is a good arrangement both for chemical purposes and also for soldering and general use. It is made in three patterns: Fig. *a*, price 11s. 6d.; Fig. *b*, with upright jet, price 13s.; and Fig. *c*, with bench light arranged to swivel so as to carry a light to the blowpipe jet, price 15s. These are made with three sizes of jet—small for chemical purposes, medium and large for soldering, &c.; and the size of jet or purpose for which it is required should be specified in ordering. This form of blowpipe is not designed for large work.

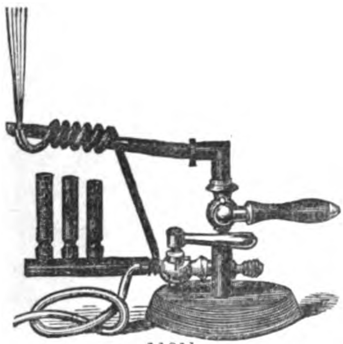
"T. Fletcher."

1182. Herapath's Gas Blowpipe, fixed on a stand, with movable joints, without the caoutchouc blowing machine, price 20s.

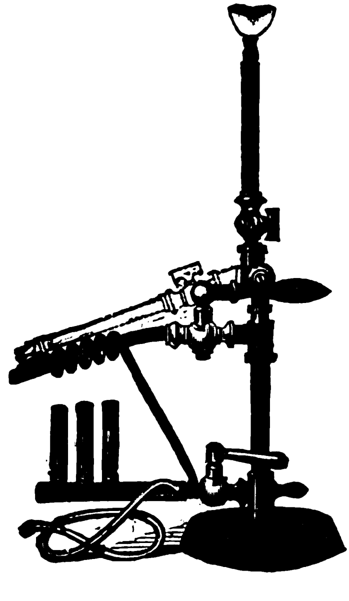
Price of Blowing Machine, see No. 1175.



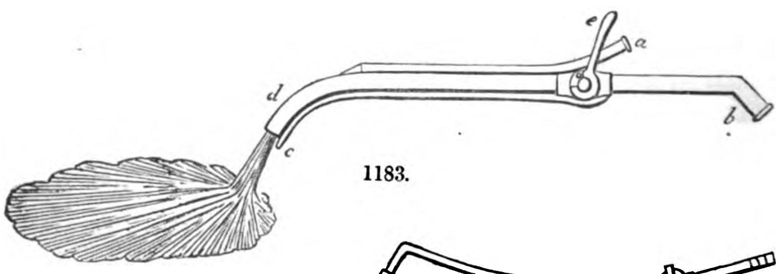
1181*a*.



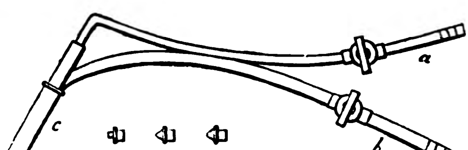
1181*b*.



1181*c*.



1183.



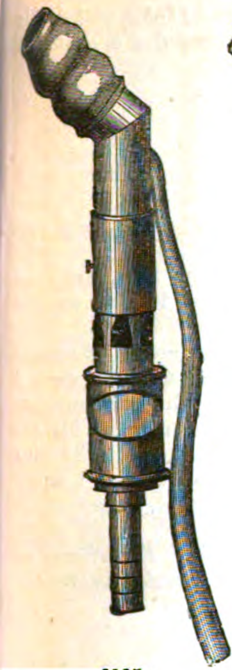
1184.

1183. **Brazier's Blowpipe**, a gas burner for the use of silversmiths, braziers, &c., Fig. 1183, 24s.

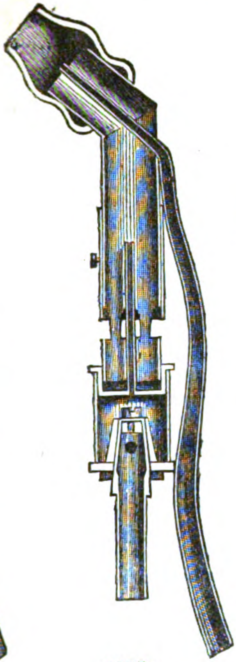
This burner keeps a very small flame constantly alight at *c*, and by means of a flexible pipe a larger jet *d* is put in connection with a blowing machine. When required for use, the spring stopcock *e* is opened, and the blowing machine set to work, upon which a large spread flame is produced which covers a surface of seven inches in diameter.

1184. **Gas Blowpipe for Soldering Lead Plates**, as in the erection of vitriol chambers, to be used with coal gas and atmospheric air, Fig. 1184, 20s.

The coal gas is supplied by the tube *b*, the atmospheric air by the tube *a*. There are three blowpipe jets, and a sliding outer tube *c*, by which, and the due management of the stopcocks, the gas and air can be mixed in proper proportions for burning. The instrument is held by the hand applied across the double tubes, above the stopcocks.

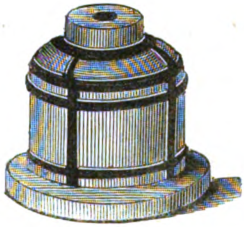


1185A.



1185B.

1187.



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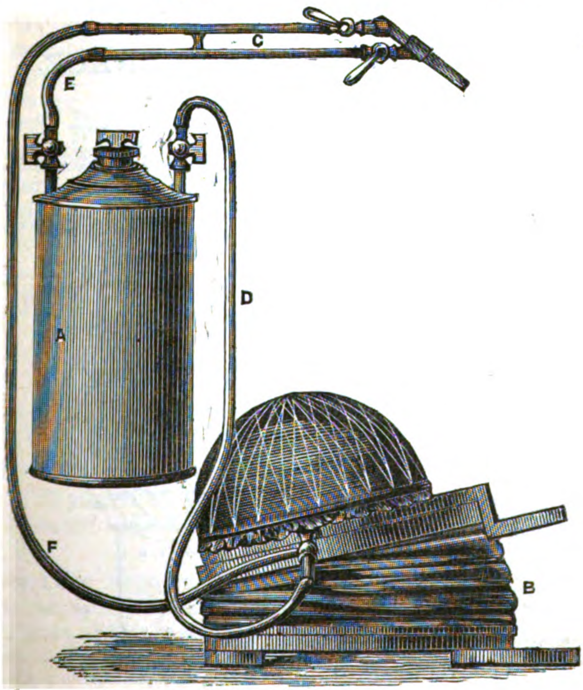


1189.

1185. Patent Regulating Gas and Air Blowpipe, Fig. 1185A and 1185B, with double valves easily regulated by the thumb and finger during the operation of blowing.

No. 1. $\frac{3}{8}$ inch,	15s.	No. 3. $\frac{5}{8}$ inch,	20s.
„ 2. $\frac{1}{2}$ „	17s.	„ 4. $\frac{3}{4}$ „	24s.

1186. **Brazing Blowpipe**, as seen in Fig. 1189; it is of small size and common make, not so powerful as Nos. 1183, 1184 or 1185, 5s.

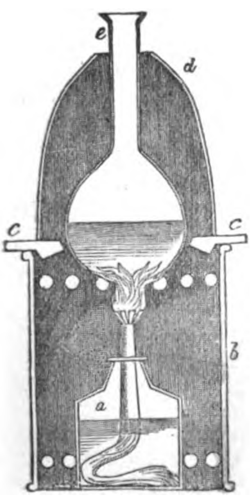
1187. Schlæsing's Gas Blowpipe, for fusions of refractory metals, etc., at high temperatures, Fig. 1187, 7s.

1188. Fireclay Reverberatory Furnace, suitable for use with the Schlæsing's Gas Blowpipe; in this furnace with high pressure of blast 1 lb. of wrought iron may be readily fused, Fig. 1188, price 6s.

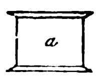
1189. Wright's Patent Gas Generator, for lighting or heating purposes. It consists of a copper vessel containing refined petroleum, and through which a stream of air is blown—and the resulting gas has a very high illuminating and heating power, Fig. 1189. The copper generators cost 31s. 6d. Any of the blast burners, from 1180 to 1187 can be used, No. 1186 being best adapted, and any of the smaller bellows, 1172 to 1175, will supply the air blast required. The rubber tube costs 7d. per foot.

GAS BLOWPIPES WITH ONE SMALL JET, *suitable for Analytical Experiments on Chemicals and Minerals, will be described in the section on* BLOWPIPE APPARATUS.

GRIFFIN'S LAMP FURNACE.



1191.



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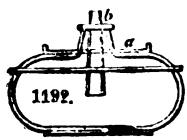

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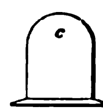

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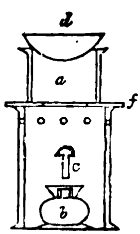

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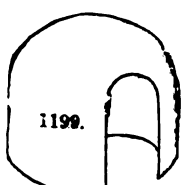

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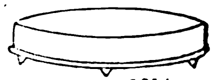
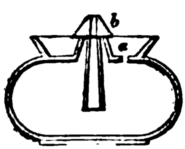


1214.



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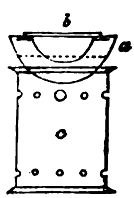
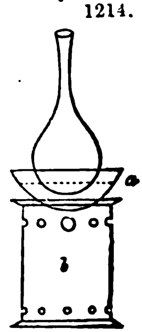
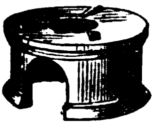


1200.

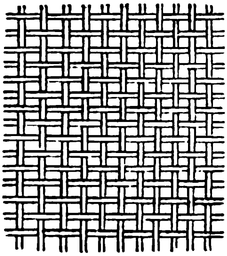


1197.

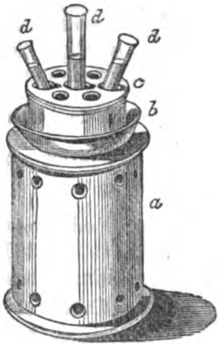
1212.



1213.



1196.



1201.

GRIFFIN'S LAMP FURNACE.

The Lamp Furnace is useful in qualitative analysis, and for other experiments with small quantities of materials, and in operations requiring only a moderate degree of heat, such as boiling, digestion, small distillation, &c. It consists of the following articles, most of them made of incorrodible saltglazed stoneware :—

1191. Stoneware Cylinder, with air-holes, intended to steady the flame of the spirit lamp, and to support vessels over it, form of Fig. 1200, and *b*, Fig. 1191, 6 inches high, 4 inches wide, 8d.

Since the introduction of gas burners, the cylinder has been made with a slit at the side for the passage of the gas-pipe. This is shown in Fig. 1212. But a taller cylinder, No. 1210, is better suited than No. 1191 for use with gas burners.

1192. Stoneware Spirit Lamp, with stoneware wick-holder *b*, and cap *c*, Fig. 1192, 8d.

1193. Stoneware Oil Lamp, with stoneware wick-holder *b*, and cup *a*, to catch the overflowing oil, useful for slow operations where gas is not procurable, Fig. 1193, 8d.

1194. Pair of Flat-iron Ring-tops for the cylinder, with perforations for supporting flasks and capsules, used as shown by *c*, Fig. 1191, and *f*, Fig. 1202 ; *per pair*, 4d.

1195. Pair of Hot Plates, or flat pieces of iron or tinplate, to support flat-bottomed vessels on the cylinder, 2d.

1196. Iron Trellis Top, to support vessels on the cylinder, Fig. 1196, 5 inches square, 2d.

1197. Tinned Iron Sand-bath, to fit the top of the cylinder, 5 inches diameter, shown by *b*, Fig. 1201, and by *a*, Fig. 1197, 4d.

1198. Stoneware Dome, to cover a flask while being heated, to economise the heat, shown by *d*, Fig. 1191, 4d.

1199. Stoneware Dome, to cover small retorts while being heated, Fig. 1199, 4d.

1120. Stoneware Water Bath, in two pieces, one to hold the water, the other for the substance to be heated, 5 inches diameter, to fit the cylinder, *a*, *b*, Fig. 1200, 8d.

1201. Stoneware Tube Support, by which glass tubes containing liquids may be kept in an upright position when heated on a sand-bath ; see Fig. 1201, where *a* is the furncae cylinder, *b* the sand-bath, No. 1197, *c* the tube support, with holes for 7 tubes, and *d*, *d*, *d*, test tubes standing in the sand, 6d.

1202. Set of Four Cylinders, adapted to heighten the lamp cylinder, No. **1191**, and adjust vessels at proper heights above the lamp, and thus regulate the heat, *a*, Fig. 1202, all of them 4 inches diameter, and respectively 2, 2½, 3, and 4 inches high; *per set*, 1s. 4d.

For the above in sets, see No. 1218.

ADDITIONAL PIECES FOR GRIFFIN'S LAMP FURNACE, *differing in size or quality from the foregoing.*

1210. Furnace Body, or Cylinder, with air-holes, saltglazed stoneware, similar to Nos. 1191 and 1212, 4 inches wide, but 8 inches high, with a slit at the side, being intended for use with gas burners, 1s.

1211. Furnace Cylinder of Saltglazed Stoneware, similar to Fig. **1191**, but of larger sizes, being 10 inches high, 9 inches diameter, and with a slit at the side, 3s.

1213. Saltglazed Stoneware Foot, Fig. 1213, intended to raise the cylinders to a proper height above lamps or gas burners, 9 inches diameter, 4½ inches high, Fig. 1213, 2s.

At No. 911, a special use for this foot is pointed out.

1214. Glazed Earthenware Pan, to place below the lamp furnace when in action, form of Fig. 1214, 9 inches diameter, 1s. 2d.

1215. The Sand-bath No. 1197, may be had in several varieties. See article on "Sand-baths and Drying Apparatus," No. 1225.

1216. A Tin-plate Still, pint size, in one piece, for distilling water, 1s. 6d.

1217. Ditto, with loose head and sieve, 2s.

GRIFFIN'S LAMP FURNACE, IN SETS.

1218. THE ORIGINAL STONEWARE LAMP FURNACE SET, comprising the seventeen articles from 1191 to No. 1202, price 6s.

1219. The same, with a glass spirit lamp instead of a stoneware spirit lamp, 6s. 6d.

1220. A SET TO USE WITH GAS, namely, the same as above, with a tall cylinder, No. 1210, and a rose gas burner, No. 973, but omitting the spirit lamp, No. 1192, the oil lamp, No. 1193, and the four cylinders, No. 1202, which are not required with a gas burner, 6s.

BATHS FOR APPLYING HEAT.

A. SAND-BATHS.

Sand-baths have been described in several instances as forming portions of particular furnaces. —See Nos. 745, 746, and 772. In the present section, only such portable sand-baths will be noticed as can be readily used over any movable source of heat, such as that of a gas furnace.

Digesting Flasks, Beaker Glasses, &c., which are apt to split when exposed to the direct flame of a lamp, are protected from that accident when a thin stratum of sand is put between the flame and the flask.

1225. SAND-BATHS, polished metal, form of *a*, Fig. 1197, or of *b*, Fig. 1201, adapted for Griffin's lamp furnace, See No. 1197, or for the rings of a retort stand, Fig. 874 *n*.

No. 1. Copper, 5 inches diameter, 8d.	No. 3. Copper, 3½ inches diameter, 5d.
2. Tin-plate, 5 „ 4d.	4. Tin-plate, 3½ „ 3d.

5. Deep form of Tin-plate sand-bath, 5 inches diameter, 6d.

1225A. Sand-baths of sheet copper or iron, Fig. 1225, but only one-third the depth.

1225.

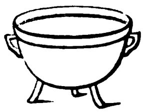
No.	Diameter.	Copper.	Iron.	No.	Diameter.	Copper.	Iron.
6.	5 inches,	6d.,	4d.	9.	8 inches,	1s. 4d.	7d.
7.	6 ,,	10d.,	5d.	10.	9 ,,	1s. 6d.	8d.
8.	7 ,,	1s. 2d.,	6d.	11.	10 ,,	1s. 8d.	11d.

1226. Cast-Iron Pots, with round bottom, for sand-baths or water-baths, form of Fig. 1226, with two handles and three legs.

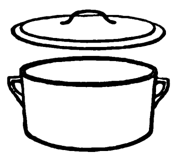
No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
1.	7 inches,	½ gallon,	9d.	3.	9 inches,	1 gallon,	1s. 3d.
2.	8 ,,	¾ ,,	1s.	4.	10 ,,	1½ ,,	1s. 9d.

1227. Shallow Cast-Iron Pans, with flat bottom, for water-baths or sand-baths, form of Fig. 1227, with two handles and flat iron covers.

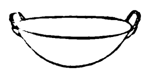
No. 1. 9 inch. wide, 4½ inch. deep, 1s. 6d. | No. 2. 10 inch. wide, 4½ inch. deep, 2s.
No. 3. 12 inches wide, 5 inches deep, 2s. 6d.



1226.



1227.



1228.

1228. Thin Cast-Iron Sand-baths, with round bottom, as represented by Fig. 1228, with two handles:

6 inch,	8d.	10 inch,	1s. 0d.	13 inch,	1s. 9d.
7 ,,	8d.	10¾ ,,	1s. 2d.	13½ ,,	2s. 0d.
8 ,,	8d.	11½ ,,	1s. 4d.	14 ,,	2s. 4d.
9 ,,	9d.	12 ,,	1s. 6d.	15 ,,	2s. 8d.
9½ ,,	10d.				

B. WATER AND STEAM BATHS.

1231. Water Bath, tin-plate, pan shape, with handle, provided with a set of rings to adapt the opening to basins of different sizes:—

No. 1. Tin Bath, 5½ inch., with set of three rings, 3s.
2. ,, 7 ,, ,, five rings, 5s.

1232. Water Bath, thin cast iron, tinned inside, with handles, Fig. 1232:—

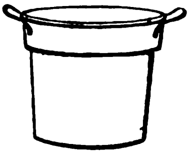
No. 0. Contents 6 pints, 6½ inches deep, 8 inches wide at top, 2s. 6d.
2. ,, 8 ,, 7 ,, 9 ,, ,, 3s. 0d.

Other sizes of this form of Water Bath can be supplied up to 13 gallons contents.

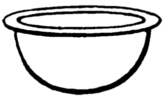
1233. Water Bath, Hemispherical, thin cast iron, lined with glazed earthenware, with flange about an inch broad, Fig. 1233:—

No.	Inside diameter.	Depth.	To fit holes.	Price.
1.	8 inch,	4 inches,	8½ inch,	4s. 0d.
3.	9½ ,,	5 ,,	10 ,,	5s. 0d.
4*a*.	11 ,,	5½ ,,	12 ,,	7s. 6d.

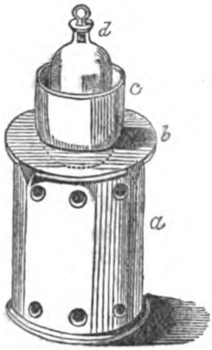
The above can be provided with tin-plate or copper covers, with holes to fit basins of any specified size.
Similar Water Baths can be supplied up to 20 inches diameter.



1232.



1233.



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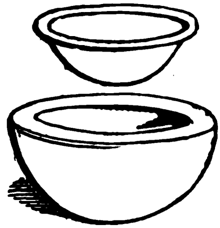
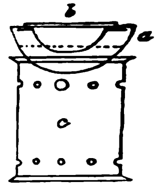
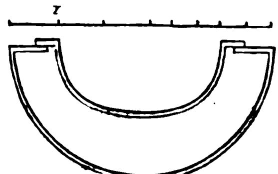


1236*a*.



1236*c*.



1236*b*.

1234. Water Bath for Bottles or other upright vessels, form of *c*, Fig. 1235, of glazed Dresden porcelain, 4 inches wide, 4 inches deep, 1s. 3d.

1235. The same Water Bath, with a saltglazed stoneware cylinder, 8 inches high, suitable for heating with gas, with metal top, Fig. 1235, 2s. 6d.

This apparatus is very handy when a solution that contains a precipitate requires to be heated, as in the precipitation of silver with chloride of sodium.

WATER BATHS, FOR DRYING POWDERS, &c., at a *steam heat.*

Water Bath, consisting of an outer boiler, and an inner capsule, shown by Figs. 1236, *a* the boiler, *b* the capsule, *c* a lamp furnace.

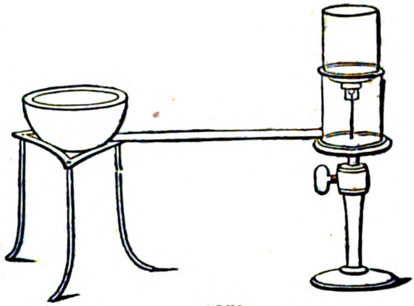
No.	Diameter of Boiler.	Contents of the Capsule.	Material.	Price.
1236.	4½ inch,	3 ounces,	Saltglazed Stoneware,	0s. 8d.
1237.	4½ "	3 "	Wedgwood Porcelain,	1s. 3d.
1238.	5 "	4½ "	"	1s. 6d.
1239.	4½ "	3 "	Berlin Porcelain,	3s. 3d.
1240.	5 "	4½ "	"	3s. 6d.
1241.	5½ "	6 "	"	5s. 6d.
1242.	3½ "	3 "	Thuringian Porcelain,	2s. 3d.
1243.	4½ "	4 "	"	3s. 0d.
1244.	6 "	8 "	"	4s. 0d.

Copper Water Bath, hemispherical, suitable for a retort-stand ring or a furnace top, with set of rings for small basins, Fig. 1248.

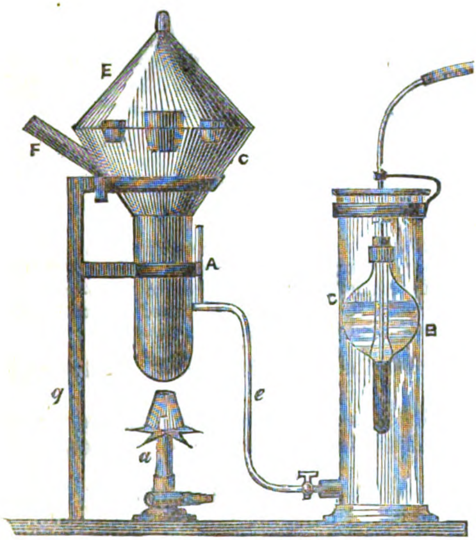
1248.	5½-inch Bath,	with	4 rings,	8s.
1249.	7 "	"	4 "	12s.
1250.	8 "	"	5 "	15s.
1251.	9 "	"	6 "	18s.

1248.

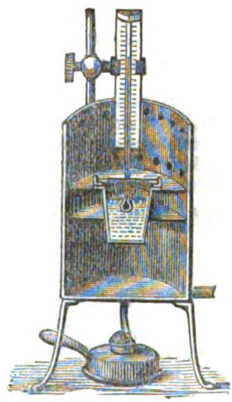
1252. Copper Water Bath, 7 inch diameter, with 4 rings, with Fresenius's contrivance for keeping the water at a constant level. Represented by Fig. 1252. This consists of a glass fountain bottle, of about 3 pints capacity, mounted in a zinc case, and connected with the water bath by a copper tube. Price, without the tripod and table support, 20s.



1252.



1253.



1254.

1253. Bunsen's Water Bath, with Regulator, by means of which one or several operations can be conducted for any length of time without disturbance or variation of either the water level or the temperature. The water supply enters by the bent pipe, and is regulated by the rise or fall of the hydrometer. The body of the evaporator is made of porcelain, Fig. 1253, 25s.

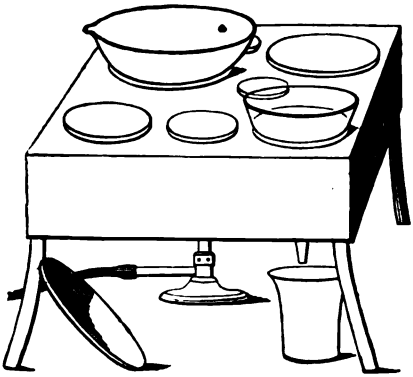
1254. Water Bath, in which to heat petroleum oils, in order to test their temperature of evaporation. Made as required by the Act of Parliament, with Thermometer, Fig. 1254, 21s.

1255. Water Bath, combined with arrangement for filtration at 212° F.

a. The bath made of japanned tin-plate, £2.

b. The bath made of polished copper, £4, 10s.

The form of this apparatus is shown by Fig. 1254. It consists of a rectangular boiler, measuring 20 inches in length, 16 inches in width, and 5 inches in depth. It is mounted on iron legs, 10 inches high, which adapt it for use with the rose gas burner No. 2 (974), with which burner, but without the rose, 3 gallons of water, which half fills the boiler, can be kept in ebullition. The side walls of the boiler descend one inch all round, to form a curtain to retain the hot air under the bottom of the boiler. There is a conical hole in which a funnel of from 5 to 7 inches in diameter can be heated, for filtrations at 212°. There are six openings measuring 1, 2, 4, 5, 6, and 8 inches in diameter for evaporating basins, with upright collars for supporting the basins, and a cover for each opening that is not in use. There are three rings for diminishing the size of the 8-inch opening, similar to the rings of the bath, No. 1248.



1255.

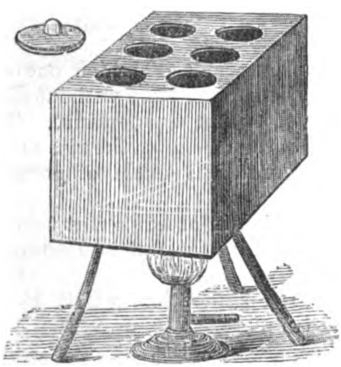
1256.

1256. Water Bath, combined with arrangement for filtration at 212° F. Smaller size than the preceding, 12s.

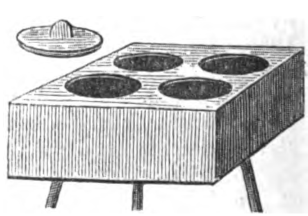
This apparatus is represented by Fig. 1256. It is made of japanned tinplate. Size, 11½ inches long, 5 inches wide, 4 inches deep. It has a conical space for a 5-inch funnel of 60°, a 5-inch opening for an evaporating basin, a 3½-inch ring for a basin, adapted to the 5-inch opening, two openings for boiling tubes, and covers to close the openings. Mounted on iron legs of suitable height for the rose burner No. 2 (974) to be placed below to boil the water.

1257. Wanklyn's Water Bath, described in his "Milk Analysis;" made of copper, form of Fig. 1256.
   a. To take 6 platinum capsules it is made 6 × 6 × 6 inches, price 12s.
   b. To take 12 platinum capsules it is made 12 × 6 × 8 inches, 21s.
   All openings have covers.

1258. Platinum Capsules for use with the above baths measure $1\frac{5}{8}$ inch diameter, price about 14s.



1257.



1259.

1259. Copper Water Bath, Fig. 1259; size, 8 × 8 × 2½ inches deep; it has four covered openings about 2½ inches diameter. Price 15s.

Tripod Supports for the above baths are described at No. 297.

C. GAS BATHS, FOR REGULATED TEMPERATURES.

The Bunsen's Gas Burners, No. 945, and the Rose Burners, No. 973, afford the means, when regulated as described at No. 1013, of producing a long-continued determinate heat. But to use that heat it is necessary to place over the burner a proper chamber to enclose the hot air and the substance to be exposed to it, thus cutting off the action of the atmosphere and loss of heat by radiation. If the apparatus is to be sustained at a given heat for a period too long to be continually watched, the supply of gas must be regulated by Bunsen's thermostat, No. 1274. It must be recollected that all objects that are exposed to the heat that rises directly from a gas burner sustain also the action of the vapour of water and the carbonic acid gas which accompany the heated air, so that such an arrangement is to be distinguished from the *Drying Baths* described in the next subdivision. The size and material of the chamber for confining the heat must depend upon the object that is to be heated. The chamber may be, for example, a cylinder of clay or a box of wood. Suppose you wish to heat a long glass tube for a considerable time at a given temperature, between 100° and 600° F., you may use a gas tube furnace, such as No. 1078, removing the bricks, and placing on the iron frame an oblong box of dry wood, open at the top and the bottom, and having, if necessary, glass sides or windows. Between the iron frame and this box must be placed 4 or 5 layers of fine iron-wire gauze. By a proper regulation of the gas jets, and a due thickness of wire gauze, it is not difficult to produce in this manner a pretty uniform atmosphere of any desired temperature under 600° F., and to keep it within a few degrees of the required point. Thus, also, by using a fireclay cylinder, and a proper arrangement of gas jets, a large included space can be brought easily up to a heat of 400° or 500°; and this kind of apparatus may be usefully employed in many technical operations.

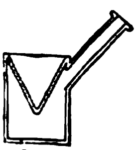
D. AIR DRYING BATHS, HEATED BY WATER OR OIL.

1260. **Water Bath** (or Oil Bath), consisting of a boiler and capsule, in one piece of porcelain, with a pipe to carry away the steam when water is used, Fig. 1260. The capsule is made conical, as shown in section by Fig. 1261, in order to fit a wet filter transferred with a precipitate from a filtering funnel of 60°. Height of the bath, 4½ inches; diameter of funnel, 4 inches. 4s. 6d.

1261. Similar Oil Bath of saltglazed stoneware, 1s. 6d.

1262. Tin Sand-Bath, to spread the heat uniformly over the bottom of the water bath, *b*, Fig. 1260, 6d.

1263. Griffin's Hot-water Bath, by which substances can be rapidly dried in a current of air at 212° F. Copper double bath, the joints hammered close and soldered, with door at the top. Inside measurement, 5 by 6 inches by 6 inches deep; outside, 7 by 7 inches by 7½ inches deep, with perforated shelf and a chimney, to draw air through the bath. 25s.



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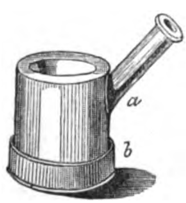
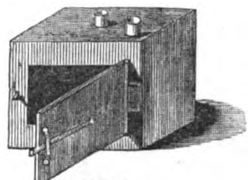
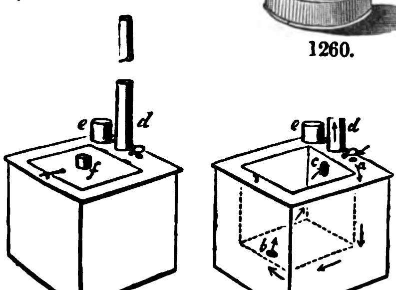


1260.



1266.



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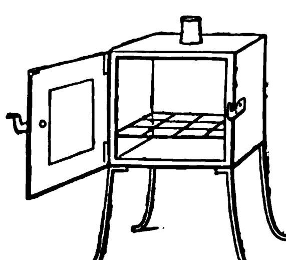


1273.

1264. Griffin's Hot-water Bath, larger size; inside, 7 by 7 inches by 7½ inches deep; outside, 9 by 9 inches by 9 inches deep. 42s.

1265. Thermometer suitable for this bath, showing 212° F., with paper scale, enclosed in glass, 1s. 9d.

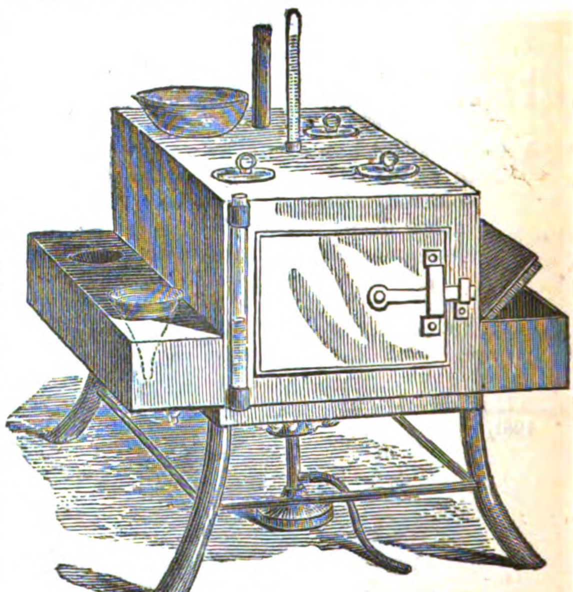
The air enters by the orifice *a*, and is carried through the hot water in the direction of the arrows by an air-tube not shown in the figure. The air thus heated goes into the drying-chamber at *b*, and escapes by the orifice *c* into the chimney *d*, upon which two extra tubes can be placed to increase the draught. When the casing contains water only, a temperature of 212° F. is easily sustained, and the change of air causes the desiccation to proceed rapidly. A movable shelf, not shown in the figure, is placed across the middle of the chamber. The tube *c* admits a thermometer into the water. The tube *f* communicates with the hot chamber.

1266. Copper Water Bath, intended for drying substances for organic analysis, &c., by means of heated water, as used in the laboratories of Liebig, Rose, &c., made of strong copper plates, the joints hammered close and soldered, Fig. 1266; size of hot chamber, 7 inches square; size of the apparatus, 9 inches square. One of the upper openings is for taking the temperature of the water, the other for ascertaining the degree of heat in the chamber. 42s.

1267. Copper Water Bath, smaller size, same pattern as Fig. 1266; size of the hot chamber, 5 by 6 inches and 6 inches deep; outside measurement, 7 by 7 inches by 7½ inches deep. 25s.

The baths of the form of Fig. 1266 are handier in use than those of the form of Fig. 1263; but the latter gain the highest temperature, dry the quickest, and can be most effectually regulated.

1267A. Will's Hot-water Bath, Fig. 1267*a*; designed by Mr. William H. Wills, of the Inland Revenue Laboratory, Somerset House. It consists of a hot-water bath, the air-chamber of which measures 10 inches wide, 7 inches high, and 8 inches from back to front; a pair of hot-water funnels, a hot-air box for drying test tubes, &c., and four openings with covers on the top for platinum evaporating capsules. It is provided with a water-gauge glass beside the door, and is supported on a four-legged stool.



1267*a*.

This apparatus is very convenient for general laboratory purposes, and is excellently suited for use in food analysis. Price £3, 13s. 6d.

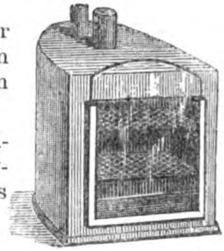
1268. Copper Oil Bath, form of Fig. 1266, thick metal, brazed joints, outside measure, 6 inches wide, 5 inches high, 5 inches from front to back; size of hot chamber, 4 inches wide, 3 inches high, 3½ inches from front to back. 31s. 6d.

1269. Copper Oil Bath, thick metal, brazed and riveted; size of hot chamber, 7 inches square, 6 inches high; outside measurement of the bath, 9 inches square, 8 inches high. £3, 3s.

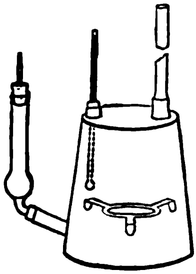
E. AIR DRYING BATHS, WITHOUT WATER OR OIL.

1273. Fresenius's Copper-air Bath, with trellis shelf, and door in front; mounted on iron legs; size of the warm chamber, 6 inches wide, 5 inches high, 4½ inches from front to back, Fig. 1273, page 127, 21s.

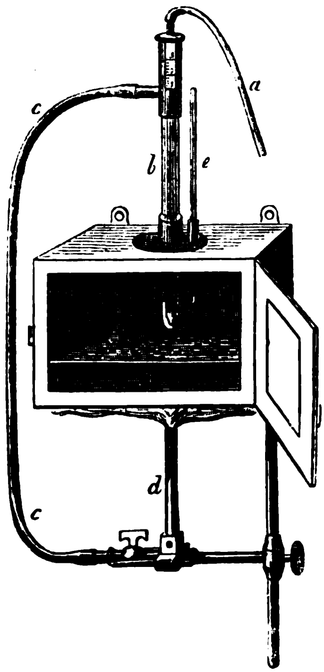
1273A. Hot Air Bath, semicircular, of Copper, having a sliding glass front, two openings at top and two movable wire-gauze shelves; size 5½ inches high, 5 inches wide, and 4½ inches from back to front, 14s.

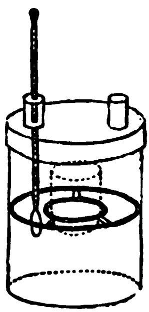


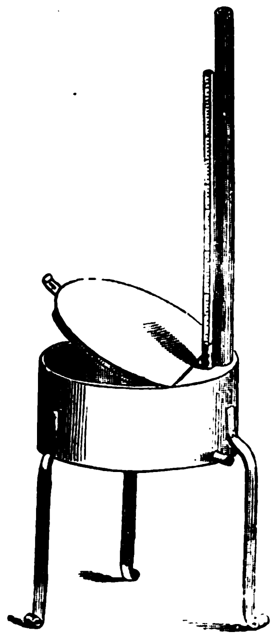
1273*a*.



1278.







1276. 1274. 1279.

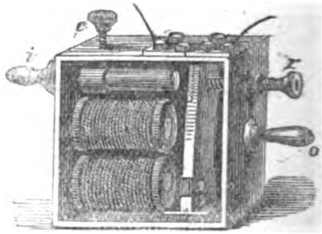
1274. Bunsen's Hot-air Bath, with modification of Kemp's regulator, to cause the supply of gas to produce a constant temperature. Copper bath, with hooks to hang it to a wall; size of hot room, 7 inches wide, 4¾ inches high, 5 inches from front to back. Price, with regulator for the flow of gas, but without thermometer and gas burner, Fig. 1274, 25s.

1274A. The Regulator without the bath, 6s.

The regulation of the temperature is effected by increasing or diminishing the supply of gas to the burner *d*. This is managed by the action of the apparatus marked *a*, *b*, *c*. The gas enters by *a*, passes into a narrow tube which is continued for about two-thirds of the length of *b*, and is open at the lower end. The gas escapes there and passes out by the tube *c* to supply the burner *d*. The lower part of the tube *b* is cut off from the upper by a diaphragm, and it contains mercury; a small tube open at both ends passes through the diaphragm to the bottom of the mercury. There is a scale and a screw at the upper end of the tube *b*, by which the proper supply of gas can be regulated at the commencement of a process. Supposing the apparatus to be in action, as represented by the figure, if the heat becomes greater than is required, the air enclosed above the mercury in the lower chamber expands and drives out the mercury, which rises in the tube *b*, and closes the lower end of the continuation of the supply pipe *a*. But, in order to prevent the extinction of the flame at *d*, the inner supply pipe is either pierced with a small hole which remains always open, or the lower part of the tube is provided with fine slits, which permit a slight passage of gas when the bottom is closed. When the heat falls in the bath, the air enclosed in the tube *b* condenses, the mercury falls, and a greater supply of gas is admitted to the burner.

1275. Scheibler's Gas Regulator, in which the flow of gas is governed by the action of the armature of an electro-magnet on the orifice of the inlet pipe *i*, Fig. 1275, 35s.

The screw *r* is to prevent the armature receding too far; *o* is the outlet, and the screw *c* is to prevent the extinguishment of the burner when the armature has completely closed the inlet pipe *i*, by permitting the passage of gas through a small hole in *i*.


1275.

Rammelsberg's Hot-air Bath, form of Fig. 1276, made of copper. The substance to be dried is put in a crucible, and fixed in the centre of the bath. The apparatus is set over a spirit lamp, or gas light, and one or two thermometers are introduced through the necks in the lid to ascertain the temperature, 2 sizes.

1276. 4 inches high, 3½ inches wide, 8s.; 1277. 5 inches high, 3½ inches wide, 10s.

1278. Rammelsberg's Hot-air Bath, made of brass, with a neck at which a chloride of calcium tube may be attached for securing a current of dry air through the bath, 4 inches high, 4 inches wide, conical form, Fig. 1278, 8s.

Taylor's Hot-air Bath, for drying powders, &c., in a current of hot air, to any temperature up to 360° F.; form of Fig. 1279, circular chamber, 3½ inches deep and 8½ inches diameter.

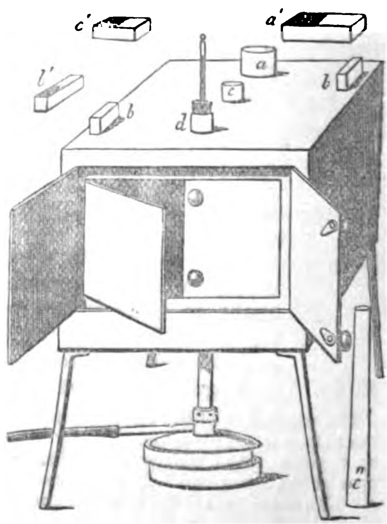
1279. Japanned Tin-plate, 15s. 1280. Copper, 30s.

1281. Griffin's Hot-Air Bath, for drying substances in a rapid current of hot air, kept within a few degrees of any desired temperature up to 500° F. Form of Fig. 1281, but without legs.

Price, without Thermometer and Gas Burner, £3, 10s.

This apparatus consists of a copper chamber, measuring 12 inches from left to right, 9 inches from top to bottom, and 8 inches from front to back. This chamber is enclosed in a case made of stout sheet iron, which measures 14 inches from left to right, 12 inches from top to bottom, and 11 inches from front to back. There is, consequently, a clear space of at least an inch all round between the copper chamber and the iron case. Hot air rising from a rose gas burner is made to pass continuously through this space, while a rapid current of heated atmospheric air is made to pass through the copper chamber containing the objects that are to be dried. The arrangement for carrying out this plan is as follows:—

Production and Regulation of the Heat.—The bottom of the iron case has a round hole in the middle rather wider than the head of the rose gas burner No. 2 (974). This burner being lighted and applied there, air rushes up through the flame into the space between the copper chamber and the iron case, and passes out by a chimney at the top, marked *a* in the figure. If it is desired to diminish the draught, the cap *a'* is put upon the neck *a*. This cap has an oblong form. When pulled to the right, it opens the chimney *a* entirely. When pushed to the left, it closes it more or less as may be desired.

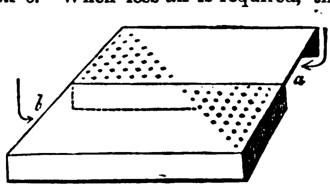


1281.

Attention to this chimney must be combined with due attention to the burner. The latter can be fully or only partially supplied with gas, and it may be pushed up close to the copper chamber, or be lowered two or three inches from it, the clay plates shown in Fig. 1281, being used to regulate the height of the burner. A ledge or partition of copper runs along the front lower edge of the copper chamber, and closes the space between that chamber and the iron case. A similar ledge runs along the back upper edge of the copper chamber. The former is intended to prevent the rising of the flame from the gas burner into the copper chamber when the front doors are opened; the latter serves to prevent the flame passing directly from the gas burner up the back of the chamber and out at the chimney *a*. The effect of these obstructions is to force the hot air to rise up on each side of the chamber, and to pass over the top, to make its way to the chimney *a*. On applying a chimney such as *c″* to the neck *a*, and removing the flame, the whole apparatus is rapidly cooled.

Circulation of Hot Air through the Copper Chamber.—The copper chamber has a false bottom, which is divided into two compartments, as shown by Fig. 1282. It is a sort of shelf or stool that lies about an inch above the solid bottom of the chamber. Each half of the space included between the true and false bottom is open at one end and closed at the other, and the surface is perforated in the manner shown by the figure. Air passes into the enclosed spaces by two flat copper tubes, the upper ends of which are marked *b b* in Fig. 1281, and the lower ends of which communicate with the open ends of the spaces marked by arrows in Fig. 1282. These air tubes are fixed in the space between the copper chamber and the iron case, and being exposed to the hot air that rises from the gas burner, while the flame of the burner acts directly upon the solid bottom of the chamber, the air supplied by these tubes becomes rapidly and strongly heated, and is delivered in that condition through the holes in Fig. 1282, into the hot chamber, from which it escapes by the two openings *c d*, after passing over the objects that are placed in the chamber.

Regulation of the Current of Air.—When a strong current of air is required, the tubes *b b* are both left open, and the chimney *c″* is placed upon the neck *c*. When less air is required, the chimney *c″* is taken off, or is replaced by the oblong cap *c′*, by which the chimney *c* can either be entirely obstructed or opened to any desired degree. The draught of air *into* the chamber can also be regulated by two caps of the form of *b′*, which are adapted to the openings *b b*, and can open or shut the passage to any necessary degree by merely sliding along them. The neck *d* can be closed by a cap, or it can be used for the insertion of a thermometer to indicate the temperature of the hot chamber. The four pipes, *b*, *b*, *c*, *d*, shown in Fig. 1281, are all in communication with the copper chamber, and pass through holes in the top of the iron case. The chimney *a* alone communicates with the space between the two chambers.



1282.

This construction of the apparatus enables the operator, by attention to the gas burner and the chimney *a*, *a′*, to regulate the amount of heat applied, and by attention to the ventilators, *b*, *b′*, and *c*, *c′*, *c″*, to regulate the circulation of air through the drying chamber.

For operations that do not demand a drying heat beyond 300° F., the small rose gas burner No. 973, is sufficiently powerful; but when a higher temperature is required, and especially when a large quantity of air is to be forced through the chamber, the rose burner No. 974, is requisite.

The iron case and the copper chamber are separately opened, by double doors, in front, as represented in Fig. 1281. The copper chamber contains two movable stools, to sustain capsules, crucibles, &c.

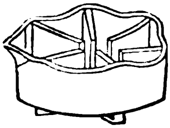
F. APPARATUS FOR DRYING POWDERS IN A VACUUM.

Leslie's Apparatus for Freezing Water, Desiccators, &c.

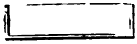
The articles in this subdivision do not properly belong to the section on the "Application of Heat;" but they are placed here because it is convenient to have in one group an account of the different methods employed to dry powders at a definite temperature. Apparatus used in the drying of gases will be described in the section respecting "Gas Apparatus."

1285. Desiccating Pan, to contain sulphuric acid, for drying substances in vacuo, or under a glass receiver; with numerous partitions and indented edges for the ready support of capsules, Fig. 1285.

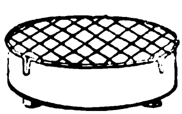
No. 1.	Berlin Porcelain,	4½	inch diameter,	6	partitions,	4s. 0d.
2.	Dresden Porcelain,	4	„	3	„	2s. 6d.
3.	„	5	„	3	„	3s. 0d.
4.	„	5	„	6	„	4s. 0d.
5.	Thuringian Porcelain,	4½	„	6	„	3s. 6d.
6.	„	5½	„	6	„	4s. 0d.
7.	„	6	„	6	„	4s. 6d.



1285.



1286.



1287.

1286. Desiccating Pan, of Saltglazed Stoneware, to contain sulphuric acid, for drying substances in vacuo, cylindrical form, flat bottom, Figs. 1286, 1287, 2 inches deep :—

6 inch diameter, 1s. | 8 inch, 1s. 3d. | 10 inch, 1s. 6d.

1287. Brass Trellis Tops for the stoneware pans, to support vessels over the sulphuric acid, Fig. 1287 :—

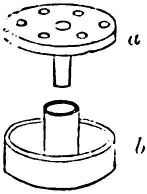
6 inch, 1s. 6d. | 8 inch, 1s. 9d. | 10 inch, 2s.

1288. Desiccating Pan, to contain sulphuric acid, for drying substances in vacuo, form of *b*, Fig. 1288 ; white Berlin semi-porcelain, glazed ; three sizes :—

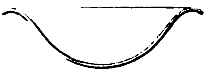
$4\frac{1}{2}$ inch, 1s. 6d. | 5 inch, 1s. 9d. | 6 inch, 2s.

1289. Perforated Wood Table, *a*, Fig. 1288, adapted to the pan No. 1288, and suited to support either funnels or capsules, see Fig. 1294 :—

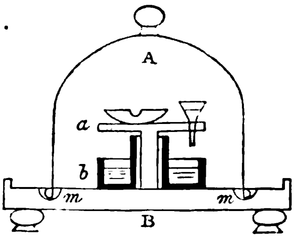
5 inch diameter, 1s. 6d. | 6 inch, 1s. 9d. | 8 inch, 2s.



1288.



1291.



1294.

Bell-Shaped Glass Receivers, with stout edges, well ground, suitable for these experiments. See No. 655.

1290. Leslie's Apparatus for Freezing Water over oil of vitriol in vacuo, consisting of a flat bell-shaped receiver for the air-pump, a porcelain pan for the acid, and a glass capsule for the water. There should be half an inch in depth of the strongest oil of vitriol. The pump must be well screwed up, and the receiver greased to fit close. Price of a set to suit Tate's Air Pump, No. 650, 7s. 6d.

1291. Porous Clay Evaporating Basins, for holding water over sulphuric acid in vacuo, in order to be converted into ice, form of Fig. 1291 :—

4 inch, 8d. | 5 inch, 1s. 4d. | 6 inch, 1s. 8d. | 8 inch, 2s.

1292. In using this desiccating apparatus, the acid pan, half full of concentrated sulphuric acid, is placed on the plate of an air pump, or on one of the separate plates described at No. 687, and being covered with a flat gas receiver, such as No. 655, the air pump is set in action, and the receiver is exhausted. The stopcock is then closed, and the apparatus allowed to rest till the required effect is produced. The entire apparatus is represented by Fig. 650.

1293. Leslie's Original Apparatus for the Freezing of Water (see article Cold in the "Encyclopædia Britannica") consisted of a powerful air pump with single vertical barrel, connected with a large wooden table, on which were fixed six pump-plates, connected separately by pipes and stopcocks with the pump. That was a very expensive and cumbrous form of apparatus.

The production of several portions of ice, each over a separate pan of sulphuric acid, can be much more conveniently effected by using a series of separate tables, such as are described at No. 687, each of them fitted with a flat glass receiver, an acid pan, and a porous water dish of the kind that has just been described; the size of these parts being chosen to suit the power of the pump and the required quantity of ice. The choice of the pump depends upon the principles explained at paragraph 653. The glass receiver should be no larger than barely to cover the vessels that contain the acid and the water. A larger capacity is injurious. In a room at the temperature of 62° F., half a pound of water can be readily frozen in this apparatus, with the aid of the pump No. 653.

When the freezing of water by the air pump is to be shown as a class experiment, the acid should be concentrated, and the pump, the acid, and the water, all be kept as cold as possible, see page 58.

1294. DESICCATION IN CONFINED AIR.

Desiccating Apparatus, for drying powders and crystals, and condensing aqueous solutions, by the action of sulphuric acid, confined in a limited quantity of air under a glass receiver without the use of an air pump, Fig. 1294. This apparatus consists of a glass receiver A, or of a japanned tinplate dome of the same form, the rim of which dips into a circular groove *m m*, turned in a flat wooden base *b*, and which contains either mercury or oil. The acid pan *b*, and the perforated table *a*, have been already explained at Nos. 1288 and 1289. This was an apparatus used by Berzelius, and the figure exhibits the process clearly; but the wooden base is now advantageously replaced by a ground glass plate, as described in the next article.

1295. SOLID SQUARE GLASS PLATES, ¼-inch thick, ground upon the upper surface, so that glass receivers ground and greased on the edge fit them air-tight. These are used with acid pans and glass receivers in the manner represented by Fig. 1294, and with every form of acid pan from No. 1285 to No. 1288. The plates are square, and the price is according to the diameter:—

7 inch, 1s. 6d.	10 inch, 3s. 0d.	12 inch, 4s. 6d.
8 inch, 2s. 0d.	11 inch, 3s. 6d.	14 inch, 6s. 0d.
9 inch, 2s. 6d.		

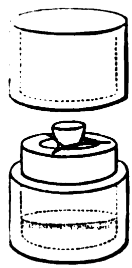
GLASS RECEIVERS. See No. 655.

1296. EXSICCATOR, on portable stand, Fig. 1296; the glass plate is 6 inches in diameter. Price 8s. Porcelain pan, No. 1285, 4s. extra.

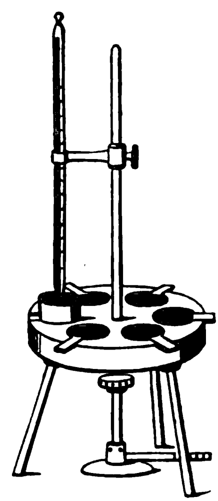
1296A. EXSICCATOR, a divided glass vessel, for drying substances in a confined atmosphere over sulphuric acid, or for cooling crucibles before weighing, Fig. 1296*a*. The vessels are of Bohemian glass, with ground and polished edges that fit together in the middle, where a pierced metal diaphragm fits on the lower vessel; 6 inches high, 4 inches diameter. 4s. 6d.

1297. FRESENIUS'S DRYING DISC, for drying five powders at a time at the same given temperature, Fig. 1297, 63s.

1296.



1296*a*.



1297.

This apparatus consists of a flat circular block of iron, which measures 8 inches in diameter, and 2 inches in thickness, and weighs about 19 lbs. It is turned smooth and provided with 6 cavities, similar in size, and at equal distances from the centre. In one of these cavities a thermometer is bedded in iron filings, and the other five cavities are exactly filled by five turned brass pans, which are 2 inches in diameter and ¾ inch deep, to contain the substances which are to be dried. The heat is applied below the centre of the iron block. The apparatus is used by Fresenius in drying manganese ores for analysis, and is useful when many samples require to be rapidly tried at the same temperature.

SCHRÖTTER'S DESICCATOR, for cooling substances in dry atmospheric air at ordinary atmospheric pressure.

1298. Price of the apparatus Fig. 1298 *b, d, e, f, g*, without the plate *a* and the acid pan *c*, but with a receiver 7 inches wide and $7\frac{1}{4}$ inches high, 9s.

1299. Price of a plain ground glass plate for it; size, 8 inches square, 2s.

1300. Price of the tube *d, e, f*, unfitted, 2s. 6d.

For other sizes of Receivers and Ground Plates, see Nos. 673 to 678 and 1295.

Description.—*a* is a separate air-pump plate, No. 687. Instead of this, a plain square ground glass plate unmounted, No. 1295, may be used; *b* is an air-pump receiver, No. 675; *c*, a divided porcelain dish to contain sulphuric acid, No. 1285, upon the divisions of which the warm crucible is placed; *d, e, f*, a combination of three glass tubes; *g*, a small chloride of calcium tube; *h*, a glass tube affixed to the cork *i*, below the point of the tube *d*. A small quantity of sulphuric acid is put into the tube *d*, so as to cover the holes in the tube *e*.—*Use.* When the apparatus is put over the hot crucible the expanded air passes out by the tubes *f* and *e* through the sulphuric acid in *d*, and finally through the chloride of calcium tube *g*. When the apparatus cools, atmospheric air re-enters to establish an equilibrium in the receiver *b*, through the tubes *g, d, e, f*. If in doing so a little sulphuric acid is carried over mechanically, it is deposited in the tube *h*, suspended for its reception.

When the cooled crucible is removed from this apparatus the substance within it is saturated with dry air at common pressure, and therefore is not disposed to attract moist air, as is the case when the crucible is cooled in air rarefied by heat.

ASSAY SHADES, to keep off dust and damp from preparations that are intended for analysis, while being weighed, &c.

1301. Small Bell Receiver, with glass plate; diameter of the receiver and plate, 5 inches, Figs. 1301, *a b*, 1s. 6d.

1302. Bell Receiver with glass capsule, the receiver 3 inches wide, the basin 4 inches wide, both ground on the edges, Fig. 1302, 1s. 6d.

1303. Glass Basin with cover, the basin 3 inches wide, Fig. 1303, 1s. 6d.

1304. Ditto, the basin 4 inches wide, 2s.

1305. Glass Capsules, watch-glass form, ground on the edge, and fitted in pairs, to protect filters and hygroscopic substances from damp while being weighed. Per pair: $1\frac{1}{2}$-inch, 6d.; 2-inch, 6d.; $2\frac{1}{2}$-inch, 7d.; 3-inch, 8d.

1306. Brass Spring Clips, for holding the pair of capsules close together while being weighed, form of Fig. 1306, 6d.

1307. Ditto, form of Fig. 1307, 6d.

1308. Glass Plate, Tray, and oblong Bell Receiver, to protect substances from moisture during weighing, Bohemian glass, three pieces, all ground to fit exactly; weight of the whole between 150 and 250 grains. Price of the set in a box, 4s.

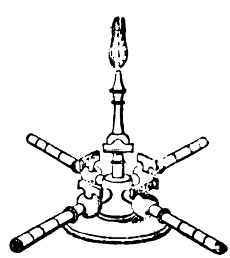
1309. Very light Glass Tubes in which to weigh dried filters:—

3-inch × $\frac{3}{4}$-inch, $1\frac{1}{2}$d; 4-inch × 1-inch, $1\frac{1}{2}$d.

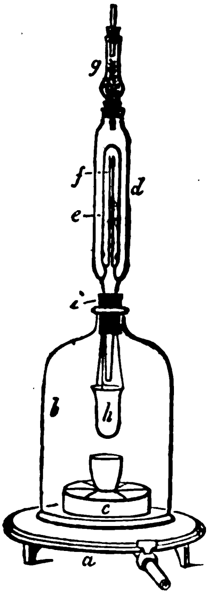
1310. Ditto, about 4 × 1 inch, with light ground stoppers, 9d.

1311. Gas Distributor, with five stopcocks, Fig. 1310, 7s.

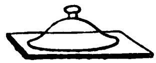
1312. Ditto, superior style, with best stopcocks, 18s.


1310.

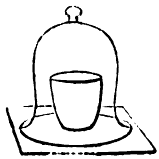
It is sometimes necessary, on a lecture-table or in a laboratory, to use several gas burners at once, where there happens to be only one supply pipe, or one source of gas. The apparatus represented by Fig. 1310 is then useful. One of its tubes can be attached to the supply pipe, and the three others to as many different burners or furnaces. The vertical tube, terminating in a very small jet, serves to keep a light always ready.



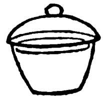
1298.



1301*a*.

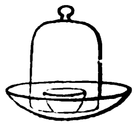


1301*b*.



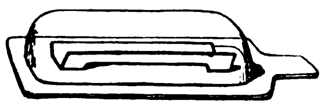
1303.

1306.

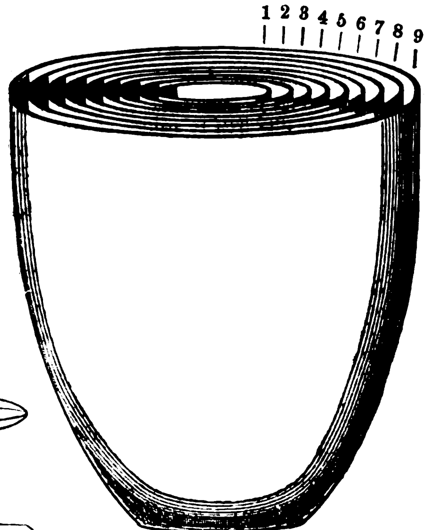


1302.

1307.



1308.



1320.

CRUCIBLES.

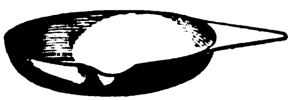
CRUCIBLES—CLASS 1, PLATINUM.

1320. **Platinum Crucibles**, with covers, form of Fig. 1320.

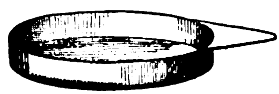
No.	Diameter.	Depth.	Contents.	Weight.	Price.
1.	$\frac{5}{8}$ inch,	$\frac{3}{4}$ inch,	1 drachm,	60 grains,	12s.
2.	$\frac{3}{4}$,,	1 ,,	2 ,,	100 ,,	18s.
3.	1 ,,	$1\frac{1}{8}$,,	4 ,,	280 ,,	£1, 10s.
4.	$1\frac{1}{8}$,,	$1\frac{1}{4}$,,	5 ,,	400 ,,	£2, 2s.
5.	$1\frac{1}{4}$,,	$1\frac{1}{2}$,,	7 ,,	500 ,,	£2, 12s.
6.	$1\frac{1}{2}$,,	$1\frac{5}{8}$,,	$1\frac{1}{4}$ ounce,	600 ,,	£3, 3s.
7.	$1\frac{3}{4}$,,	$1\frac{3}{4}$,,	$1\frac{5}{8}$,,	750 ,,	£4, 0s.
8.	2 ,,	$1\frac{7}{8}$,,	2 ,,	950 ,,	£5, 0s.
9.	$2\frac{1}{4}$,,	2 ,,	$2\frac{3}{4}$,,	1400 ,,	£7, 7s.

The prices are merely approximate. They change with the market price of the metal, and still more with variations in the thickness of the metal.

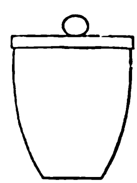
When a particular thickness of metal is desired, it should be ordered with reference to the scale of metal thicknesses given in No. 38, page 3. The weights given in the table, generally speaking, are for such thin light crucibles as can be most readily heated over a spirit lamp. When greater strength is required, the crucibles must be made heavier.



1321*a*.



1321*b*.



1321*c*.

1321. **Covers for Platinum Crucibles** may be made either to bend over the outside of the crucible, as represented by Fig. 1321*c*, or in the form of capsules, Figs. 1321 *a* and *b*, which kinds can, in fact, be used as capsules. The approximate prices of platinum capsules will be found under the head of Evaporation.

SILVER CRUCIBLES, of any size, made to order.

CRUCIBLES—CLASS 2, PORCELAIN.

Porcelain crucibles are preferable to those of platinum for igniting soils to destroy organic matter, because in some cases the ignition of soils containing oxide of iron causes oxide of iron and, perhaps, metallic iron to adhere so strongly to a platinum crucible, that it can only be detached by using aqua regia, which damages the platinum. When, therefore, the purpose is simply to destroy organic matter in a soil, a porcelain crucible should be used.

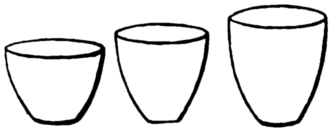
1322. *Comparison of the Shapes of the Thin Light Conical Porcelain Crucibles produced by different Manufacturers.*—Although crucibles made by the same manufacturer at different times are never exactly alike, those from each manufactory have a general character which may be pointed out for the guidance of those who wish to procure crucibles of a peculiar form. Fig. 1322, *a*, *b*, *c*, represent the three principal varieties of German porcelain crucibles. Fig. *b* is the form of the Berlin crucible, *c* that of the Dresden or Meissen crucible, and *a*, that of the Thuringian crucible. The latter is glazed inside, but biscuit outside. The two former are glazed all over, except the bottom outside. In general, the Dresden are the thinnest, and the Berlin the thickest of the three kinds.

1323. **Berlin Porcelain Crucibles**, best quality, very thin, highly glazed on both sides, conical form, Fig. 1323, with covers, Government stamp.

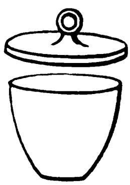
No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
000.	1 inch,	$\frac{1}{8}$ ounce,	3d.	2.	$2\frac{1}{4}$ inch,	1 ounce,	1s. 0d.
00.	$1\frac{1}{4}$,,	$\frac{1}{4}$,,	5d.	3.	$2\frac{1}{2}$,,	2 ,,	1s. 3d.
0.	$1\frac{1}{2}$,,	$\frac{3}{8}$,,	6d.	4.	3 ,,	4 ,,	1s. 5d.
1.	$1\frac{3}{4}$,,	$\frac{1}{2}$,,	9d.	5.	$3\frac{1}{2}$,,	8 ,,	1s. 8d.

1323A. Berlin Porcelain Crucibles, similar and equal in quality to those described at No. 1323, but without the Government stamp.

No. 000.	2s. 8d.	per dozen.	No. 2.	10s. 6d.	per dozen.
,, 00.	4s. 6d.	,,	,, 3.	12s. 6d.	,,
,, 0.	5s. 6d.	,,	,, 4.	15s. 6d.	,,
,, 1.	6s. 6d.	,,	,, 5.	17s. 0d.	,,



a. 1322*b.* *c.*



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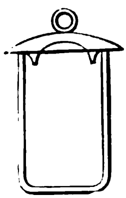
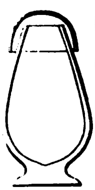
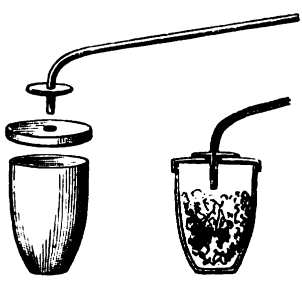


1324.



1327.

1326.



1328.

1324. Berlin Porcelain Crucibles, Liebig's form, Fig. 1324, cylindrical, with cover, glazed on both sides :—

No. 1. 1 inch diameter, $1\frac{1}{4}$ inch high, $\frac{1}{2}$ ounce, 8d.
2. $1\frac{1}{2}$,, $1\frac{3}{4}$,, 1 ,, 10d.

1326. Berlin Porcelain Crucibles, conical form, Fig. 1326, for fusing nitrate of silver, &c. Biscuit, with perforated cover, to permit the escape of gases.

No.	Height.	Width.	Contents.	Price.
1.	2½ inch,	1½ inch,	1 ounce,	8d.
2.	3¼ ,,	2 ,,	2¾ ,,	8d.

1327. Berlin Porcelain Assayers' Crucibles, Fig. 1327, biscuit, with perforated cover.

No.	Height.	Diameter in the Middle.	Contents.	Price.
1.	3¾ inch,	2 inch,	3 ounces,	1s. 4d.
2.	4½ ,,	2¾ ,,	6 ,,	1s. 8d.

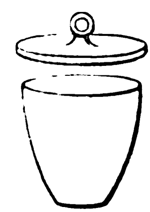
1328. Berlin Porcelain Apparatus for exposing substances to the action of oxygen or hydrogen gas at a red heat; consisting of a crucible, a perforated cover, and a gas-leading tube, all of biscuit porcelain, and fitted to one another, complete, Fig. 1328, 4s. 6d.

1328A. The flanged tube alone, 4s. | 1328B. The crucible and cover, 8d.

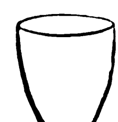
1329. The above Crucible, Cover and Tube of biscuit porcelain, Dresden ware, 2s.

1331. Dresden Porcelain Crucibles, extremely thin and light, conical form, Fig. 1331, glazed both inside and outside, with covers.

No.	Diameter.	Depth.	Capacity.	Price.	Per Doz.
1.	3 inch,	2⅝ inch,	6 ounces,	1s. 6d.	16s. 0d.
2.	2¾ ,,	2⅜ ,,	4 ,,	1s. 2d.	12s. 0d.
3.	2½ ,,	2 ,,	3 ,,	1s. 0d.	10s. 0d.
4.	2¼ ,,	1⅞ ,,	2 ,,	10d.	9s. 0d.
5.	1¾ ,,	1⅝ ,,	1⅜ ,,	9d.	7s. 0d.
6.	1⅝ ,,	1⅜ ,,	6½ drachms,	8d.	6s. 6d.
7.	1⅜ ,,	1⅛ ,,	4½ ,,	7d.	6s. 0d.
8.	1⅛ ,,	⅞ ,,	2½ ,,	6d.	5s. 6d.
9.	1 ,,	¾ ,,	40 grains,	5d.	5s. 0d.
10.	⅝ ,,	½ ,,	15 ,,	5d.	5s. 0d.
11.	½ ,,	1/16 ,,	10 ,,	5d.	5s. 0d.



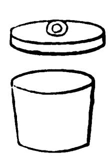
1331.



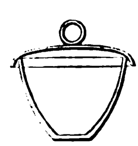
1332.

1332. Dresden Crucibles, Nos. 9, 10, 11, without covers, Fig. 1332, at 3d. *each*.

1333. Plattner's Blowpipe Crucible, Dresden porcelain, conical, with flat bottom, Fig. 1333, glazed, very thin, for use in the qualitative analysis of minerals by the blowpipe, with cover, 1-inch high, 1½-inch diameter, contents ½-ounce, 6d.



1333.



1335.

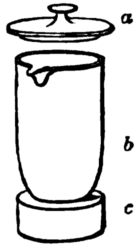
1335.

1334. The same, without the cover, 4d.

1335. Thuringian Porcelain Crucibles, conical form, wide mouth, with cover, Figs. 1335 and 1322*a*, glazed inside, biscuit outside.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
1.	1 inch,	¼ ounce,	4d.	6.	2¾ inch.	3 ounces.	10d.
2.	1¼ ,,	½ ,,	5d.	7.	3 ,,	4 ,,	1s. 0d.
3.	2 ,,	1 ,,	6d.	8.	3¼ ,,	6 ,,	1s. 3d.
4.	2¼ ,,	2 ,,	7d.	9.	3⅝ ,,	8 ,,	1s. 8d.
5.	2½ ,,	2½ ,,	8d.		*The Set of Nine,*		6s. 6d.

1336. Thuringian Porcelain Crucibles, biscuit inside and outside, suitable for fusions at high temperatures, with spout, tall and narrow, form of Fig. 1336 : *a* the cover, *b* the crucible, *c* the support to put below it in a furnace.



1336.

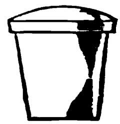
The following prices include Crucible and Cover, but not the Support:—

No.	Contents.	Price.	No.	Contents.	Price.
1.	½ ounce,	4d.	7.	8 ounce,	1s. 4d.
2.	1 „	5d.	8.	12 „	1s. 6d.
3.	2 „	6d.	9.	16 „	1s. 9d.
4.	4 „	10d.	10.	24 „	2s. 0d.
5.	5 „	1s. 0d.	11.	32 „	2s. 6d.
6.	6 „	1s. 2d.			

1337. Crucibles of the above quality and sizes, *glazed inside*, with covers, at the following prices :—

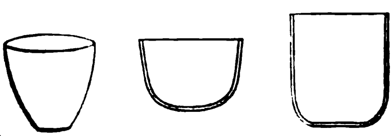
No. 1.	5d.	No. 4.	1s. 0d.	No. 7.	1s. 8d.	No. 10.	2s. 6d.
„ 2.	6d.	„ 5.	1s. 2d.	„ 8.	1s. 10d.	„ 11.	3s. 0d.
„ 3.	7d.	„ 6.	1s. 4d.	„ 9.	2s. 0d.		

1339. Berlin Semi-Porcelain Crucibles, glazed within and without, with covers, form of Fig. 1339.


1339.

No. 1.	5 ounces,	9d.	No. 3.	10 ounces,	1s. 3d.
„ 2.	8 „	1s. 0d.	„ 4.	16 „	1s. 6d.

1343. Porcelain Cups, for use in ignitions, as uncovered crucibles. Many varieties are figured and described under the head of "Evaporation." These cups are often of great use in chemical operations, that are performed with small quantities of materials. As a substance may be dissolved in an acid, its solution be evaporated to dryness, and the dry product be ignited in one vessel. See Plattner's *Treatise on the Blowpipe*, especially the sections on the Analysis of Minerals and Metalliferous Substances by the Combination of the Wet and Dry Processes of Analysis.


1343.

CRUCIBLES—CLASS 3, PLUMBAGO.

1346. Patent Plumbago Crucibles, suitable for the fusion of the most refractory metals, gold, silver, brass, copper, steel, iron, &c. ; not subject to crack, and may be used repeatedly for most metals. Fig. 1346.

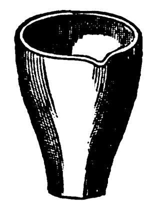

1346.

Each No. is equal to the bulk of $2\frac{1}{10}$-lbs. of copper.

No.	*Per dozen.*	No.	*Per dozen.*	No.	*Each.*	No.	*Each*
00.	3s. 0d.	10.	45s.	30.	11s.	70.	25s.
0.	3s. 0d.	12.	54s.	35.	13s.	80.	30s.
1.	4s. 6d.	14.	63s.	40	15s.	90.	34s.
2.	9s. 0d,	16.	72s.	50	18s.	100.	37s.
4.	18s. 0d.	18.	80s.	60.	22s.	200.	74s.
6.	27s. 0d.	20.	90s.				
8.	36s. 0d.	25.	112s.				

1347. Covers for Patent Plumbago Crucibles, all sizes, at $1\frac{1}{4}$d. per Number.
1350. Blocks of Patent Plumbago, to support crucibles in the furnace, at $1\frac{1}{4}$d. per Number.
1351. Plumbago Stirrers, best quality, per dozen, 16s.

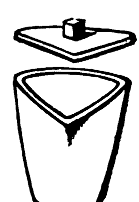
CRUCIBLES.—CLASS 4, FIRECLAY.



1352.

1352. London-made Fireclay Crucibles, round conical form, of the best manufacture, capable of resisting high temperatures and the action of fluxes, will retain melted copper and cast iron, and, when heated to *softening*, they retain their compact structure, and do not become vesicular.

No.	Height.	Price. Per Dozen.	Covers. Per Dozen.	No.	Height.	Price. Per Dozen.	Covers. Per Dozen.
1.	$2\frac{1}{2}$ inch,	8d.	8d.	6.	$6\frac{1}{2}$ inch,	5s.	2s. 9d.
2.	$2\frac{3}{4}$,,	1s. 0d.	8d.	$6\frac{1}{2}$.	$6\frac{7}{8}$,,	7s.	3s. 6d.
3.	$3\frac{3}{8}$,,	1s. 4d.	1s. 0d.	7.	$7\frac{1}{4}$,,	9s.	4s. 6d.
$3\frac{1}{2}$.	$3\frac{5}{8}$,,	1s. 9d.	1s. 4d.	8.	$8\frac{1}{4}$,,	12s.	4s. 6d.
4.	$4\frac{1}{4}$,,	2s. 0d.	1s. 4d.	9.	$9\frac{1}{4}$,,	15s.	5s. 0d.
$4\frac{1}{2}$.	$4\frac{3}{4}$,,	2s. 9d.	1s. 9d.	10.	10 ,,	21s.	6s. 6d.
5.	$5\frac{1}{4}$,,	3s. 6d.	2s. 0d.	11.	11 ,,	27s.	7s. 0d.
$5\frac{1}{2}$.	$5\frac{1}{2}$,,	4s. 0d.	2s. 9d.	12.	12 ,,	34s.	9s. 0d.



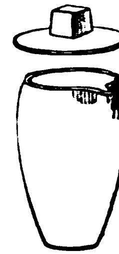
1354.

1353. London-made Fireclay Crucibles, of *triangular* form, Fig. 1354, at the same prices as the Round Crucibles, No. 1352.
1354. Hessian Crucibles, refractory fireclay, triangular, Fig. 1354.

Sizes, .	No. 1,	2,	3,	4,	5,	6,	7,	8,	9,	10.
Inches high,	1,	2,	$2\frac{1}{2}$,	3,	$3\frac{1}{2}$,	$4\frac{1}{2}$,	$6\frac{3}{4}$,	7,	8,	$9\frac{1}{2}$.

No.	Prices of Nests.			Single Crucibles per Dozen.	
1.	Nest of 3,	No. 2 to 4,	4d.	No. 1.	5d.
2.	,, 5, small,	1 ,, 5,	7d.	2.	9d.
3.	,, 5, large,	2 ,, 6,	10d.	3.	1s. 6d.
4.	,, 6, ,,	2 ,, 7,	1s. 8d.	4.	3s. 0d.
5.	,, 8, ,,	1 ,, 8,	2s. 0d.	5.	4s. 0d.
6.	,, 10, ,,	1 ,, 10,	7s. 0d.	6.	5s. 6d.
				7.	8s. 6d.
				8.	11s. 0d.

1360. French Assay Crucibles, or Fluxing Pots, from the factory of Beaufay; soft, white material, smooth surface, tall narrow form (Fig. 1360), with spout. Covers charged separately. *At market prices.*



1360.

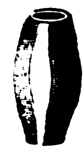
1360A. English White Fluxing Pots, similar to the French in form and material. Per dozen :—

Nos.	1.	2.	3.	4.	5.	6.
Pots,	1s. 9d.,	2s. 9d.,	3s. 0d.,	3s. 6d.,	4s. 6d.,	5s. 6d.
Covers,	1s. 9d.,	1s. 9d.,	1s. 9d.,	2s. 9d.,	2s. 9d.,	2s. 9d.

Nos.	8.	10.	12.	13.	14.	16.
Pots,	7s. 0d.,	11s. 0d.,	18s. 0d.,	25s. 0d.,	30s. 0d.,	40s. 0d.
Covers,	3s. 6d.,	3s. 6d.,	5s. 6d.,	6s. 6d.,	7s. 6d.,	11s. 0d.

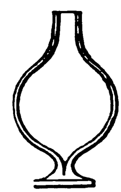
1361. Skittle Pots, fireclay, without covers, for purifying jewellers' sweep, &c. Price per dozen :—

3	4	5	6	7	8	9	inches.
2s. 3d.,	3s. 0d.,	3s. 6d.,	4s. 6d.,	5s. 0d.,	6s. 6d.,	8s. 6d.	per doz.
10	11	12	14	16	18	20	inches.
10s. 6d.,	13s. 0d.,	15s. 0d.,	25s. 0d.,	34s. 0d.,	59s. 0d.,	84s. 0d.	per doz.



1361.

1362. Metallurgists' Crucibles (Poelons), of refractory fireclay, for the reduction and fusion of metals, globular form, narrow mouth; on foot, Fig. 1362, 3½ inches high. 5s. per dozen.



1362.

1365. Fireclay Supports for Crucibles in a Furnace, to keep them at a distance from the grate :—

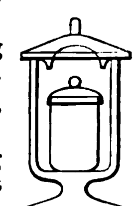
No.	Height.	Diameter.	Price.
1.	1¼ inch,	1½ inch,	3d.
2.	1¼ "	2 "	4d.
3.	1¼ "	3½ "	5d.
4.	1¼ "	7 "	9d.
5.	1¾ inch,	6 inch,	1s. 0d.
6.	3 "	6 "	1s. 2d.
7.	4¼ "	6 "	1s. 6d.

1366. Crucible Cases of refractory fireclay, with feet and covers, Fig. 1366, intended to protect Porcelain or Platinum Crucibles from contact with the coal in a fire, and to elevate them to a proper height above the grate. 4 inches deep, 3 inches wide, 1s., and smaller.

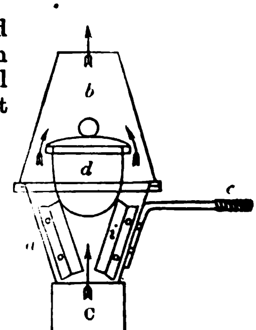
1367. Infusible Fireclay Stirrers, for mixing powders in crucibles. See No. 110.

1368. Crucible Tongs. See Tongs, No. 120, page 11.

1369. Iron Crucible Jacket, for supporting a Platinum Crucible over a Spirit Lamp, Fig. 1369, 1s. 6d.



1366.



1369.

The Crucible Jacket is intended to hold a crucible over a spirit lamp in such a manner as to exclude all atmospheric air, except what passes up the chimney of the lamp. The crucible is supported by three knife edges, so placed as not to obstruct the action of the flame. C, chimney of the spirit lamp; *a*, crucible jacket with the knife edges *i*; *b*, movable cover; *c*, handle with screw adapted to the thumbscrew of a lamp rod; *d*, the crucible. The arrows show the direction of the flame.

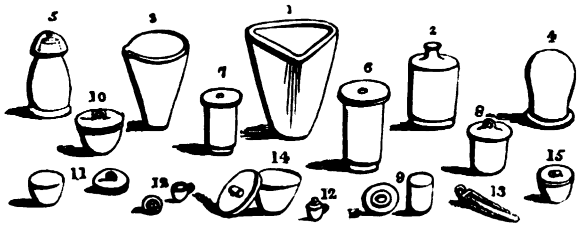
CRUCIBLES.—CLASS 5, IRON.

1370. Thin Cast-iron Crucibles, form of Fig. 1333, with Covers:—

No. 1.	2 inches high,	2 inches wide,	contents	$3\frac{1}{2}$ oz.,	9d.
2.	$2\frac{1}{4}$ „	$2\frac{1}{4}$ „	„	5 „	1s. 0d.
3.	3 „	$2\frac{1}{2}$ „	„	8 „	1s. 6d.
4.	The set of Three Crucibles,	.	.	. .	3s. 0d.

1371. Wrought-iron Crucible, stout, form of Fig. 1371, without cover, 4 inches, 4s. 6d.

1371.



1372.

TUBE OPERATIONS.

Only porcelain tubes and iron tubes will be noticed here. Operations with glass tubes are described in many other sections. See Gas Combustion Furnace, Nos. 1051 to 1090, the Articles on "Organic Analysis," and on "Apparatus for Experiments with Gases."

PORCELAIN TUBES.

Porcelain Tubes for containing substances that are to be exposed to heat in a furnace while gases are passed over them, or for exposing a current of any gas to the action of heat.

The furnaces suitable for use with tubes are described at Nos. 846 and 1064.

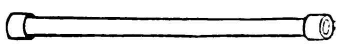
1373. Tubes of Berlin Porcelain, without collars, glazed both inside and outside.

These can be supplied of the following diameters, namely, $\frac{1}{2}$, $\frac{3}{4}$, $1\frac{1}{8}$, $1\frac{1}{2}$, 2, and $2\frac{1}{4}$ inches, and of any length from 12 inches up to 52 inches. The following sizes are generally kept in stock:—

No.	Diam.	Length.	Price.	No.	Diam.	Length.	Price.	No.	Diam.	Length.	Price.
1.	$\frac{1}{2}$ in.	12 in.	1s. 6d.	6.	$\frac{3}{4}$ in.	35 in.	9s.	11.	$1\frac{1}{8}$ in.	40 in.	15s.
2.	$\frac{1}{2}$ „	20 „	3s. 0d.	7.	$\frac{3}{4}$ „	40 „	12s.	12.	$1\frac{1}{2}$ „	26 „	12s.
3.	$\frac{1}{2}$ „	26 „	4s. 0d.	8.	$1\frac{1}{8}$ „	20 „	6s.	13.	$1\frac{1}{2}$ „	35 „	16s.
4.	$\frac{3}{4}$ „	20 „	4s. 6d.	9.	$1\frac{1}{8}$ „	26 „	9s.	14.	2 „	35 „	18s.
5.	$\frac{3}{4}$ „	26 „	6s. 0d.	10.	$1\frac{1}{8}$ „	35 „	14s.	15.	$2\frac{1}{4}$ „	52 „	27s.

The sizes are stated in Prussian inches, which are about $\frac{1}{34}$ longer than English inches.

1374. Tubes of Dresden Porcelain, with collar at each end (Fig. 1374), glazed inside, biscuit outside; length, 24 inches.



1374.

No. 1.	Bore $1\frac{3}{8}$ inch,	4s.	No. 3.	Bore $\frac{5}{8}$ inch,	2s. 3d.
2.	„ 1 „	3s.	4.	„ $\frac{3}{8}$ „	1s. 9d.

1375. Tubes of Thuringian Porcelain, Fig. 1374, but with collar at one end only, glazed inside, biscuit outside; bore $\frac{3}{4}$ inch, outside diameter about 1 inch. Price according to length, as follows:—

12 inches,	1s. 0d.	21 inches,	2s. 6d.	30 inches,	4s. 6d.
18 „	1s. 8d.	24 „	3s. 0d.		

1376. Tube of Thuringian Porcelain, glazed inside and outside, for exciting electricity; $24\frac{1}{2}$ inches long, $1\frac{1}{4}$ inch bore, and nearly 2 inches outside diameter, without collar, 4s. 6d.

1377. Tubes of Thuringian Porcelain, with a collar at one end and a small neck at the other, to enable them to be fitted together for conducting gases or liquids, 36 inches long, bore $1\frac{3}{4}$ inch, outside diameter $2\frac{1}{4}$ inch, 8s.

1378. Tubes of Wedgwood's Porcelain, 18 inches long:—

1 inch bore, 2s. 6d.	$1\frac{1}{2}$ inch bore, 2s. 8d.	2 inch bore, 4s.

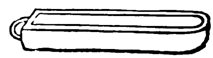
1379. Tubes of Berlin Semi-Porcelain:—

Diam.	Length.	Price.	Diam.	Length.	Price.	Diam.	Length.	Price.
$\frac{1}{4}$ inch,	12 inches,	2s. 9d.	1 inch,	12 inches,	5s. 6d.	$1\frac{1}{2}$ inch,	12 inches,	8s. 6d.
$\frac{1}{2}$ "	12 "	4s. 0d.	1 "	20 "	9s. 0d.	$1\frac{1}{2}$ "	20 "	10s. 0d.
$\frac{1}{2}$ "	20 "	5s. 6d.	1 "	24 "	10s. 6d.	$1\frac{1}{2}$ "	24 "	16s. 6d.
$\frac{1}{2}$ "	24 "	7s. 6d.						

1380. Boat-shaped Trays, of Porcelain, to contain solid substances which are to have gases passed over them while they are heated to redness in tubes.

No. 1. $2\frac{1}{4}$ inches long,	$\frac{1}{2}$ inch wide,	Berlin Porcelain,		6d.
2. 3 "	$\frac{1}{2}$ "	"		6d.
3. 4 "	$\frac{1}{2}$ "	"		6d.
4. 3 "	$\frac{1}{2}$ "	Thuringian Porcelain,		4d.
5. 3 "	$\frac{1}{2}$ "	Meissen	"	5d.
6. 3 "	$\frac{3}{8}$ "	"	"	4d.
7. $5\frac{1}{2}$ "	$1\frac{1}{4}$ "	"	"	8d.

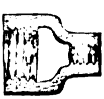
8. Boat-shaped Tray of Platinum, *price, according to weight,* 15s. to 21s.



1380.

IRON PIPES AND JOINTS.

1381. Iron Pipes are frequently required in the construction of chemical apparatus; such as the arrangements for the conveyance of gases, for the prolongation of the necks of iron retorts when used for destructive distillation, or in the preparation of gases, for containing substances to be exposed to a red heat in a furnace, while subjected to the action of a current of some kind of gas, and for various other purposes. I give here, therefore, some account of the pipes, joints, and fittings in most frequent demand, with a list of their prices. The pieces are all provided, at the given prices, with the screws represented in the figures, which fit well together, but these prices do not include the cost of the fitting together of these pieces into special complex forms of apparatus, or of attaching them to retorts, &c., on which additional screws require to be cut. Such compound apparatus is priced according to the amount of work it requires.



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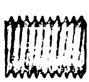

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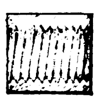

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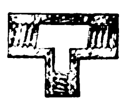

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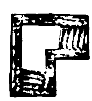

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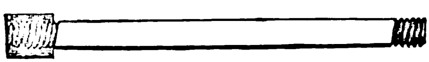

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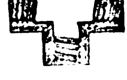

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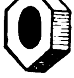
1386.



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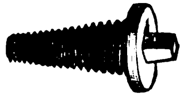


1391.

Fig.	Bore of the Pipe in inches.	2		$1\frac{1}{2}$		$1\frac{1}{4}$		1		$\frac{3}{4}$		$\frac{1}{2}$		$\frac{3}{8}$		$\frac{1}{4}$	
		s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
1382	Long pipes, *per foot,*	1	9	1	1		10		7		5		5		4		4
1383	Short pipes, *per foot,*	3	0	2	0	1	9	1	3	1	0		9		7		6
1384	Elbow-joint,	3	9	2	3	1	9	1	0		10		8		7		7
1385	Diminishing elbow-joint,	3	9	2	3	1	9	1	0		10		8		7		7
1386	Elbow-bend,	3	9	2	3	1	9	1	0		10		8		7		7
1387	Plain socket,	1	0		8		7		5		4		3		3		3
1388	Nipple,	1	3		9		7		6		5		5		5		4
1389	Diminishing socket,	1	3		9		8		6		5		5		5		4
1390	Cap,	1	3		9		7		6		5		5		5		4
1391	Plug,	1	3		9		7		6		5		5		5		4
1392	Back nut,	1	3		9		7		6		5		5		5		4
1393	Tee-piece,	4	0	2	6	2	0	1	6	1	2		9		8		7
1394	Cross-piece,	6	0	3	6	3	0	2	3	1	9	1	6	1	3	1	1

1395. *Explanation.*—The standard for size is the *bore of the iron pipe.* Thus, under 1 *inch bore,* the prices are quoted of joints the screws of which fit the screws on a pipe of 1 inch bore. By *long pipes* is meant any pipe not less than 2 feet long, nor more than 12 feet long. By *short pipes,* all lengths that are less than 2 feet. The elbow-joint, Fig. 1384, is for connecting two pipes at a right angle. The diminishing elbow-joint, Fig. 1385, serves this purpose for pipes that differ in their bore. The elbow-bend, Fig. 1386, makes a joint with a curve. The plain socket, Fig. 1387, and the nipple, Fig. 1388, serve to connect two pipes of the same bore, and in the same straight line. The diminishing socket, Fig. 1389, is used to connect two pipes of different sizes in the same straight line. The cap, Fig. 1390, and plug, Fig. 1391, serve to close the ends of pipes. The back nut, Fig. 1392, is employed to make a tight joint. The cross-piece, Fig. 1394, and the tee-piece, Fig. 1393, are used to connect together pipes that run in several directions.

1396. Iron Melting Ladles, with long handles, for the granulation of zinc and the fusion of cements, tin, lead, bismuth, antimony, &c.

$1\frac{1}{2}$ inch bowl, 6d.; 2 inch, 7d.; $2\frac{1}{2}$ inch, 8d.; 3 inch, 9d.; 4 inch, 10d.; 5 inch, 1s.

A special Gas Furnace, for melting zinc, lead, &c., is described at No. 1008.

Iron Pots, for melting lead, zinc, and other easily fusible metals, are described at Nos. 1226, 1227.

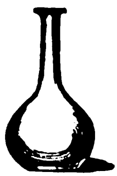
Vessels for preparing Solutions.

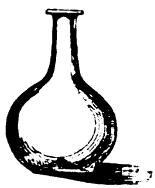
FLASKS.
WOULFF'S BOTTLES.
BEAKERS.
PORCELAIN BOILERS.
DIGESTERS.
JARS WITHOUT FEET.
JARS WITH FEET.
STOPPERED JARS.
PANS.

FLASKS.

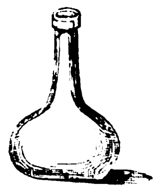
The sizes are expressed in OUNCES *of water, the* PINT *containing* 20 OUNCES.

1400. **German Hard Glass Flasks**, flat bottoms, with phial lip, uniform in substance, form of Figs. 1400 and 1401. Sometimes the largest sizes are welted like Fig. 1404*a*.


1400.


1401.


1404*a*.


1404*b*.

PRICE PER DOZEN.

1 ounce,	1s. 6d.	8 ounces,	3s. 3d.	1¼ pint,	6s. 6d.	4 pints,	15s.
2 ,,	2s. 0d.	9 ,,	3s. 6d.	1½ ,,	7s. 0d.	4½ ,,	16s.
2½ ,,	2s. 0d.	10 ,,	4s. 0d.	1¾ ,,	8s. 0d.	5 ,,	17s.
3 ,,	2s. 0d.	12 ,,	4s. 3d.	2 ,,	9s. 0d.	6 ,,	18s.
4 ,,	2s. 3d.	14 ,,	4s. 6d.	2½ ,,	10s. 0d.	7 ,,	24s.
5 ,,	2s. 6d.	16 ,,	5s. 0d.	3 ,,	12s. 0d.	8 ,,	26s.
6 ,,	2s. 9d.	18 ,,	5s. 6d.	3½ ,,	14s. 0d.	10 ,,	28s.
7 ,,	3s. 0d.	1 pint,	6s. 0d.				

1401. **Bohemian Hard Glass Flasks**, best quality, made of the same glass as the hard Bohemian beakers, and of the same shape as the flasks No. 1400—namely, those under 3 pints, of the form of Figs. 1400 and 1401; above 3 pints, sometimes of the form of Fig. 1404*a*, *b*.

PRICE PER DOZEN.

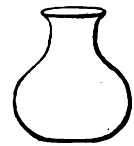
1 ounce,	3s. 0d.	7 ounces,	5s. 6d.	18 ounces,	8s. 6d.	4 pints,	16s. 0d.
2 ,,	3s. 0d.	8 ,,	6s. 0d.	1 pint,	9s. 0d.	5 ,,	20s. 0d.
2½ ,,	3s. 0d.	9 ,,	6s. 6d.	1¼ ,,	10s. 0d.	6 ,,	24s. 0d.
3 ,,	3s. 3d.	10 ,,	7s. 0d.	1½ ,,	10s. 6d.	7 ,,	28s. 0d.
4 ,,	4s. 0d.	12 ,,	7s. 0d.	2 pints,	12s. 0d.	8 ,,	30s. 0d.
5 ,,	4s. 6d.	14 ,,	7s. 6d.	2½ ,,	13s. 0d.	9 ,,	31s. 6d.
6 ,,	5s. 0d.	16 ,,	8s. 0d.	3 ,,	14s. 0d.	10 ,,	33s. 0d.

1402. **Mixing Flasks**, namely, hard German or Bohemian globular flasks, with flat bottoms, form of Fig. 1402, with very short and wide necks, for use as Mixing Flasks in Centigrade Testing. Contents, 3 to 4 ounces. Per dozen, 3s.

1403. **French Flasks**, white glass, Fig. 1400, flat bottom and phial lip for corking, no punty mark.

PRICE PER DOZEN.

1	ounce,	1s. 3d.	10	ounces,	3s. 3d.
2	,,	1s. 4d.	12	,,	3s. 6d.
3	,,	1s. 5d.	14	,,	4s. 0d.
4	,,	1s. 6d.	16	,,	4s. 6d.
4½	,,	1s. 9d.	18	,,	4s. 9d.
5	,,	2s. 0d.	1	pint,	5s. 0d.
6	,,	2s. 3d.	1¼	,,	5s. 6d.
7	,,	2s. 6d.	1½	,,	6s. 0d.
8	,,	2s. 9d.	1¾	,,	7s. 0d.
9	,,	3s. 0d.	2	,,	8s. 0d.



1402.

1404. **French Flasks**, crown glass, slightly tinted with green, globular form, with thin flat bottom, the mouths welted and ground, form of Fig. 1404 *a, b*.

PRICE PER DOZEN.

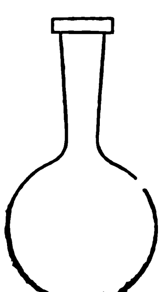
1	ounce,	1s. 2d.	9	ounces,	2s. 9d.	1¾	pints,	6s. 0d.
2	,,	1s. 3d.	10	,,	3s. 0d.	2	,,	7s. 0d.
3	,,	1s. 4d.	12	,,	3s. 6d.	2½	,,	8s. 0d.
4	,,	1s. 5d.	14	,,	3s. 9d.	3	,,	9s. 0d.
4½	,,	1s. 6d.	16	,,	4s. 0d.	3½	,,	10s. 6d.
5	,,	1s. 9d.	18	,,	4s. 3d.	4	,,	12s. 6d.
6	,,	2s. 0d.	1	pint,	4s. 6d.	5	,,	16s. 0d.
7	,,	2s. 3d.	1¼	,,	5s. 0d.	6	,,	20s. 0d.
8	,,	2s. 6d.	1½	,,	5s. 6d.	8	,,	24s. 0d.

1405. **French Ballons**, or Flasks of globular form, round bottom, with short, wide necks, and welted and ground mouths, Figs. 1405 *a, b*, white glass. These serve also as plain receivers, for use with retorts in distillation.

PRICE PER DOZEN.

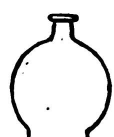
1 to 2½	ounces,	2s. 0d.	16	ounces,	4s. 6d.	2½	pints,	10s. 0d.
3 and 4	,,	2s. 3d.	18	,,	4s. 9d.	3	,,	12s. 0d.
5 and 6	,,	2s. 6d.	1	pint,	5s. 0d.	3½	,,	14s. 0d.
7 and 8	,,	3s. 0d.	1¼	,,	6s. 0d.	4	,,	16s. 0d.
9 and 10	,,	3s. 6d.	1½	,,	7s. 0d.	5	,,	18s. 0d.
12	,,	3s. 9d.	1¾	,,	8s. 0d.	6	,,	24s. 0d.
14	,,	4s. 0d.	2	pints,	9s. 0d.	8	,,	30s. 0d.

1405*a*.



1405*b*.

1406.



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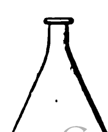


1408.

1409.

1406. Bohemian Gas Bottles, upright form, Fig. 1406; hard glass, uniformly thin, with welted and ground mouth. Price per dozen :—

½ pint,	8s.	2 pints,	12s.	4 pints,	18s.
1 „	10s.	3 „	15s.	5 „	24s.

1407. Flasks to fix on a ring over a lamp or gas burner, Fig. 1407, Bohemian glass,

3 ounces, 5s. per doz.	6 ounces, 8s. per doz.	10 ounces, 10s. 6d. per doz.
4 „ 6s. „	8 „ 9s. „	20 „ 14s. 0d. „

1408. Triangular Flasks, for exposing a large surface of solid matter to the action of a liquid, or for boiling a liquid with rapidity over a rose gas burner, Fig. 1408; best hard white Bohemian glass, uniform in substance, with turned-over mouth for corking.

¼ pint,	9d.	1 pint,	1s. 6d.	2½ pints,	2s. 3d.
½ „	1s. 0d.	1½ „	1s. 9d.	3 „	2s. 6d.
¾ „	1s. 3d.	2 „	2s. 0d.	4 „	3s. 0d.

1409. Pear-shaped Flask, round bottom, and tapering gradually to the neck, which is about ¾ inch diameter, and turned over for corking, Fig. 1409; fine white French glass. Contents, 16 ounces; per dozen, 3s. 6d.

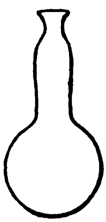
1410. Globular Flask, with wide cylindrical neck, having a contraction near the mouth; fine white hard German glass, Fig. 1410.

10 ounces, 9d.	20 ounces, 1s.	35 ounces, 1s. 6d.

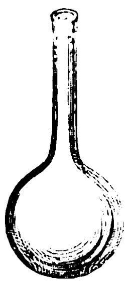
1411. Bolt Heads, or Globular Flasks, Fig. 1411; hard white Bohemian glass.

¼ pint,	6d.	1 pint,	9d.	4 pints,	1s. 6d.
½ „	8d.	2 „	1s.	6 „	2s. 6d.

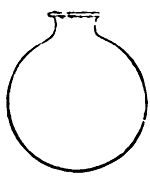
1412. Bolt Heads, of hard white glass, Fig. 1411, the globe from 8 to 12 inches diameter, the neck about 18 inches long and 3 inches diameter; white German glass. 10 to 12 pints, 5s. 6d. each; 17 to 20 pints, 6s. 6d. each.



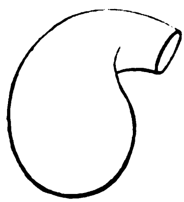
1410.



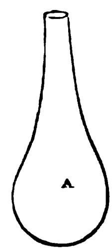
1411.



1414.



1415.



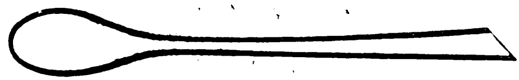
1423.

1414. Globular Flask, very short neck, Fig. 1414, hard German glass, for boiling down mineral waters, &c., welted mouth.

8 or 9 inches in diameter, 3s.	11 or 12 inches in diameter, 4s. 6d.

1415. Flasks suitable for the solution of carbonates in acids; namely, for the solution in hydrochloric acid of fused mixtures of silicates with alkaline carbonates, so formed as to prevent loss by spirting, form of Fig. 1415, hardest Bohemian glass, the mouth ground, sizes 3 and 6 ounces, each 1s. 6d.

1416. Glass Parting Flask, or French Matras d'Essai, oval form, long neck, Fig. 1416, white glass.

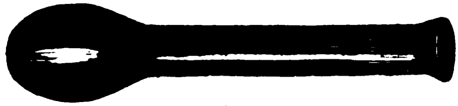


1416.

1 ounce, 1s. 6d. per dozen.	3 ounces, 2s. per dozen.
2 ounces, 1s. 6d. „	4 and 5 ounces, 2s. 6d. per dozen.

For other forms of Parting Flasks, see article "Assaying."
Light Flasks with more than one neck are described under the head of "Gas Bottles," or of "Receivers."

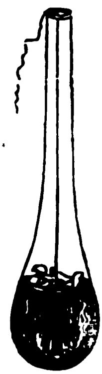
1419. Bulb Boiling Tubes, of hard German glass, Figs. 1419, *a*, *c*, the mouth turned over like that of a test tube.



1419*a*.

PRICE PER DOZEN.

1.	Round Bulb, about	$1\frac{1}{4}$ inch,	Neck, about	$2 \times \frac{1}{3}$ inch,	1s. 4d.
2.	„ „	$1\frac{1}{4}$ „	„	$2 \times \frac{1}{2}$ „	1s. 6d.
3.	„ „	$1\frac{3}{4}$ „	„	$4 \times \frac{1}{2}$ „	1s. 10d.
4.	„ „	2 „	„	$3 \times \frac{5}{8}$ „	2s. 0d.
5.	Oval Bulb, „	$2 \times 1\frac{3}{4}$ inch,	„	$3 \times \frac{1}{3}$ „	1s. 6d.
6.	„ „	$2\frac{1}{2} \times 1\frac{3}{4}$ „	„	$7 \times \frac{1}{2}$ „	2s. 6d.
7.	„ „	$2\frac{1}{4} \times 1\frac{1}{2}$ „	„	$4 \times \frac{3}{4}$ „	2s. 0d.
8.	„ „	$2 \times 1\frac{1}{2}$ „	„	$3 \times \frac{1}{2}$ „	2s. 0d.
9.	„ „	$2\frac{1}{2} \times 1\frac{3}{4}$ „	„	$3 \times \frac{1}{2}$ „	2s. 6d.
10.	„ „	$2\frac{3}{4} \times 2$ „	„	$3 \times \frac{5}{8}$ „	2s. 9d.
11.	„ „	$3 \times 2\frac{1}{4}$ „	„	$3 \times \frac{3}{4}$ „	3s. 0d.



1419*c*.

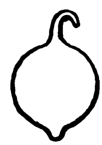
1423. Flasks of Infusible Thuringian stoneware, brown colour, form of Fig. 1423, or between that and Fig. 1411.

$1\frac{1}{2}$ pints, 4s. each.	4 pints, 6s. each.
$2\frac{1}{2}$ „ 5s. „	$6\frac{1}{2}$ „ 8s. „

1426. Flasks of Dresden Porcelain, form of Fig. 1423.

No.	Diameter of Bulb.	Contents.
1.	3 inch,	10 ounces, 2s.
2.	4 „	20 „ 4s.

1427. Cover for Flasks during digestions, to keep out dirt, and to prevent loss by spirting, thin glass, form of Fig. 1427, 1 inch, $1\frac{1}{4}$ inch, and $1\frac{1}{2}$ inch diameter; per dozen, assorted, 1s. 6d.



1427.

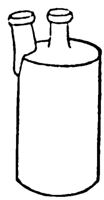
Supports for Flasks with round bottoms. See article "Supports," Nos. 402–404.
Brushes for cleaning Flasks. See page 14, No. 158.

WOULFF'S BOTTLES.

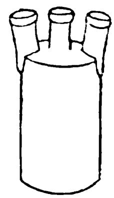
Woulff's Bottles, for preparing, condensing, or washing gases, best French make, form of Figs. 1431 and 1432, fine white glass, with well-formed necks, of a size to fit wine corks :—

1431. WOULFF'S BOTTLES, WITH TWO NECKS, Fig. 1431, per dozen,

¼ pint,	9s. 0d.	3 pints,	18s. 0d.
½ ,,	10s. 0d.	3½ ,,	20s. 0d.
¾ ,,	12s. 0d.	4 ,,	22s. 0d.
1 ,,	14s. 0d.	5 ,,	24s. 0d.
1½ ,,	14s. 0d.	6 ,,	30s. 0d.
1¾ ,,	15s. 0d.	8 ,,	40s. 0d.
2 ,,	16s. 0d.	10 ,,	55s. 0d.
2½ ,,	16s. 0d.		



1431.



1432.

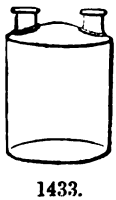
1432. WOULFF'S BOTTLES, WITH THREE NECKS, Fig. 1432, each,

¼ pint,	1s. 6d.	1¾ pints,	2s. 0d.	5 pints,	3s. 0d.
½ ,,	1s. 8d.	2 ,,	2s. 0d.	6 ,,	3s. 3d.
¾ ,,	1s. 9d.	2½ ,,	2s. 6d.	8 ,,	4s. 6d.
1 ,,	1s. 9d.	3 ,,	2s. 6d.	10 ,,	5s. 6d.
1½ ,,	2s. 0d.	3½ ,,	2s. 9d.	20 ,,	12s. 0d.
		4 ,,	3s. 0d.	30 ,,	16s. 0d.

Woulff's Bottles, fine white German glass, form of Fig. 1433, the necks ground inside, and therefore perfectly round.

1433. WITH TWO NECKS, Fig. 1433, the necks equidistant from the middle.

½ pint,	1s. 10d.
¾ ,,	2s. 0d.
1 ,,	2s. 6d.
1¾ ,,	3s. 3d.



1433.

1434. WITH THREE NECKS, Fig. 1434, the middle neck accurately stoppered.

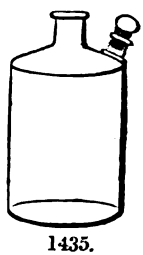
½ pint,	2s. 6d.
¾ ,,	2s. 9d.
1 ,,	3s. 0d.
1¾ ,,	3s. 6d.

1434.

1435. Woulff's Bottles, with a wide neck in the middle and a small neck at the shoulder, the latter stoppered, and the former ground smooth inside, so as to be easily closed by a cork, best white German glass.

1 pint, 2s. 6d. | 1¾ pint, 3s. 6d. | 3½ pints, 4s. 6d.

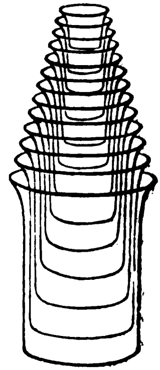
Woulff's Bottles, fitted for use as Gas Bottles, are described in the section on "Gas Apparatus."



1435.

1436. Woulff's Bottles, with a neck at the side near the bottom, and three necks on the shoulder, contents 6 to 8 pints, 6s.

BEAKERS.



1440.

1440. **BERZELIUS'S BEAKER GLASSES**, FOR HOT SOLUTIONS, cylindrical form, equally thin at the bottom and sides, with projecting edges, without punty mark at bottom, best hard white Bohemian glass.

Two kinds of Beakers are now manufactured. First, the common Bohemian, or Berzelius, or NARROW form; and secondly, A WIDE form, first introduced by J. J. Griffin. The sizes and capacities of the individual beakers are stated in the following table; but as no two beakers can be made *precisely* alike, these measurements are only to be understood as *nearly or approximately* accurate.

The beakers are supplied in nests of from 3 to 15 beakers in each, as shown by the following lists.

1440. TABLE OF THE SIZES OF BEAKERS.

Common or Narrow Form.				Griffin's Wide Form.			
No.	Height.	Width.	Contents.	No.	Height.	Width.	Contents.
000	1½ inch,	¾ inch,	½ oz.	00	1¾ inch,	1½ inch,	1 oz.
00	2 „	1 „	1 „	0	2 „	1½ „	1¾ „
0	2 „	1¼ „	1½ „	1	2½ „	1¾ „	3 „
1	2½ „	1½ „	3 „	2	3 „	2 „	5 „
2	3 „	1¾ „	4 „	3	3¾ „	2¼ „	8 „
3	3⅜ „	2 „	6 „	4	4¼ „	2¾ „	12 „
4	4 „	2¼ „	9 „	5	4¾ „	3 „	18 „
5	4⅝ „	2⅝ „	15 „	6	5½ „	3½ „	27 „
6	5⅜ „	3 „	21 „	7	6½ „	3¾ „	40 „
7	6⅜ „	3¼ „	33 „	8	7¼ „	4 „	56 „
8	7½ „	3¾ „	48 „	9	8½ „	4½ „	80 „
9	8¼ „	4 „	70 „	10	9½ „	5 „	100 „
10	9¼ „	4½ „	85 „	11	10 „	5½ „	104 „
11	10 „	5 „	110 „	12	10 „	6 „	180 „
12	11 „	5½ „	140 „	13	11 „	6¾ „	220 „

1441. PRICES OF BEAKERS IN SETS, USUAL NARROW FORM.

No. of Set.	Beakers in the Set.	Nos. included.	Contents of Beakers.	Price of the Set.
1441	3	000 to 0	½ oz. to 1½ oz.	7d.
1442	3	0 to 2	1½ „ 4 „	10d.
1443	3	1 to 3	3 „ 6 „	1s. 0d.
1444	4	5 to 8	15 „ 48 „	3s. 6d.
1445	6	00 to 4	1 „ 9 „	2s. 3d.
1446	8	1 to 8	3 „ 48 „	5s. 0d.
1447	8	3 to 10	6 „ 85 „	6s. 6d.
1448	10	00 to 8	1 „ 48 „	5s. 6d.
1449	13	00 to 11	1 „ 110 „	9s. 6d.
1450	14	00 to 12	1 „ 140 „	10s. 6d.
1451	15	000 to 12	½ „ 140 „	10s. 9d.

1461. PRICES OF BEAKERS IN SETS, GRIFFIN'S WIDE FORM.

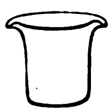
No. of Set.	Beakers in the Set.	Nos. included.	Contents of Beakers.	Price of the Set.
1461	4	00 to 2	1 ounce to 5 ounces,	1s. 3d.
1462	4	1 „ 4	3 „ 12 „	1s. 9d.
1463	4	5 „ 8	18 „ 56 „	4s. 6d.
1464	5	0 „ 4	1¾ „ 12 „	1s. 9d.
1465	5	1 „ 5	3 „ 18 „	2s. 6d.
1466	8	00 „ 6	1 „ 27 „	3s. 6d.
1467	8	1 „ 8	3 „ 56 „	5s. 0d.
1468	8	3 „ 10	8 „ 100 „	7s. 0d.
1469	12	00 „ 10	1 „ 100 „	8s. 0d.
1470	14	00 „ 12	1 „ 180 „	12s. 0d.
1471	15	00 „ 13	1 „ 220 „	12s. 6d.

1480. PRICES OF LARGE BEAKERS, SEPARATELY :—

Narrow Form.			Wide Form.		
No.	Contents.	Price.	No.	Contents.	Price.
8	2½ pints,	1s. 3d.	8	3 pints,	1s. 4d.
9	3⅓ „	1s. 4d.	9	4 „	1s. 6d.
10	4¼ „	1s. 6d.	10	5 „	1s. 8d.
11	5½ „	1s. 8d.	11	7 „	1s. 10d.
12	7 „	1s. 10d.	12	9 „	2s. 0d.
			13	11 „	2s. 3d.

1481. **BEAKED TUMBLERS FOR PRECIPITATIONS,** Griffin's Pattern. Best hard Bohemian glass, same quality as the Bohemian beakers, of uniform thickness throughout, with spouts, Figs. 1481, 1482. The following sizes :

	Deep.	Wide.	Contents.
1.	3 inch,	2¼ inch,	5 ounces.
2.	3⅛ „	2½ „	8 „
3.	4 „	3 „	12 „
4.	4½ „	3½ „	20 „
5.	5 „	3¾ „	25 „
6.	5½ „	4½ „	40 „.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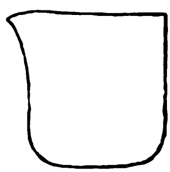
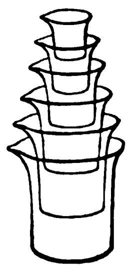
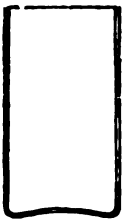

1481.


1482.

1482. Price of the set of six Beakers, Fig. 1482, 4s.
1483. Price of Numbers 1 to 5, 3s.
1484. Price of Numbers 1 to 4, 2s. 4d.
1485. Griffin's Beaked Tumblers, with Two Spouts, Fig. 1485, same sizes and quality as the preceding.

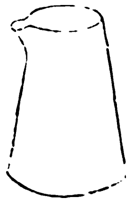
Set of 4, 3s. | Set of 5, 4s. | Set of 6, 5s.

1486. Cylindrical Jars, flat bottoms, without spout, Fig. 1486, uniformly thin in the glass, from $2\frac{1}{2}$ by $1\frac{1}{2}$ inches to 8 by $4\frac{1}{2}$ inches. See particulars under the head of "Receivers for Gases." The set of Seven, 4s. 6d.

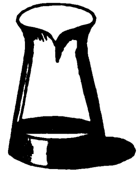


1486.

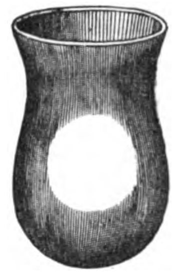
1487.



1488.



1489.



1490.

CONICAL BEAKERS.

1487. Conical Precipitating Beakers, of hard Bohemian glass, uniform in substance, form of Fig. 1487, tall and narrow, for hot liquors.

$\frac{1}{4}$ pint, 7d.	1 pint, 1s. 0d.	3 pints, 2s. 0d.
$\frac{1}{2}$ „ 9d.	2 „ 1s. 6d.	4 „ 2s. 6d.

1488. Conical Precipitating Beakers, German glass, uniform in substance, thin bottom, Fig. 1488, for hot liquors.

$\frac{1}{4}$ pint, 4d.	$1\frac{1}{2}$ pints, 10d.	$4\frac{1}{2}$ pints, 1s. 8d.
$\frac{1}{2}$ „ 6d.	3 „ 1s.	9 „ 3s. 0d.

1489. Conical Mixing Beaker, with a contraction near the mouth, to permit of shaking a liquor by a circular motion without losing any of it, 5 ounce size, 4d.

PORCELAIN BEAKERS AND BOILERS.

1490. Beaker, or Digester, of Thuringian porcelain, egg-shaped, with wide mouth, glazed within and without, useful in dissolving metals in acids, also as crucibles, a small capsule forming a cover, Fig. 1490.

No. 1. $2\frac{1}{4}$ by $1\frac{3}{4}$ inch, contents, 2 ounce, 7d.
„ 2. $2\frac{3}{4}$ by $2\frac{1}{4}$ „ contents, 4 „ 9d.

1491. Dresden Porcelain Beakers, glazed within and without, form of Fig. 1491, without spout or rim.

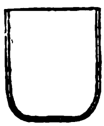
No.	Depth.	Diameter.	Contents.	Price per Dozen.
1.	4 inch,	4 inch,	15 ounces,	11s. 0d.
2.	$3\frac{1}{4}$ „	$3\frac{1}{4}$ „	10 „	9s. 0d.
3.	$2\frac{1}{2}$ „	$2\frac{3}{4}$ „	6 „	6s. 6d.
4.	2 „	$2\frac{1}{4}$ „	3 „	4s. 6d.
5.	$1\frac{3}{4}$ „	$1\frac{1}{2}$ „	$1\frac{1}{4}$ „	3s. 6d.

1492. Price of the nest of five Beakers, 3s.

1493. Porcelain Digesters, or deep basins, Thuringian porcelain, very thin and light, glazed; can be used for evaporation to dryness, and will bear a red heat. Form of Fig. 1491.

No. 1. 2 inch diameter, 1 inch deep, 1 ounce, 4d.
2. 2¼ „ 2½ „ 3 „ 8d.

PORCELAIN BOILERS, for manufacturing purposes. *Not kept in stock, but made to order at the following prices :—*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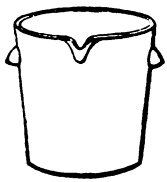
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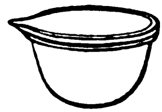
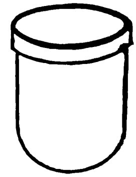

1497.


1500.

1494. Thuringian Porcelain Boilers, form of Fig. 1494, with two ears as handles, 19 inches deep, contents about 12 gallons, £5, 5s.
1495. Similar, but larger, 22 inches deep, contents about 22 gallons, £9, 9s.
1496. Similar, but without handles, and smaller, 13½ inches deep, contents about 30 pints, 22s.
1497. Thuringian Porcelain Boilers, form of Fig. 1497, the following seven sizes :—

	Diameter.	Contents.	Price.		Diameter.	Contents.	Price.
a.	17 inch,	2 gallons,	12s.	*e.*	18 inch,	4 gallons,	27s.
b.	17 „	2½ „	14s.	*f.*	18 „	5 „	33s.
c.	17 „	3 „	18s.	*g.*	19 „	6 „	45s.
d.	18 „	3½ „	23s.				

1498. If the boilers, Fig. 1497, are provided with an iron handle, the extra price is,

For Nos. *a, b, c, d,* 4s. each. | For Nos. *e, f, g,* 5s. each.

1499. If the boilers, Fig. 1497, are covered with iron network, but without handles, the extra price is,

For Nos. *a, b, c, d,* 1s. 6d. each. | For Nos. *e, f, g,* 2s. each.

The method of mounting porcelain vessels with iron handles and iron network, is represented in the section on "Evaporation" in the article on Thuringian Porcelain Basins.

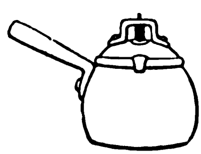
1500. Berlin Semi-porcelain Boilers, form of Fig. 1500.

	Diameter at mouth, inside.	Depth.	Contents.	Price.
a.	11 inch,	8 inch,	7 quarts,	9s.
b.	13 „	12 „	3½ gallons,	22s.

DIGESTERS.

Clark's Patent Digesters, cast iron, lined with china, the valves with wire springs.

1501. Form of Fig. 1501, 2 pints, 4s. 6d.
1502. Form of Fig. 1501, 4 „ 5s. 6d.
1503. Form of Fig. 1503, 3 „ 6s. 6d.
1504. Form of Fig. 1504, 8 „ 8s. 0d.
1505. Form of Fig. 1504, 10 „ 10s. 0d.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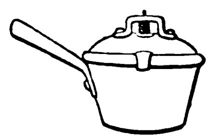

1503.

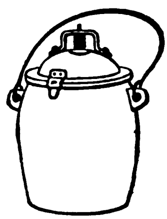
1506. Larger sizes of these Digesters can be supplied to order. No. 1501 up to 8 quarts; No. 1503 up to 5 quarts; No. 1504 up to 14 gallons.

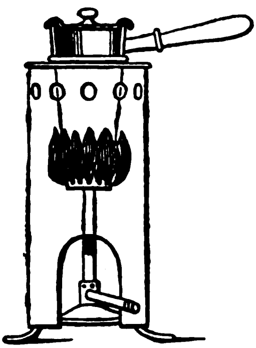
1508. Porcelain Digesters, form of Figs. 1508 and 1507, mounted on iron-plate furnaces to suit the Rose Gas Burner, No. 973, which may be used without a water-bath, Fig. 1508.

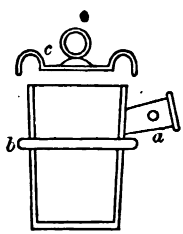
No. 1.	Digester and Furnace, 5s. 6d.	Either of them, with the gas burner, No. 973, 1s. 6d. extra.
2.	Digester and Furnace, 7s. 0d.	
3.	Digester and Furnace, 9s. 0d.	

1509. Quick Boiler, for rapidly boiling one or two pints of water, Fig. 1509. The furnace, kettle, and gas burner complete, 8s.
1510. Ditto, the furnace and kettle, without the gas burner, 5s.

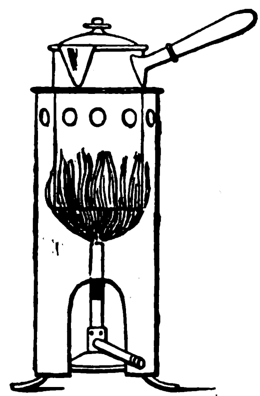
The gas burner is No. 974, namely, the Rose Burner No. 2, price 3s., which, in this case, is used without the rose top, the direct flame applied to metal vessels giving the quickest result; while the safety of the porcelain vessels described at the previous number demands the use of the rose burner. In the quick boiler, 1 pint of cold water can be boiled in 5 minutes, and 2 pints in 8 minutes.


1504.


1508.



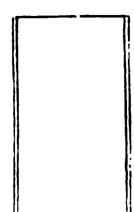
1507.


1509.

GLASS JARS WITHOUT FEET.

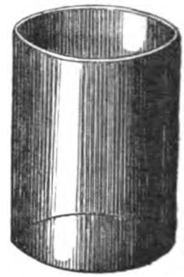
Cylindrical Jars, without foot, flange, or spout, but ground at the mouth, form of Figs. 1516 *a*, *b*, very stout, in glass, for galvanic batteries, for the solution in water of substances that require pressure with a stirrer, or for collecting gases; hard German glass.

No.	Diameter.	Height.	Contents (about).	Price.
1516.	3½ inches,	4 inches,	35 ounces,	6d.
1517.	3¾ "	5 "	50 "	9d.
1518.	3¾ "	5½ "	55 "	9d.
1519.	4 "	6¼ "	70 "	1s. 0d.
1520.	4½ "	6¾ "	95 "	1s. 3d.
1521.	4 "	7½ "	85 "	1s. 3d.
1522.	4¼ "	8 "	100 "	1s. 3d.
1523.	4 "	8½ "	90 "	1s. 3d.


1516*a*.


1516*b*.

1530. Cylindrical Jars, without feet, vertical sides, flat bottom, without flange or spout, Bohemian glass, stoutly made, the edges cut flat. For cold liquors. Fig. 1530.



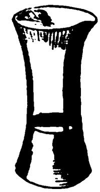
1530.

No.	Height.	Diameter.	Contents.	Price.
1.	8 inches,	4 inches,	3 pints,	1s. 6d.
2.	9 ,,	5 ,,	5 ,,	2s. 6d.
3.	10 ,,	6 ,,	7 ,,	3s. 6d.
4.	11 ,,	7 ,,	10 ,,	5s. 0d.
5.	12 ,,	8 ,,	14 ,,	6s. 6d.

1531. Lixiviating Jars, for cold liquors, tall and narrow in the middle so as to be conveniently handled, solid bottom, with spout, Fig. 1531.

1 pint,	6d.	4 pints,	1s. 2d.
1½ ,,	8d.	5 ,,	1s. 6d.
2 ,,	9d.	6 ,,	1s. 9d.
2¼ ,,	10d.	7 ,,	2s. 0d.
3 ,,	1s. 0d.		

1532.



1531.

1532. Jar with wide mouth, beaker form, but stout and strong, Bohemian glass, welted mouth; contents, 28 pints. Fig. 1532, 10s. 6d.

GLASS JARS WITH FEET.

1533. Jars with Feet, cylindrical, with ground edge, not expanded, no spout, hard German or Bohemian glass, Fig. 1533, page 156.

No. 1.	4 ins. high,	1 in. wide,	5d.	No. 4.	12 ins. high,	2 ins. wide,	1s. 3d.
2.	6 ,,	1¼ ,,	7d.	5.	16 ,,	2½ ,,	1s. 6d.
3.	8 ,,	1½ ,,	10d.	6.	15 ,,	4 ,,	4s. 0d.

JARS WITH FEET, cylindrical, hard German glass, of two kinds, namely :—

1534. Fig. 1534, with flange at the mouth, no spout, no cover.
1535. Fig. 1535, with spout and without flange.

Both Patterns at the same Price.

Letter *c*, Fig. 1534, is a glass cover to close the flanged jar. See "Covers" in the section on Filtration.

The width is taken across the middle, not including the flange.

1¼, 1½, *and* 1¾ inch wide.

No. 1.	6 inches high,	8d.
2.	8 ,,	8d.
3.	9 ,,	9d.
4.	10 ,,	10d.
5.	12 ,,	1s. 0d.
6.	14 ,,	1s. 2d.
7.	15 ,,	1s. 4d.
8.	16 ,,	1s. 6d.

2 inches wide.

No. 9.	3 inches high,	5d.
10.	6 ,,	9d.
11.	8 ,,	10d.
12.	9 ,,	11d.
13.	10 ,,	1s. 0d.
14.	12 ,,	1s. 2d.
15.	14 ,,	1s. 4d.
16.	15 ,,	1s. 6d.
17.	16 ,,	1s. 8d.
18.	18 ,,	2s. 0d.

2½ INCHES WIDE.

No. 19.	4 inches high,		9d.
20.	6 „		10d.
21.	8 „	1s.	0d.
22.	10 „	1s.	2d.
23.	12 „	1s.	4d.
24.	14 „	1s.	6d.
25.	15 „	1s.	9d.
26.	16 „	2s.	0d.

3 INCHES WIDE.

27.	5 inches high,	1s.	0d.
28.	10 „	1s.	3d.
29.	12 „	1s.	6d.
30.	14 „	2s.	0d.
31.	15 „	2s.	3d.
32.	16 „	2s.	6d.

3½ INCHES WIDE.

33.	5 inches high,	1s.	0d.
34.	7 „	1s.	6d.
35.	14 „	2s.	6d.
36.	15 „	3s.	0d.

4 INCHES WIDE.

No. 37.	7 inches high,	1s.	9d.
38.	10 „	2s.	0d.
39.	14 „	3s.	0d.
40.	16 „	3s.	6d.

4¾ INCHES WIDE.

41.	12 inches high,	3s.	6d.
42.	19 „	4s.	6d.
43.	20 „	5s.	0d.

5 INCHES WIDE.

44.	13 inches high,	4s.	0d.
45.	15 „	4s.	6d.
46.	19 „	5s.	6d.

5½ INCHES WIDE.

47.	12 inches high,	5s.	0d.
48.	16 „	6s.	0d.
49.	20 „	8s.	0d.

6 INCHES WIDE.

50.	23 inches high,	9s.	0d.

6½ INCHES WIDE.

51.	24 inches high,	10s.	6d.

8 INCHES WIDE.

52.	25 inches high,	12s.	6d.

STOPPERED JARS.

1536. Cylindrical Jars on foot, with ground glass stoppers, similar in form to Fig. 1536, but not graduated; fine white German glass.

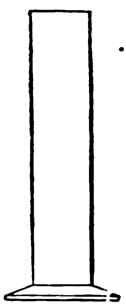
Approximate measurements, including the foot and flange.

No.	Height.	Diameter.	Price.
1.	7½ inch,	1 inch,	10d.
2.	11½ „	2 „	1s. 10d.
3.	13½ „	1 „	1s. 2d.
4.	13½ „	2 „	2s. 0d.
5.	13½ „	2⅓ „	3s. 0d.
6.	13½ „	3 „	3s. 6d.
7.	15 „	3⅓ „	4s. 0d.
8.	16 inch,	3⅓ inch,	4s. 0d.
9.	17 „	1 „	2s. 0d..
10.	17 „	4 „	5s. 0d.
11.	18 „	4⅓ „	6s. 0d.
12.	19 „	4¾ „	8s. 0d.
13.	23 „	4 „	7s. 0d.

1537. Glass Cylinders on foot, with broad ground stoppers; fine white Bohemian glass, suitable for anatomical and zoological preparations, &c., Fig. 1537.

No.	Width.	Height.	Price.
1.	1 inch,	4 inch,	8d.
2.	1½ „	6 „	1s. 2d.
3.	1½ „	10 „	1s. 10d.
4.	2 „	7 „	2s. 0d.
5.	2½ „	5 „	1s. 10d.
6.	2½ „	9 „	3s. 0d.
7.	3 „	15 „	6s. 6d.
8.	3½ „	6 „	3s. 0d.
9.	3½ „	8 „	4s. 0d.
10.	3½ „	12 „	6s. 6d.
11.	4 „	7 „	4s. 0d.
12.	4 „	9 „	4s. 6d.
13.	4½ „	6 „	4s. 0d.
14.	4½ inch,	11 inch,	7s. 0d.
15.	4½ „	15 „	9s. 0d.
16.	5 „	18 „	12s. 0d.
17.	5½ „	8 „	6s. 0d.
18.	5½ „	10 „	6s. 6d.
19.	6 „	18 „	18s. 0d.
20.	6½ „	10 „	10s. 0d.
21.	6½ „	13 „	12s. 0d.
22.	6½ „	19 „	18s. 0d.
23.	7½ „	15 „	18s. 0d.
24.	7½ „	19 „	25s. 0d.
25.	7½ „	24 „	31s. 0d.
26.	10 „	18 „	30s. 0d.

1539. **Glass Balls**, thin in glass, with glass hooks attached, for suspending zoological and anatomical preparations in jars of spirits; per dozen, 1s. 6d.



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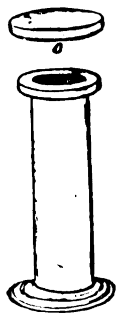
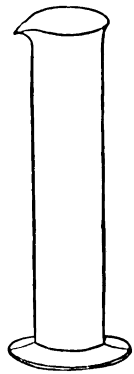


1534.



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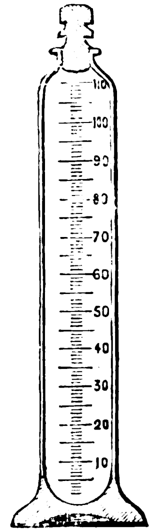

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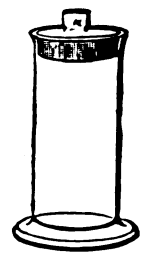
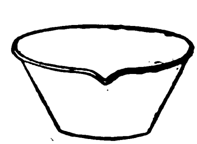


1537.

PANS.

1540. **Deep Conical Pans**, flat bottoms with spout, saltglazed stoneware, Fig. 1540. Can be heated over a sand-bath or water-bath, suitable for crystallising pans.



1540.

No. 1.	Diameter	8 inch,	Contents	3 pints,	1s. 3d.
2.	„	10 „	„	5 „	1s. 6d.
3.	„	12 „	„	8 „	1s. 10d.

1542. **Shallow Conical Pans**, of pale green glass, suitable for Dialysers, or analytical operations; like Fig. 1540, but not so deep.

No. 1.	Diameter	9 inches,	Contents	6 pints,	2s. 0d.
2.	„	11 „	„	8 „	3s. 0d.
3.	„	13 „	„	13 „	3s. 6d.
4.	„	15 „	„	16 „	5s. 0d.

1543. **Deep Pots for Caustic Liquors, dye-stuffs, &c.**, form of Fig. 1543, saltglazed stoneware, impervious to colours, acids, or alkaline liquors.

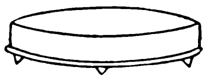
2 pints,	8d.	1 gallon,	1s. 6d.	3 gallons,	4s. 6d.
3 „	10d.	1½ „	1s. 10d.	4 „	6s. 0d.
4 „	1s. 0d.	2 „	3s. 0d.	6 „	9s. 0d.

Other sizes made to order, up to 20 gallons.

1544. Pans of Glazed Earthenware, yellow colour, to place below lamps, basins, &c.; also for use as shallow pneumatic troughs, Fig. 1544.

9 inches diameter, 2 inches deep, with 3 feet, 1s. 0d.
12 " " " 1s. 4d.

1545. Pan of Enamelled Iron on wooden frame; size, about 28 by 16 by 10 inches. It has a plug in the bottom to run off the water; Fig. 1545. £3.



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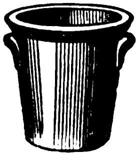

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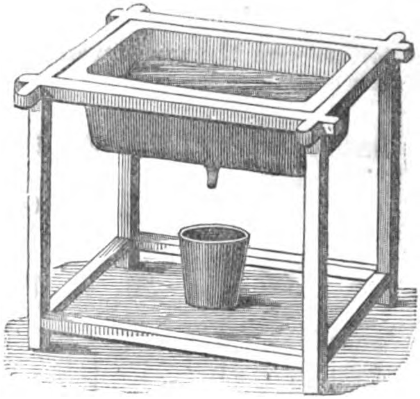
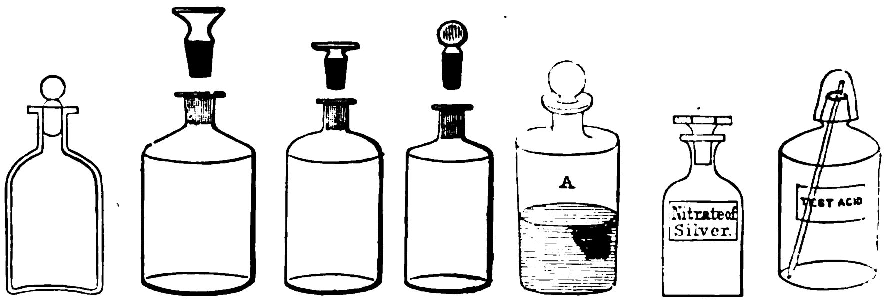


1545.

Bottles for Chemicals.

Class I. Bottles with Narrow Mouths for Test Solutions. | Class II. Bottles with Wide Mouths for Dry Chemicals.

Class I. BOTTLES WITH NARROW MOUTHS.



1550. 1551. 1552. 1553. 1554. 1555. 1556.

1550. Bottles for containing Test Solutions, German glass, free from lead, narrow mouths, with ground glass stoppers, Fig. 1550, at per dozen,

⅛ ounce,	1s. 4d.	3 ounce,	3s. 0d.	10 ounce,	4s. 6d.	1½ pint,	9s. 0d.
¼ „	1s. 4d.	4 „	3s. 6d.	12 „	5s. 0d.	2 „	11s. 0d.
½ „	1s. 6d.	5 „	3s. 6d.	14 „	5s. 6d.	2½ „	15s. 0d.
1 „	1s. 9d.	6 „	3s. 9d.	16 „	6s. 0d.	3 „	17s. 0d.
1½ „	2s. 9d.	8 „	4s. 0d.	18 „	7s. 6d.	4 „	18s. 0d.
2 „	2s. 9d.	9 „	4s. 0d.	1 pint,	8s. 0d.	5 „	20s. 0d.
2½ „	2s. 9d.						

1551. Bottles for containing Test Solutions, best white German glass, of hard quality, free from lead, and of a good colour, the lips thin, projecting, and well formed for dropping tests; the stoppers are long and of a conical form, and particularly well ground in, the heads of the stoppers flat, projecting, and sufficiently large to afford a good grip to the fingers; the bottoms of the bottles cut flat, Fig. 1551. Price per dozen,

¼ or ½ ounce,	4s. 0d.	4 ounce,	9s. 0d.	14 ounce,	14s. 0d.
1 „	5s. 0d.	6 „	10s. 6d.	20 „	16s. 0d.
2 „	7s. 0d.	10 „	12s. 0d.	27 „	17s. 0d.
2 „	8s. 6d.	12 „	13s. 0d.	35 „	21s. 0d.

1553. Square Bottles for chests, flint glass, strong, with narrow mouths, and ground stoppers. Price per dozen,

2 ounce,	4s. 6d.	4 ounce,	5s.	8 ounce,	6s.

1554. Bottles for containing Test Solutions, London made, flint glass, squat rounds, short necks, and square-headed stoppers, well fitted by grinding. Fig. 1554.

Price per Dozen.

½ ounce,	6s.	3 ounce,	9s.	8 ounce,	12s.
1 „	6s.	4 „	10s.	12 „	15s.
2 „	8s.	6 „	11s.	20 „	20s.

1555. Bottles to contain Acids and Alkalies, narrow mouths, German glass, with accurately-ground stoppers, form of Fig. 1551, with white enamel name plates and names in black enamel, in the style of Fig. 1555, two sizes :—

10 ounce, each bottle, 2s.	20 ounce, each bottle, 2s. 6d.

The following names :—

No. 1. Sulphuric Acid.	No. 4. Soda.	No. 7. Alcohol.
„ 2. Hydrochloric Acid.	„ 5. Potash.	„ 8. Ether.
„ 3. Nitric Acid.	„ 6. Ammonia.	

1556. Bottles for Test Solutions, German glass, with ground caps and pipettes, without stoppers, form of Fig. 1556, but without names.

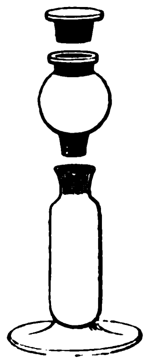
1 ounce,	6d.	2 ounce,	7d.	4 ounce,	9d.	6 ounce,	1s. 0d.
1½ „	6d.	3 „	8d.	5 „	10d.	8 „	1s. 2d.


1557.


1565.


1567.


1568.


1569.

1557. Bottles, with ground stoppers and caps, for acids and volatile re-agents, Fig. 1557, Bohemian glass.

1 ounce,	6d.	5 ounce,	1s. 0d.	10 ounce,	1s. 6d.
2 „	8d.	6 „	1s. 1d.	15 „	2s. 0d.
3 „	9d.	8 „	1s. 3d.	20 „	2s. 6d.
4 „	10d.				

1559. Acid Bottles, English blue or green glass, narrow mouths, well-ground stoppers, *Corbyns* and *Winchesters*.

½ pint,	5d.	80 or 90 ounce, Winchester,	10d.	Corbyn quarts,	8d.
1 „	6d.				

1561. Opaque Black Glass (Hyalith) or Dark Blue Glass Bottles, narrow mouths, stoppered, 4 ounce, 8s. per dozen.

1563. Caustic Holder; a tube bottle with long hollow stopper, for holding a stick of caustic, 6d.

1565. Stoppered Bottles for Acids, saltglazed stoneware, cased in white wicker, Fig. 1565.

2 quarts, 3s. | 1 gallon, 3s. 6d. | 2 gallons, 5s.

1566. Acid Jugs, saltglazed stoneware, with spout and handle.

2 pints, 1s. | 3 pints, 1s. 2d. | 4 pints, 1s. 6d. | 6 pints, 1s. 8d.

Bottles for holding Photographic Collodion, fine German glass.

1567. Contents, 4 ounces, with ground cap, Fig. 1567, 2s. 6d.

1568. Contents, 3 ounces, with cap, funnel-shaped mouth, and spout, all ground to fit, Fig. 1568, 3s. 6d.

This bottle can be used to supply small quantities of acid. Any liquor that flows over the spout is caught by the funnel, and descends into the bottle by a groove cut in the ground part of the spout.

1569. Contents of bottle, 5 ounces, of the tubular funnel 7 ounces, with flat cut glass stopper, all ground to fit, Fig. 1569, 5s.

The globular funnel is intended to hold cotton for the filtration of the collodion when returned to the bottle.

1571. Bottle Caps, flexible vulcanised caoutchouc, price per dozen,—

¾ inch,	2s. 9d.	1¼ inch,	3s. 6d.	2 inch,	5s.
1 "	3s. 0d.	1½ "	4s. 0d.	2½ "	6s.

Class II. BOTTLES WITH WIDE MOUTHS.

1575. Bottles for containing chemicals in the solid state, white French glass, Fig. 1575, wide mouths, without stoppers, intended for corking.

Price per Dozen.

½ ounce,	9d.	8 ounce,	1s. 10d.	1¾ pint,	6s. 6d.
¾ "	10d.	9 "	2s. 0d.	2 "	8s. 0d.
1 "	10d.	10 "	2s. 0d.	2½ "	9s. 0d.
1½ "	1s. 0d.	12 "	2s. 0d.	3 "	10s. 0d.
2 "	1s. 2d.	14 "	3s. 0d.	3½ "	12s. 0d.
3 "	1s. 3d.	16 "	4s. 0d.	4 "	14s. 0d.
4 "	1s. 4d.	18 "	4s. 6d.	5 "	17s. 0d.
5 "	1s. 6d.	1 pint,	5s. 0d.	6 "	21s. 0d.
6 "	1s. 8d.	1¼ "	5s. 6d.	8 "	25s. 0d.
7 "	1s. 9d.	1½ "	6s. 0d.		

1576. Powder Bottles for containing chemicals in the solid state, German glass, wide mouths, ground glass stoppers, with square heads, Fig. 1576.

Price per Dozen.

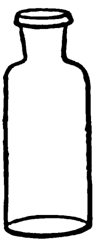
¼ ounce,	2s. 6d.	5 ounces,	5s. 6d.	1 pint,	11s.
½ "	3s. 0d.	6 "	6s. 0d.	1¼ "	13s.
¾ "	3s. 6d.	7 "	6s. 6d.	1½ "	14s.
1 "	4s. 0d.	8 "	7s. 0d.	2 "	18s.
1½ "	4s. 0d.	10 "	7s. 6d.	3 "	21s.
2 "	4s. 6d.	12 "	8s. 0d.	4 "	24s.
2½ "	4s. 6d.	14 "	8s. 6d.	5 "	30s.
3 "	5s. 0d.	16 "	9s. 0d.	6 "	36s.
4 "	5s. 0d.				

1577. Bottles for containing chemicals in the solid form, wide mouths, best hard white German glass, similar to the Solution Bottles, No. 1551, and the stoppers of the form shown by that figure; conical below, flat above, with a strong neck, the grinding very accurate, Fig. 1577. *Price per dozen,*—

½ ounce,	5s. 0d.	4 ounce,	9s.	20 ounce,	16s.
1 ,,	5s. 6d.	6 ,,	10s.	35 ,,	21s.
2 ,,	7s. 0d.	10 ,,	12s.		

1579. Bottles of hard white Bohemian glass, extremely wide necks, with glass stoppers, ground, but not air-tight, Fig. 1579. Price each,

½ pint,	6d.	3 pints,	1s. 2d.	12 pints,	3s. 0d.
1 ,,	7d.	4 ,,	1s. 4d.	15 ,,	4s. 0d.
1½ ,,	8d.	6 ,,	1s. 8d.	18 ,,	5s. 0d.
2 ,,	10d.	8 ,,	2s. 0d.	20 ,,	5s. 6d.
2½ ,,	1s. 0d.	10 ,,	2s. 6d.	24 ,,	6s. 0d.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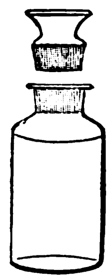
1576.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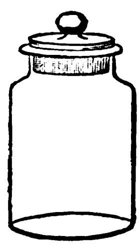
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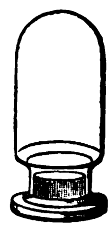

1580.

1580. Reversed Bottles, for exhibiting chemical preparations in museums, flat glass stoppers, Fig. 1580, fine Bohemian glass.

¼ pint,	10d.	¾ pint,	1s. 6d.	2 pints,	2s. 6d.
½ ,,	1s. 2d.	1 ,,	2s. 0d.	3 ,,	4s. 0d.

1581. Round Bottles, Flint Glass, wide mouths, with short, square-headed stoppers, well ground, Fig. 1576.

Price per Dozen.

1 ounce,	7s.	4 ounce,	11s.	8 ounce,	14s.	16 ounce,	17s.
2 ,,	9s.	6 ,,	13s.	12 ,,	15s.	20 ,,	21s.

1582. Square Bottles, for chests, flint glass, strong, with wide mouths, well ground stoppers. *Per dozen,*—

2 ounce,	7s.	4 ounce,	8s.	8 ounce,	9s.


1584.

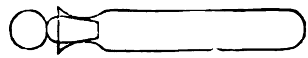
SPECIMEN BOTTLES.

1584. Bottles with wide mouths and flat-headed stoppers, made of slight glass, blown before the lamp, and adapted for small quantities of chemicals, fitted to form part of blowpipe and micro-chemical cabinets, Fig. 1584.

¼ ounce,	2d.	½ ounce,	3d.	¾ ounce,	3½d. each.

1588. **Bottles made of Glass Tube**, with contracted necks and bordered mouths, for corks or stoppers :—

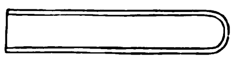
No. 1. Bottle, 1½ inch by ¼ inch, per dozen, 8d.
2. Bottle, with ground stopper, per doz., 1s. 9d.
3. Bottle, 2 inch by ½ inch, per dozen, 1s.
4. Bottle, with ground stopper, per dozen, 2s.
5. Bottle, 1½ inch by ⅜ inch, per dozen, 6d.
6. Bottle, 2¼ inch by 7/16 inch, narrow neck, globular stopper, per dozen, 3s.
7. Bottle, 3 inch by ⅝ inch, narrow neck, globular stopper, per dozen, 3s. 6d.
8. Bottle, 1¼ inch by 7/16 inch, with cut glass stoppers, per dozen, 2s. 6d.



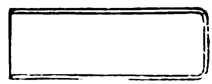
1588.

1589. **Plain Tube Bottles**, of stout white German glass, mouths not expanded, but fused smooth; serving to contain specimens of chemicals, or to collect small quantities of gas over mercury.

Round Bottoms, Fig. 1589, or Flat Bottoms, Fig. 1590, *at the same price.*



1589.



1590.

Length of the Tubes in Inches.	Diameter of the Tubes in Inches, and Price *per Dozen.*								
	¼	⅜	½	⅝	¾	⅞	1	1¼	1½
2 inch,	4d.	6d.	7d.	10d.	1s. 0d.	—	—	—	—
3 "	4d.	6d.	8d.	1s. 0d.	1s. 2d.		—	—	—
4 "	—	6d.	8d.	1s. 0d.	1s. 3d.	2s. 10d.	2s. 0d.	—	—
5 "	—	10d.	10d.	1s. 2d.	1s. 4d.	1s. 0d.	2s. 6d.	—	—
6 "	—	—	1s. 0d.	1s. 3d.	1s. 6d.	2s. 0d.	2s. 8d.	3s. 0d.	3s. 6d.
7 "	—	—	1s. 2d.	1s. 4d.	1s. 10d.	2s. 2d.	3s. 0d.	3s. 3d.	4s. 0d.
8 "	—	—	1s. 3d.	1s. 8d.	2s. 0d.	2s. 6d.	3s. 2d.	4s. 0d.	4s. 6d.

1591. Tube Bottles of German glass, with wide mouths and ground glass stoppers. Round Bottoms and Flat Bottoms, *at the same price.*

Length of the Tubes in Inches.	Diameter of the Bottles in Inches, and Price *per Dozen*					
	¼	⅜	½	⅝	¾	1
2 inches,	1s. 6d.	1s. 10d.	2s. 0d.	2s. 0d.	—	—
3 "	—	1s. 10d.	2s. 0d.	2s. 0d.	2s. 6d.	—
4 "	—	—	2s. 0d.	2s. 6d.	2s. 8d.	3s. 0d.
5 "	—	—	2s. 6d.	2s. 8d.	3s. 0d.	3s. 6d.
6 "	—	—	2s. 8d.	3s. 0d.	3s. 0d.	3s. 6d.

Chemical Labels.

1592. A SERIES of SIX HUNDRED CHEMICAL LABELS printed to the annexed pattern, comprehending the names of all the Re-agents used in Analysis, the Photographic Chemicals, and most other substances employed by the experimental chemist, arranged in alphabetical order. *Gummed ready for use*, 6d.

Barium
Nitrate.

1593. A SERIES OF CHEMICAL LABELS, 500 in number, comprising the names of the TESTS USED IN ANALYSIS, including all the tests recommended by Rose, Berzelius, Fresenius, Wackenroder, Graham, Hofmann, Parnell, &c., also of other chemical preparations in general use, printed according to the annexed pattern. Gummed ready for immediate use, and bound in order in a book. The set, 1s. 6d.

MAGNESIA
Sulphate.

1594. DE LA RUE'S (WARREN) CHEMICAL LABEL BOOK; Imperial 4to., containing 644 LABELS OF ELEMENTARY AND COMPOUND BODIES, systematically arranged. Each label contains the Symbol of the Compound, and the Atomic Weight according to Berzelius, Brande, and Liebig. Printed according to the following pattern, on fine glazed paper, 4d.

BI CHLORIDE MERCURY

symb. $Hg\ Cl_2$

Eq. Liebig 272·84 **Brande 272** **Berzelius 136·9, 2 Eq. 273·8**

Filtration, Percolation, Edulcoration.

FUNNELS.

1595. GLASS FUNNELS FOR FILTRATION, form of Fig. 1595, the sides inclined at an angle of 60°, and the vertical section being an equilateral triangle, which adapts them to the shape of a plain paper filter; German glass, the following sizes:—

Diameter.	Price.	Diameter.	Price.	Diameter.	Price.
1 inch,	1½d.	3 inch,	3d.	8 inch,	1s. 6d.
1¼ "	1½d.	4 "	4d.	9 "	1s. 9d.
1½ "	1½d.	5 "	6d.	10 "	2s. 0d.
2 "	2d.	6 "	9d.	11 "	2s. 6d.
2½ "	2½d.	7 "	1s. 2d.	12 "	3s. 6d.

1596. Glass Funnels, ground on the edges so as to be closed air-tight by glass covers (see Covers, No. 1677), are charged extra for each funnel, as follows:—

1 to 4 inch, 1d. | 5 to 7 inch, 2d. | 8 to 10 inch, 3d.

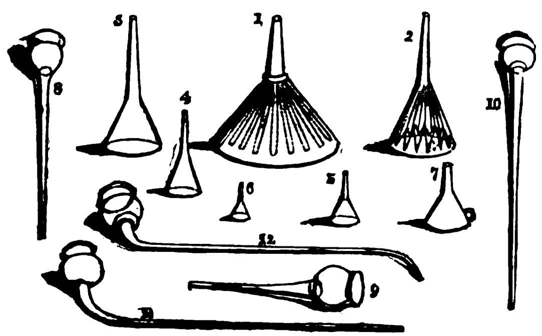
1597. Glass Funnels of 60°, for filtration, of stout Bohemian glass, with the top edge and the end of the neck ground:—

1 inch,	3d.	3½ inch,	7d.	7 inch,	1s. 8d.
1½ "	4d.	4 "	8d.	8 "	2s. 0d.
2 "	5d.	4½ "	10d.	9 "	2s. 6d.
2½ "	6d.	5 "	1s. 0d.	10 "	3s. 0d.
3 "	6d.	6 "	1s. 4d.		

1598. Glass Funnels, French form, long and narrow sides, forming an angle of about 40°. These funnels are well suited for fillers, but do not hold filters conveniently, unless the papers are folded as represented by Fig. 1598, No. 2:—

1 to 4 ounces,	2d.	12 ounces,	4½d.	1½ pint,	8d.
5 " 7 "	2½d.	16 "	5d.	2 "	10d.
8 "	3d.	1 pint,	6d.		

1595.



1598.

1601.

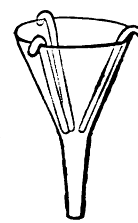
1599. Glass Funnels, ribbed, No. 1, Fig. 1598, angle of 60°, useful for rapid filtration when the insoluble matter is not required.

2 inch diameter,	3d.	4 inch diameter,	6d.
$2\frac{1}{2}$,,	4d.	5 ,,	7d.
3 ,,	5d.	6 ,,	10d.

1600. Funnels, slight blown glass, form nearly of 60°, $\frac{1}{2}$ inch to 1 inch wide, with narrow necks; very light, intended to rest on test tubes, or for pouring mercury into narrow vessels, &c., Fig. 1598, Nos. 4, 5, 6; *per set of three*, 4d.

1601. Funnel, slight blown glass, $1\frac{1}{2}$ inch diameter, suitable for filtrations into tubes, Fig. 1601, 2d.

1602. Filter Hooks, to facilitate filtration, and prevent the bursting of paper filters when loaded with a precipitate, Fig. 1602, the hooks, 5, 6, 7, or 8 inches long, *per dozen*, 1s. 6d.



1602.

When it is desired to filter a liquid rapidly, and a ribbed filter is not at hand, or when using a large funnel, or one that is too wide at the part where the cone joins the tube, it is desired to strengthen the paper, it is advisable to arm the funnel with three glass rods, bent and arranged as shown by Fig. 1602. This plan not only facilitates the filtration of the liquid, but supports the filter at the bottom, and prevents its bursting under the weight of the superincumbent liquid or precipitate.

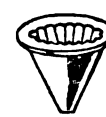
BERLIN SEMI-PORCELAIN FUNNELS.

1603. Plain Funnel, or Filler, useful also for filtering, being formed at an angle of 60°, Fig. 1603.

1603.

No. 00.	2 inch,	6d.	No. 2.	$4\frac{1}{2}$ inch,	1s. 6d.
0.	$3\frac{1}{2}$,,	1s. 0d.	3.	5 ,,	2s. 0d.
1.	4 ,,	1s. 3d.	4.	6 ,,	2s. 6d.

1604. Ribbed Funnels, without necks, Fig. 1604.



1604.

No. 1.	3 inch,	8d.	No. 2.	4 inch,	1s.

1605. Ribbed Funnels, with neck, Fig. 1605.

No. 0.	$3\frac{1}{2}$ inch,	1s. 6d.	No. 4.	6 inch,	3s. 6d.

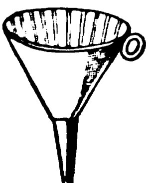
1606. Pierced Funnels, for rapid filtration, with cloth filters, Fig. 1606.

No. 2.	$5\frac{1}{2}$ inch, 2s. 3d.	No. 3.	7 inch, 3s.	No. 4.	$7\frac{1}{2}$ inch, 3s. 9d.

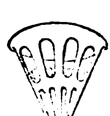
1607. Ribbed Funnels, without neck, the lower part pierced with holes, with a flange or collar to rest on a jar, Fig. 1607.

No. 1.	$4\frac{1}{2}$ inch,	2s. 6d.	No. 2.	$6\frac{1}{4}$ inch,	3s.

1608. Ribbed Funnel, without neck, the lower part pierced with holes, similar to Fig. 1607, but without the collar, 2 inch, 8d.



1605.



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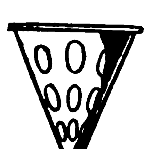

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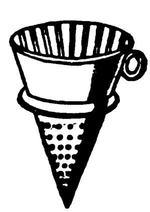

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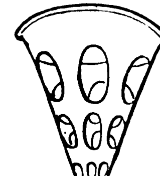


1609.

1609. **Berlin Porcelain Funnels**, for filtrating through cloth, form of Fig. 1609, white glazed.

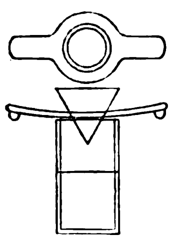
	Deep.	Wide.	Price.		Deep.	Wide.	Price.
No. 00.	4¼ inch,	4 inch,	1s. 2d.	No. 2.	7 inch,	6 inch,	3s. 0d.
0.	5 „	4¼ „	1s. 9d.	3.	7½ „	6½ „	3s. 6d.
1.	6 „	5 „	2s. 0d.	4.	8½ „	7½ „	4s. 6d.

FUNNEL HOLDERS. (See page 33.)

FILTRATION WITHOUT FUNNELS.

1610. Filter Ring, for supporting a paper filter over a solution jar, without the help of a funnel; useful in rapid filtration, when the liquid alone is required; it has two flat horizontal arms to rest on the solution jar, yellow glazed china, Fig. 1610.

Ring, 1¼ inch diameter, 3d. | Ring, 1½ inch diameter, 3d.



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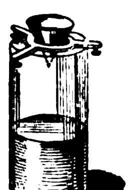


1611.

1611.

1612.

1611. Ditto, Wedgwood porcelain, 4d.
1611a. Ditto, Wedgwood, with three arms, Fig. 1611, 7d.
1611b. Ditto, large size, 10d.

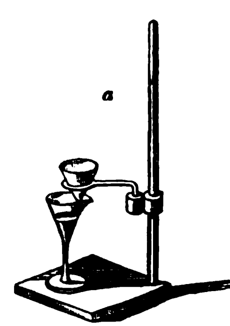
1612. **Holder for Glass Filter Rings**, by which a filter is held without a funnel, in such a manner that the point of the filter is made to touch the inner surface of the receiving jar, so as to ensure effectual draining, Fig. 1612. In mahogany, French polished, 3s.

There are two movable blocks by which the height of the solution glass can be adjusted to agree with the point of the filter.

1613. Glass Ring with flat handle, adapted to this support, from ¾-inch to 1¼-inch diameter, per dozen, 3s.; singly, 4d.

1614. **Holder for Glass Filter Rings**, consisting of a double cylinder of japanned tinplate fitted with corks, one of which slides on an upright rod, while the other is perforated to receive the bent handle of the Glass Ring, Fig. 1614, the rod and foot of polished black wood, 1s.

1615. Glass Ring, with bent handle; ring ¾-inch diameter, 2d.; 1 inch diameter, 2d.



1614.

1616. Glass Slips, for the filtration of small quantities of liquid in qualitative analysis, as shown by Fig. 1616.

6 inch by 1 inch, per doz., 4d.	4 inch by $\frac{5}{8}$ inch, per doz., 3d.
5 „ by $\frac{3}{4}$ „ „ 3d.	

QUICK FILTERS.

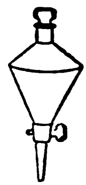
1617. **Beale's Quick Filter**, for use in Centigrade testing, Fig. 1617, 9d.

This is used to filter off a small quantity of a solution, to test for sulphates or other substances in solution. A bit of filter paper and muslin is tied over the end *a*. The bottom is dipped into the turbid liquor, and the filtered liquor, which rises in the tube *b*, is decanted from the spout *c*, into a test glass for trial.

1618. **Berzelius's Quick Filter for Large Quantities of Liquid**, Fig. 1618, Bohemian glass.

5 to 6 inch diameter, 10s. 6d. each.

This apparatus is filled with the liquid that is to be filtered, and is fixed over the filter in such a manner that the point of the funnel, Fig. 1618, is one-tenth of an inch below the edge of the paper filter; the stopcock is then to be opened, upon which the filter becomes filled, and the filtration goes on till the angular funnel is empty, air entering through its lower tube and stopcock as the liquor runs down. The bore of the stopcock must be about $\frac{3}{8}$-inch, to allow sufficient passage for the air and water. The vessel when empty is refilled, the stopcock being closed while the liquid is inserted by the upper neck. At the end of the process any precipitate which adheres to the inner surface of the vessel is carefully rubbed off with a feather.



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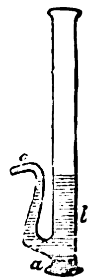

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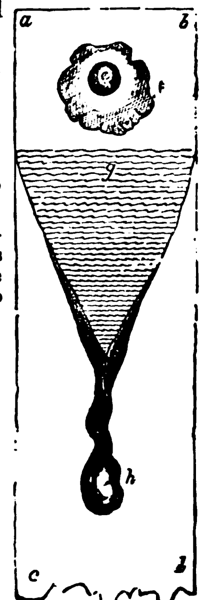


1616.

FILTRATIONS IN ANALYSIS.

1619. GRIFFIN'S FILTERING PAPER, of the best quality, in square sheets, measuring 21 inches by 17 inches, per quire of 24 sheets, 1s.

Cut Filters, seven sizes, in packets of 100, according to the table at page 168.

This Filtering Paper is prepared with the greatest care, and can be recommended for its great purity and property of rapid filtration. It contains no matter soluble in water, and its ashes amount to only 0·57 per cent.

1620. The following Report by Professor J. Alfred Wanklyn, shows that our paper, although very thick and tough, has but an extremely small ash-residue, and that it filters quickly and clearly, more so than any other paper in the market, except the Swedish, which is three times the price.

Report on Filter Paper from Messrs John J. Griffin & Sons:—

"The Swedish Paper, 17 × 21 inches, water mark, J. H. Munktell. This paper yields an ash of 0·50 per cent. on the paper. The weight of a square foot of the paper is 5·084 grammes, or the square inch, 0·0353 grammes. It filters sulphate of baryta, *freshly precipitated in the cold*, with great perfection. The only drawback is that it filters slowly; but this is inevitable. It is tough in texture.

"Griffin's Paper, without water-mark, size 17 × 21 inches. The ash is 0·57 per cent. The weight of a square foot of the paper is 6·060 grammes. It filters sulphate of baryta, *freshly precipitated in the cold*, with tolerable clearness, and a little quicker than the Swedish paper. It is very tough.

"(Signed.) J. Alfred Wanklyn."

1621. **SWEDISH FILTERING PAPER**, size of the sheets 21 by 17 inches, *per quire of* 24 *sheets*, 3s.

1622. Swedish Filtering Paper, cut into circular filters, in packets of 100, at the following prices :—

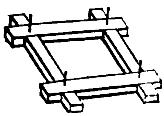
No. 0.	2	inch, for a	1	inch funnel,	*per packet*,	4d.
1.	2¼	” ”	1¼	”	”	5d.
2.	2¾	” ”	1½	”	”	8d.
3.	3¾	” ”	2	”	”	1s. 0d.
4.	4½	” ”	2½	”	”	1s. 2d.
5.	5½	” ”	3	”	”	1s. 8d.
6.	7½	” ”	4	”	”	2s. 3d.

1623. Swedish Filters, seven sizes, one packet, 100 filters of each size, 7s. 6d.

1624. Grey Woollen Filtering Paper for tinctures, very stout, in sheets measuring 24 inches by 24 inches, per quire of 24 sheets, 2s. 6d.

This paper is also kept cut into circles of the usual sizes.

1625. Filtering Frame, for supporting a linen or woollen cloth filter, Fig. 1625; Plate Glass, with German silver pins, 10 inches diameter, 12s.



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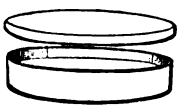

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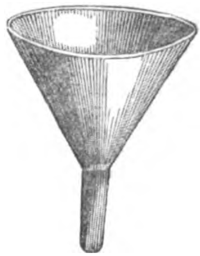

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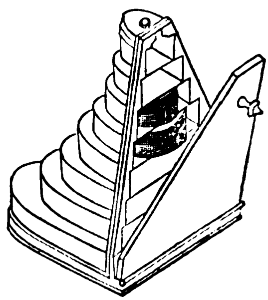


1629.

GLASS FUNNELS for FILTRATION, superior circular FILTER-PAPERS, in packets of 100, and JAPANNED BOXES for the filters, each box able to contain 200 papers.

1626. The following table embraces the seven sizes most commonly used in analytical operations :—

Nos.	Funnels. Diameter.	Funnels. Price.	Filters at per 100. Diameter.	Filters at per 100. Price.	Filter Boxes. Price.
0.	1 inch, . .	1½d.	2 inch, . .	1d.	5d.
1.	1¼ ” . .	1½d.	2¼ ” . .	1d.	6d.
2.	1½ ” . .	1½d.	2¾ ” . .	2d.	6d.
3.	2 ” . .	2d.	3¾ ” . .	3d.	7d.
4.	2½ ” . .	2½d.	4½ ” . .	4d.	8d.
5.	3 ” . .	3d.	5½ ” . .	6d.	10d.
6.	4 ” . .	4d.	7½ ” . .	9d.	1s. 0d.

1626A. Filters, No. 7, 9½ inches, per 100, 1s. 6d.; No. 8, 11½ inches, per 100, 2s.

1627. The set of seven Glass Funnels, Fig. 1627, 1s. 4d.

1628. The set of seven round japanned tin boxes, with 100 filters in each, 6s. 8d.

The Filter Boxes are made of Japanned tinplate, round, with lift-off covers, so that the filters are easily kept clean and ready for immediate use; each box will hold 200 filters. Fig. 1628.

1629. Pyramid Filter Case, Fig. 1629, of japanned tinplate, with hinged door closing with a spring, containing 700 filters, namely, 100 of each size, Nos. 0 to 6, 11s. Price of the filter case without filters, 9s.

1630. Donovan's Apparatus for the filtration of solutions of caustic potash, by which the filtration is made without any change of atmospheric air, and therefore without the continuous absorption of carbonic acid, funnel 4 inch diameter, receiving bottle 1½ to 2 pints, German glass, with stopper and caoutchouc connector, Fig. 1630, 5s.

FILTRATION OF BOILING LIQUIDS.

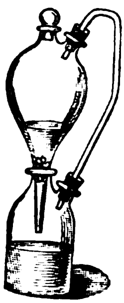
1631. Apparatus for Filtration, at 212° Fahr., consisting of a water-bath of japanned tin, as described at No. 1256, having a space for a 5 inch funnel of 60°, Fig. 1631, 12s.

1632. Ditto, with a 5 inch funnel, ground edge, and a 6 inch ground glass plate, 13s.

1633. Hot-water Funnel, after Plantamour, with side tube for boiling the water so as to filter at 212° Fahr., Fig. 1633.

	Single Funnel.	Double Funnel.
a. Tinplate, for a 4 inch Funnel,	3s.	4s.
b. „ „ 6 „	4s.	5s.
c. Copper, „ 4 „	5s.	7s.
d. „ „ 6 „	7s.	9s.

This apparatus is made of two kinds: the first, made according to Plantamour, is simply an outer metal case, in which the glass funnel is fixed by a cork at the neck. The second kind is a double metal funnel, holding the water in an enclosed space, the glass funnel being placed inside the double funnel, but not in contact with the water. The first kind gives the greatest heat to the filter. The second kind permits the ready changing of the funnel, but does not heat the filter so strongly as the first kind. The prices quoted are for the metal funnels only, whou the other articles represented in Fig. 1633. The tinplate funnels are japanned.



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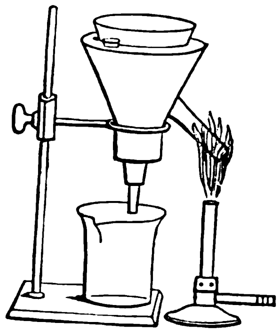


1633.

PERCOLATORS AND SEPARATORY FUNNELS.

1635. Funnels, German glass, angle of 60°, with glass stopcocks, Fig. 1636.

3 inch, 4s. 6d. | 4 inch, 5s. | 5 inch, 5s. 6d. | 6 inch, 6s.

Covers for Funnels, circular glass plates. See No. 1677.

1636. Funnels, fine white Bohemian glass, with cut glass stopcock, Fig. 1636.

4 inch, 6s. 6d.	6 inch, 8s.	8 inch, 10s.
5 „ 7s. 0d.	7 „ 9s.	9 „ 12s.

1637. Funnels, fine white Bohemian glass, with cover and groove for a water lute, with neck and cut stopper, Fig. 1637, 5 inches diameter, 3s. 6d.

1638. Funnel, fine white Bohemian glass, with cover and water lute, ground stopper and stopcock, cut glass, Fig. 1638, 5 inches diameter, 9s.

1639. Funnel, fine white Bohemian glass, with cover and groove for a water lute, two necks with ground stoppers and a stopcock, Fig. 1639, 5 inches diameter, 10s. 6d.

1640. Separatory Funnel, spindle form, Fig. 1640, German glass, stoppered or plain, capacity about 1 quart, size about 18 × 4 inches, 1s. 6d.

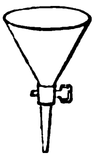
1641. Separatory Funnel, with stopcock, form of Fig. 1641, small size, funnel 2 inches wide, tube 12 inches long, 2s.

1642. Separatory Funnel, with globular head, stopper and stopcock, Fig. 1642, bulb 2 inches wide, tube 12 inches long, 2s. 6d.

Figs. 1640, 1641, 1642, are on page 171.

1643. Separatory Funnel, fine Bohemian glass, with stoppered neck, and two arms, Fig. 1643. Price according to the diameter of the body :—

3 inch, 2s. | 4 inch, 2s. 6d. | 5 inch, 3s. 6d. | 8 inch, 4s. 6d.



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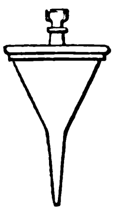

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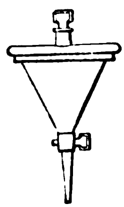

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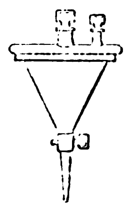

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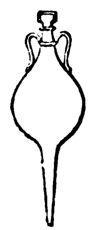

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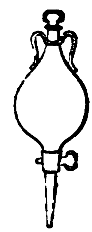


1644.

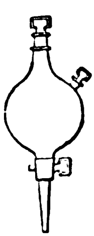
1644. Separatory Funnel, fine Bohemian glass, with stoppered neck, two arms, and a glass stopcock, Fig. 1644.

3 inch, 8s. | 4 inch, 9s. | 5 inch, 10s. | 8 inch, 11s.

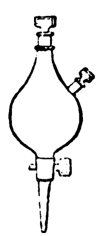
1645. Separatory Funnel, German glass, globular form, 4 inches in diameter, 36 ounces capacity, with stopper in the neck, and stopcock on the neck, form of Fig. 1644, without the arms, 5s.

1646. Separatory Funnel, fine white Bohemian glass, globular form, with two necks, stoppered, and a glass stopcock, Fig. 1646, *a*, *b*, *c*. This can be fitted up as Donovan's Filtering Apparatus, No. 1630.

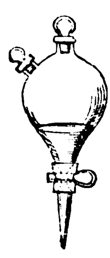
4 inch, 9s. 6d. | 5 inch, 10s. 6d. | 8 inch, 12s.



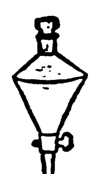
1646*a*.



1646*b*.



1646*c*.



1647.

1647. Separatory Funnel, fine Bohemian glass, angular form, with stoppered neck and glass stopcock, Fig. 1647, 5 inches diameter, 10s.; 6 inches, 10s. 6d.

For one particular use of this article, see No. 1618.

1648. Percolator, slight blown glass, pear-shaped funnel, with stopper, Fig. 1648, total height 8 inches, contents of flask about 5 ounces, 2s.

1649. Percolator, small size, with glass stopcock and stopper, form of Fig. 1649, bulb 2 inches diameter, flask contains about 4 ounces, 5s.

1650. Percolator, with glass stopcock, form of Fig. 1649, but with a neck on the shoulder like Fig. 1655, funnel 1 pint, flask $1\frac{1}{2}$ pint, German glass, 7s. 6d.

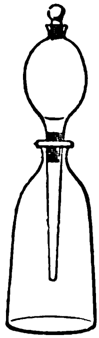
1651. Percolator, slight blown glass, with globular funnel, Fig. 1651, contents of flask $\frac{1}{2}$ ounce; serves also to apply acid in drops or small quantities, 9d.

1652. Percolator, with globular funnel, form of Fig. 1651, 6 inches diameter, wide mouth, stoppered flask 4 pints, Bohemian glass, 9s.


1640.


1641.


1642.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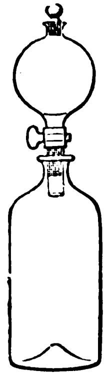

1649.


1651.

1653. Percolator, with globular funnel, Fig. 1651, contents of flask, $1\frac{1}{2}$ pint, funnel 4 inches diameter, with glass stopper, German glass, 5s.

1654. Percolator, with pear-shaped funnel, Figs. 1648 and 1640, but without handle, contents of flask $1\frac{1}{2}$ pint, German glass, 5s.

1655. Percolator, fine Bohemian glass, with angular funnel, wide mouth, stoppered, with neck at shoulder, Fig. 1655. Price, according to the capacity of the receiving bottle :—

2 pints, 7s. | 4 pints, 8s. | 8 pints, 9s.

In the event of any strong pressure being required to force the liquor through the powder that is placed in the percolator, an exhausting syringe (see No. 727) may be adapted to the side neck of the receiving bottle, and a partial vacuum being produced in the bottle, the atmospheric pressure in the unstoppered funnel then acts powerfully.

1656. Percolator, fine Bohemian glass, with ground-edge funnel, covered by a stout ground glass plate, with neck at shoulder, Fig. 1656. Price, according the capacity of the receiving bottle :—

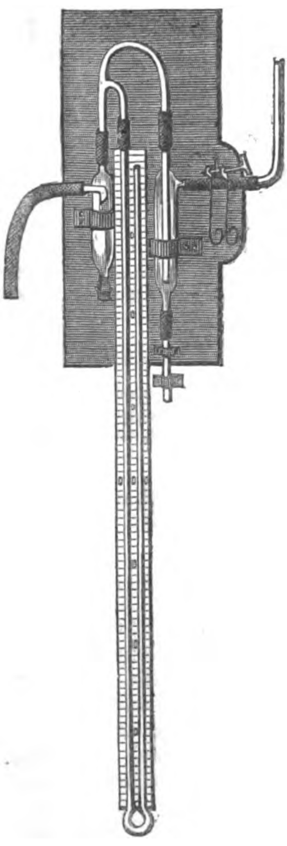
2 pints, 12s. | 4 pints, 13s. | 8 pints, 14s.

1657. Percolator, consisting of a cylindrical bottle and a cylindrical funnel, the latter with a ground glass stopper; general form nearly resembling Fig. 1657, but holes are drilled through the stopper and the neck, to which it is ground, and also through the neck of the funnel and the neck of the bottle, so that by turning round the stopper or the funnel, communication can be made between the contents and the external air. Best white German glass, the fittings well ground. Price, according to the capacity of the bottle :—

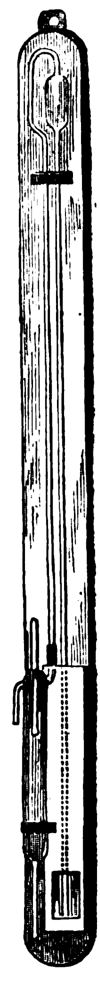
$\frac{1}{2}$ pint, 4s. | 1 pint, 5s. | $1\frac{1}{2}$ pint, 6s. | 2 pints, 8s.

1658. American Percolator, for preparing extracts by means of ether, alcohol, or other volatile liquids, Fig. 1658, capacity of the receiving bottle 12 pints; of the cylindrical funnel, 4 pints; fine Bohemian glass, with two glass stopcocks and connectors, 33s.

1659. Payen's Percolator, for preparing extracts by means of hot alcohol or ether, the bulb *a* being placed in a water bath (REGNAULT, *Cours de Chimie*, IV., p. 5). Small size, the glass part only, *a*, *b*, *c*, *d*, *e*, without furnace and bath, the bulb *a* $2\frac{1}{2}$ inches diameter, the percolator *b* 4 inches long, Fig. 1659; the set, 5s. 6d.



1661.



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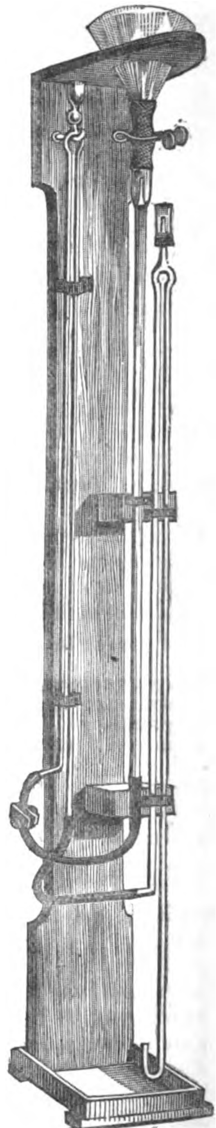


1663.

1660. Döbereiner's Percolator, or Extracting Apparatus, for experimenting on small quantities, consisting of a 3 ounce glass flask with two necks, and a tube 7 inches × ¾ inch, connected by a cork, Fig. 1660, 1s.

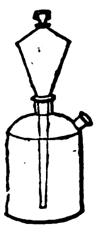
A vacuum being made in the flask *a* by the evaporation of a few drops of alcohol, and the neck *c* closed by the cork, the liquid *d* is then forced, by atmospheric pressure, through the powder *e*, and the cotton *f*, into the lower vessel, producing an extract of the powder *e*.

1661. Bunsen's Water Pump, as described by himself in *Annalen der Chemie*, is constructed on the principle of Sprengel's Mercury Pump, water being employed instead of mercury. A 40-foot fall for the water is not, however, always at command. Price of the board, with barometer and pump tubes, regulating clamps, &c., 42s.

1662. Bunsen's Water Pump, of a simpler form for student's use, one being usually sufficient for two students, Fig. 1662, 10s. 6d.

1663. Sprengel's Mercury Pump, through which the falling mercury carries air, causing it to act either as a suction or force pump. On black wooden stand, Fig, 1663, 35s.

If this pump is mounted on a mahogany frame, the price is £2, 5s.



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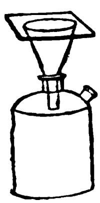

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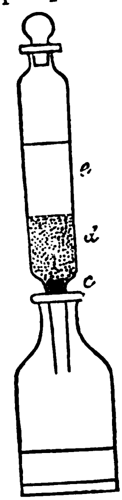

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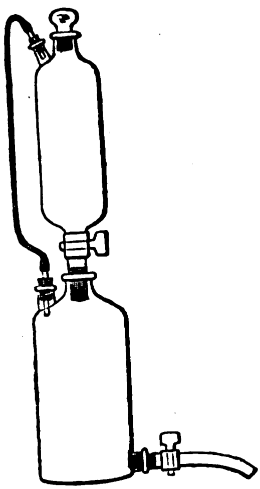

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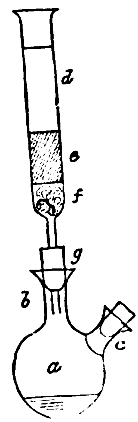

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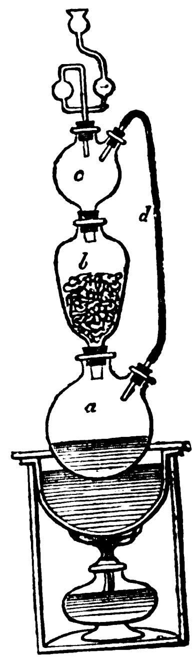

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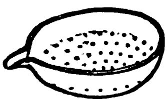
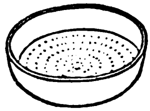


1665.



1669.

1672.

1673.

DRAINERS, STRAINERS, COLANDERS, SIEVES.

1665. Thuringian Porcelain Capsules, with perforated bottoms, for draining or filtering, Fig. 1665; can be conveniently placed over a beaker or lixiviating jar.

The following sizes :—

The four largest sizes.

No.	Diameter	Capacity	Price
No. 1.	6½ inch,	16 ounces,	1s. 6d.
2.	5¾ "	14 "	1s. 4d.
3.	5½ "	10 "	1s. 2d.
4.	4½ "	6 "	1s. 0d.

The five smallest sizes.

No.	Diameter	Capacity	Price
No. 5.	4 inch,	5 ounces,	11d.
6.	3¾ "	4 "	10d.
7.	3¼ "	3 "	9d.
8.	3 "	2 "	8d.
9.	2½ "	1 "	7d.

1665A. The set of four, 5s.
1665B. The set of five, 3s. 6d.
1665C. The complete set of nine strainers, 8s.
1669. Thuringian Porcelain Drainers, flat bottom, vertical sides, form of Fig. 1669.

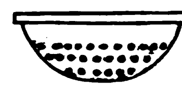
	Diameter.	Depth.			Diameter.	Depth.	
No. 1.	12 inches,	2¼ inches,	5s. 6d.	No. 4.	7½ inches,	2¼ inches,	2s. 6d.
2.	11 „	2½ „	4s. 6d.	5.	6 „	3 „	1s. 9d.
3.	9½ „	2½ „	3s. 6d.				

1670. Thuringian Porcelain Drainer, vertical form, Fig. 1670, useful as an eye-bath, 1 inch high, ½ inch wide, 4d.
1671. Colander, or Strainer, for separating crystals from mother liquor, &c., German semi-porcelain, with hard close porcelain glaze, not attacked by acids or colours, form of a basin, Fig. 1671, pierced with holes.

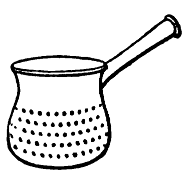
No. 9.	13 inches diameter,	Contents, 9 pints,	7s. 6d.
10.	14 „	„ 11 „	8s. 6d.
11.	16 „	„ 15 „	10s. 6d.


1670.

1672. Crystal Drainer, Berlin porcelain, 5 inches diameter.
1672. Shallow, with handles, Fig. 1672, page 173, 2s.
1673. Deep, without handles, Fig. 1673, „ „ 2s.
1674. Sieve for holding dyewood, &c., in boiling liquors, Thuringian porcelain, with handle at the side, Fig. 1674, 9s.


1671.

1675. Ditto, with pail or bow handle, Fig. 1675.
1. Deep form, 9s.
2. Broad and shallow, 7s.
1676. Decoction Strainer, consisting of four pieces, namely, funnel, sieve, pestle, and ring, Fig. 1676, Thuringian porcelain, *per set*, 5s.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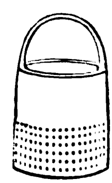
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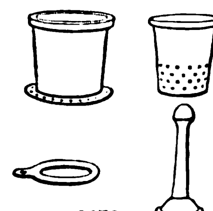
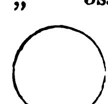

1676.

GLASS COVERS FOR JARS, FUNNELS, &c.

1677. Glass Circular Covers, for basins, funnels, jars, &c., consisting of round flat discs of glass, either plain or ground on one side, to close vessels air-tight, Fig. 1677. *Price per dozen*,—

Diameter.	1677. Plain.	1678. Ground.	Diameter.	1677. Plain.	1678. Ground.
2 inch,	5d.	9d.	5 inch,	1s. 0d.	2s. 0d.
2½ „	5d.	9d.	5½ „	1s. 3d.	2s. 3d.
3 „	6d.	10d.	6 „	1s. 6d.	2s. 6d.
3½ „	7d.	1s. 0d.	7 „	2s. 0d.	3s. 0d.
4 „	8d.	1s. 3d.	8 „	2s. 6d.	4s. 0d.
4½ „	10d.	1s. 6d.	9 „	3s. 6d.	6s. 0d.

1679. Glass Covers, circular, flat, thick glass, with 1 inch funnel-hole in the centre, Fig. 1679.
4 inch, 1s. | 5 inch, 1s. 2d. | 6 inch, 1s. 4d. *each*.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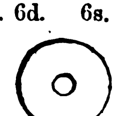
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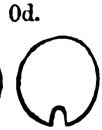

1681.

1681. Glass Covers, circular, flat, with a slit at the side to receive a funnel, Fig. 1681.
4 inch, 1s. | 5 inch, 1s. 2d. | 6 inch, 1s. 4d. *each*.

1682. Concave Covers for glass jars, with central neck to support a funnel, Fig. 1682, Bohemian glass,
3 to 4 inch, 6d. | 4½ to 5 inch, 9d. | 6 inch, 1s.


1682.

1683. Concave Covers, without funnel neck. See "Shallow Evaporating Dishes."

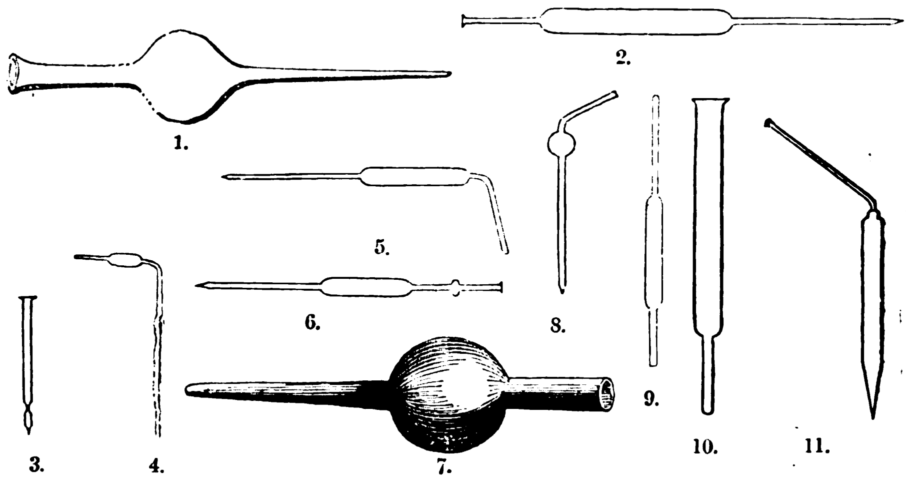
1685. Circular Glass Covers, of thick plate glass, ground and polished on the edges,
3 inch, 1s. | 4 inch, 1s. 6d. | 5 inch, 2s. | 6 inch, 3s.

1686. Covers, of dome form, to put over specimens to protect them from dust, &c., from 1s. upwards.

For other Covers of the dome form, see the article on "Receivers for Gases."

PIPETTES, SYPHONS, SYRINGES.

Glass Pipettes, for transvasing liquors, applying tests, washing filters, &c., all made of hard white German glass, not graduated.



1691.

1690. Straight Plain Glass Pipettes, without enlargement, Fig. 1690.

No. 1.	4 inches long,	¼ inch wide,	1d.	No. 4.	6 inches long,	⅜ inch wide,	2d.
2.	5 „	¼ „	1d.	5.	10 „	⅜ „	3d.
3.	5 „	⅜ „	2d.				

No. 6. 12 inches long, ⅓ inch wide, of hard Bohemian glass, with fine point, for burning a jet of hydrogen gas, 4d.
7. 6 inches long, ⅓ inch wide, with neck, Fig. 1691, No. 3, 3d.


1690.

1691. Glass Pipettes with Bulbs, or with Cylindrical Reservoirs, with necks or points either straight or bent.

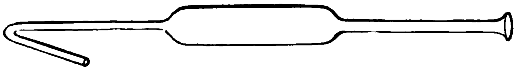
Purchasers are requested to indicate, by the Number *of the* Figure, *from 1 to 11, group of Figures 1691, which* Form *they wish to receive.*

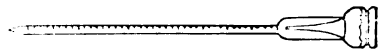
1692. Contents, ½, 1, or 1½ ounce, 3d.
1693. Contents, 2 ounces, 3d. each.
1694. Contents, 2½ or 3 ounces, 4d. each.
1695. „ 3½ or 4 „ 6d. „

1696. Large Pipette, form of Fig. 1691, No. 2, body 12 inches long by 1 inch wide, 8d.

1697. Pipette for passing solution of potash, or other liquid test, into gas tubes over mercury, Fig. 1697, 4d.

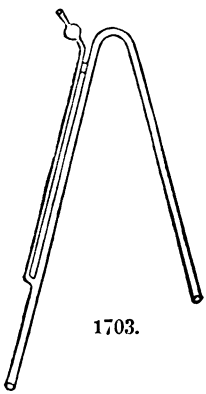
1698. Graduated Dropping Tube, with caoutchouc cover, Fig. 1698, 1s. 6d.

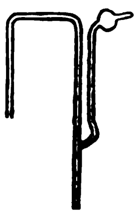

1697.

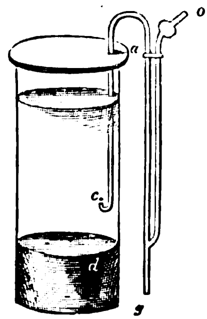

1698.

1699. Pipettes made of Thick Tube, or those which have pear-shaped reservoirs, are higher in price.

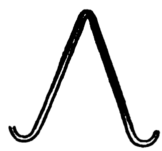
1700. Pipettes made to measure *exact quantities* of liquor are described among the apparatus for Centigrade Testing.

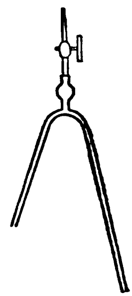

1703.


1704.



1705.


1707.


1709.

Glass Syphons, for transvasing liquids to separate them from precipitates, &c.

1701. Plain Glass Syphon, form of Fig. 1703, but without the suction tube, small size, namely, 13 inches long, 6d.

1702. Ditto, large size, namely, 15 inches long, and stronger than the preceding, 8d.

1703. Syphon, with suction tube, large size, Fig. 1703, 1s. 6d.

1704. Mitscherlich's Syphon, form represented by Fig. 1704 and by *o, c*, Fig. 1705, with suction tube.

No. 1.	10 inches to 12 inches,	9d.	No. 3.	21 inches to 24 inches,	1s. 3d.
2.	15 „ 18 „	1s. 0d.	4.	30 „ 36 „	1s. 6d.

This syphon has the two branches pretty wide apart, as represented by Fig. 1704, not so close together as shown in Fig. 1705. The lower end of the short limb is either turned upwards, as represented by Fig. 1705, or is closed and pierced with small side holes. The object of this is to avoid stirring up the precipitate which lies at the bottom of the solution that is to be decanted.

1706. Mitscherlich's Syphon, small size, with caoutchouc tube attached to the suction tube, to enable the operator to watch the rise of the liquid conveniently, 1s. 6d.

1707. Wirtemberg Syphon, with equal branches, Fig. 1707, small size, 25 inches, 1s.

1708. Ditto, large size, wide tube, 36 inches, 1s. 6d.

To set this syphon in action it is filled with some of the liquor that is to be decanted, or a small straight tube for suction may be attached to the outer end of the syphon by means of a cork. This tube is to be removed when the liquor has come over the bend of the syphon.

1709. Syphon for Decanting Acids, form of Fig. 1709, with a brass stopcock, 3s. 6d.

1710. Syphon for Decanting Acids, form of Fig. 1709, but with a glass valve and a caoutchouc tube, instead of a metal stopcock; length from end to end about 30 inches. 1s. 6d.

1711. Syphon with suction tube and a glass stopcock.

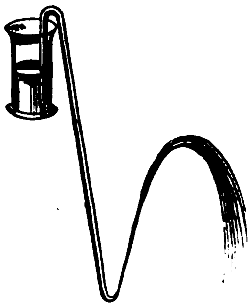
18 inches, 4s. | 24 inches, 4s. 6d.

1713. Eye Fountain, or syphon for spreading a gentle shower of water, Fig. 1713, 24 inch, 6d.

This syphon can be used to distribute liquids gradually, such as acid upon bleaching powder, to liberate chlorine continuously in small quantity for disinfection, &c.

1714. SYRINGES OR GLASS PUMPS for washing precipitates or filters, decanting liquids from above precipitates, &c., made of glass, with tow or cotton wool on the piston, form of Fig. 1714, size of wide tube 10 inches by $\frac{3}{4}$ inch, with bent point, 2s.

1715. Ditto, with straight point, Fig. 1715, 2s.



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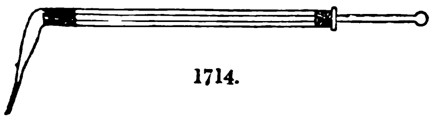
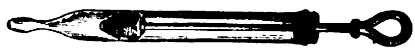


1714.



1715.

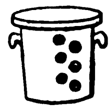
1716. Ditto, small size, straight point, for injections :—

3 inch, 3s. | 4 inch, 3s. 6d. | 5 inch, 3s. 9d. per dozen.

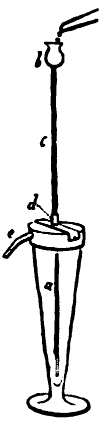
ELUTRIATION.

1717. Decanting Vessels, for the washing of powders and their separation into different degrees of fineness, Fig. 1717, Thuringian porcelain.

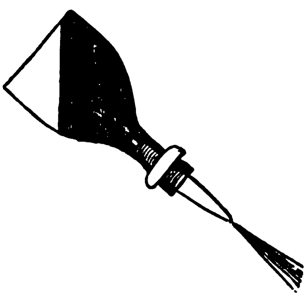
4 pints, 7s.	11 pints, 12s. 6d.	16 pints, 18s.
6 „ 10s.	13 „ 14s. 0d.	20 „ 22s.



1717.



1718.



1719.

1721.

1720.

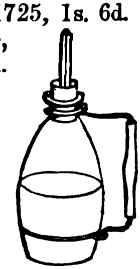
1718. Schulze's Apparatus for the mechanical analysis of soils, clays, ground ores, &c., by elutriation, or washing with water, Fig. 1718, 5s.

The soil or other powder is diffused in water in the glass *a*. Water is run from a water bottle into the funnel *b*. The lower end of the tube *c* is raised more or less from the bottom of the glass, and fixed by a cork at *d*. The fine powder flows off with the water by the pipe *e*, into a beaker placed to receive it. By raising the funnel more or less from the bottom of the glass *a*, the disturbing force of the fall of water is modified at discretion.

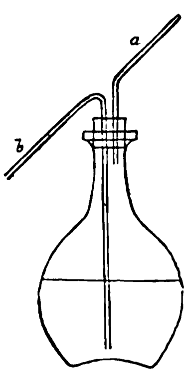
The conical glass is 9 inches high, and 3 inches diameter at the mouth.

WASHING BOTTLES.

1719. Berzelius's Washing Bottle, with single jet, for the washing of precipitates or filters, by a fine but strong jet of water produced by air compressed in the bottle by the mouth, Figs. 1719 and 1720. The jet is represented by Fig. 1721. One pint flask, fitted, 1s.
1720. Ditto, quart size, 1s. 6d.
1721. The jet alone, 2d.
1722. Berzelius's Washing Bottle, fitted with handle, for use with boiling water, Fig. 1722, *a*, *b*, pint size, 2s.
1723. Washing Bottle, with jet and blowing tube, Fig. 1723, white glass flask, size, one pint or less, 1s. 3d.
1724. Ditto, cylindrical green glass bottle, one pint size, 1s.
1725. Ditto, white glass bottle, with caoutchouc blowing tube, Fig. 1725, 1s. 6d.
1726. Washing Bottle, with jet and blowing pipe, fitted with handle, form of Fig. 1722*b*, for use with boiling water, one pint, 2s. 6d.

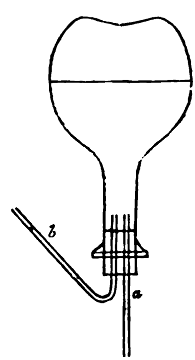


1722*a*.



1723.

1725.



1729.

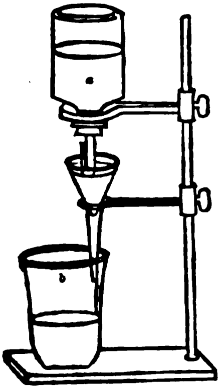
1722*b*.

1727. Berzelius's Fountain Bottle, for supplying a continuous current of pure water or other liquid, to wash a precipitate upon a filter, represented in action by Fig. 1727, the washing tube being represented by Fig. 1728, 1½ pint bottle, fitted with the tube, 1s. 6d.
1728. The Washing Tube alone, Fig. 1728, 3d.
1729. Gmelin's Modification of the Fountain Washing Bottle, represented by Fig. 1729, 1½ pint size, 1s. 3d.
1730. The same, mounted with handle, like Fig. 1722*b*, for use with hot water, 2s. 6d.
1731. Gay Lussac's Syphon Washing Bottle, which yields a continuous current of water to wash a precipitate, Fig. 1731; the syphon tube 25 inches long, the bottle 4 pint size, fitted. 3s. 6d.
1732. Washing Bottle, with a fine orifice for the jet of water, and a blowing-tube with caoutchouc mouthpiece attached; useful in washing small precipitates, and in experiments of metallic reductions with the blowpipe; contents, 2 ounces, Fig. 1732. 1s.

Washing by Pipettes.—Any of the pipettes described in Nos. 1690 to 1700 may also be used for washing precipitates.

1733. Caoutchouc Washing Bottle, with glass jet, Fig. 1733.

1 ounce, 1s. | 2 ounces, 1s. 3d. | 4 ounces, 1s. 8d. | 6 ounces, 2s.



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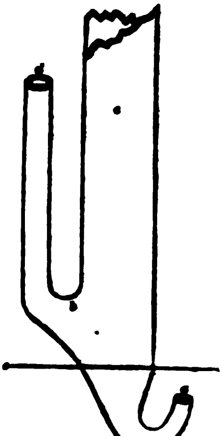

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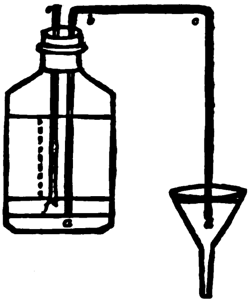
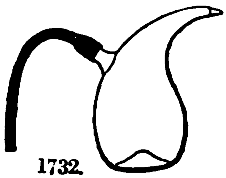


1731.



1732.

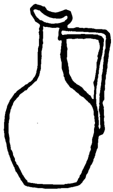
1733.

1734. Hot Water or Acid Jugs, of saltglazed stoneware, with handle and spout, capable of being heated on a sand-bath, or, with care, over a rose gas burner.

1 pint, 1s. | 2 pints, 1s. 6d. | 3 pints, 2s.

1735. Hot Water or Acid Jugs, of rough stoneware, wide-mouthed.

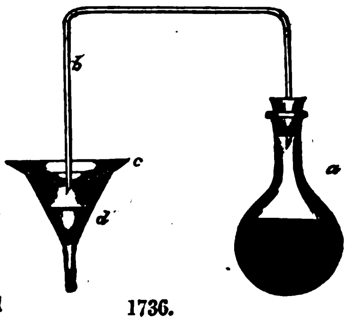
2 pints, 6d.	4 pints, 1s. 0d.	1 gallon and upwards,
3 „ 9d.	6 „ 1s. 2d.	at 1s. 3d. per gallon.



1734.

1736. Shier's Apparatus for Washing Precipitates by Steam, consisting of a flask, a syphon tube, and a perforated glass capsule, Fig. 1736, 3s. 6d.

a is a water bottle; *b*, a narrow glass tube of ⅛-inch bore; *c*, a very shallow glass capsule, perforated in the centre; *d*, a glass funnel.—*Use.* The precipitate is supposed to be on a paper filter in the funnel. Water is boiled in the bottle *a*, and the steam passed into the funnel, where it condenses into boiling hot distilled water, which rapidly washes the precipitate. The pressure of the steam and the high temperature greatly facilitate the process. If the steam comes off too fast it blows out between the capsule and the funnel, and does no harm. But it is easy, when the water is boiled by a gas flame, or over a lamp, to provide against waste of steam. Care must be taken that the water in the funnel does not rise so high as to touch the slant-cut end of the steam-pipe. The use of this apparatus effects a great saving of time in one of the most tedious operations of Analytical Chemistry.



1736.

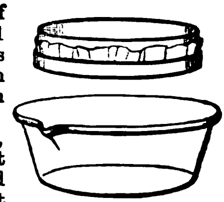
Dialysis.

The process of Chemical Analysis by means of Liquid Diffusion, discovered by the late Thomas Graham, Esq., F.R.S., Master of the Mint, is described in his Memoir on "Liquid Diffusion applied to Analysis," printed in the "Transactions of the Royal Society" for 1861, page 183.

The Dialyser, or apparatus for effecting Analysis by Diffusion, invented by Mr. Graham, consists of a species of sieve, having gutta-percha sides and a parchment paper bottom. A mixed liquid that is to be analysed is put into the Dialyser, and the Dialyser is floated in distilled water contained in a flat basin. At the end of twenty-four hours the crystallisable substances contained in the mixed liquid will have diffused into the distilled water of the basin, leaving the gelatinous substances of the mixture still in the Dialyser.

By means of this Dialysing Apparatus, arsenious acid, metallic salts, strychnine, and other poisons, mineral and organic, can be readily separated from organic solutions in medico-legal inquiries. The process has the advantage of introducing no metallic substance or chemical re-agent of any kind into the organic fluids. The arrangement for operating is also of the simplest nature. Very minute quantities of arsenic have been separated by the dialytic process from egg albumen, gum arabic, isinglass, milk, porter, blood, and animal intestines, and obtained in a solution fit for the application of re-agents.

The Dialyser serves also for the separation and decomposition of many metallic salts, for the separation of urea and other crystallisable salts from urine, for the separation in general of all *crystalloids* or crystallisable bodies from all *colloids* or gelatinous bodies, and for the preparation and purification of such colloids as hydrated silicic acid, hydrated alumina, gelatine, albumen, starch, caramel, tannin, gummic acid, &c. In short, the Dialyser is an instrument of great practical utility to all Chemists, Physiologists, &c., who are engaged in researches into the composition of organic or mixed liquids.


1737.

Instructions for operating with the Dialyser.—The Dialyser consists of two gutta-percha hoops, one of them 2 inches deep, and the other 1 inch deep. The 2-inch hoop is slightly conical, and the 1-inch hoop goes over the small end of the 2-inch hoop. Both must be washed very clean with distilled water. The parchment paper that is to form the bottom must be about 3 inches wider than the small end of the 2-inch hoop.

Soak the parchment paper for about a minute in distilled water, stretch it evenly over the small end of the 2-inch hoop, and strain it tight by pushing over it the 1-inch hoop. The paper must be pressed smoothly up round the outside of the larger hoop, and the bottom must be quite flat and even. There must be no small holes in the paper. To try this, put distilled water into the Dialyser, to the depth of a ½-inch, and place the dialyser on some white blotting-paper. If any wet or dark spots appear they indicate the existence of small holes. To close such holes, apply to the under surface of the paper about the holes some liquid albumen, put on a small patch of parchment paper, and iron the patch with a hot smooth iron. This coagulates the albumen, fixes the patch, and closes the hole.

The Dialyser being prepared, the liquid to be operated upon is to be put into it, to the depth of not more than half an inch, and the Dialyser is then to be floated on distilled water contained in a flat basin. The quantity of the water in the basin should be about five times as much as that put into the Dialyser. The whole is then to be set aside for twenty-four hours.

A Dialyser of 6 inches diameter serves to operate upon 7 or 8 fluid ounces of liquid; one of 8 inches diameter for 12 or 14 fluid ounces; one of 10 inches diameter for 20 fluid inches; and one of 12 inches diameter for 30 fluid ounces. The wider the Dialyser, and the greater the quantity of distill e water used in the outer basin, the more rapid and effective is the diffusion.

DIALYTIC APPARATUS.

1737. Gutta Percha Dialyser, in two pieces, as described above :—

6 inches in diameter, 3s.	10 inches in diameter, 5s. 6d.
8 ,, ,, 4s.	12 ,, ,, 7s. 0d.

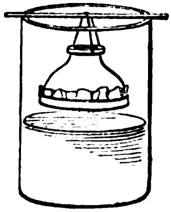
1737A. Parchment Paper, of the best quality, selected specially for this process, and in pieces to suit the sizes of the Dialyser, price per dozen :—

8½ in. square, for 6 in. Dialyser, 1s. 0d.	12½ in. square, for 10 in. Dialyser, 2s. 0d.
10½ ,, 8 ,, ,, 1s. 6d.	14½ ,, 12 ,, ,, 2s. 6d.

1737B. Flat Conical Glass Basins with Spout, to hold distilled water below the dialyser, and collect the diffusate.

9 in. basin, to suit 6 in. Dialyser, 2s.	13 in. basin, to suit 10 in. Dialyser, 3s. 6d.
11 " " 8 " " 3s.	15 " " 12 " " 5s. 0d.

1738. Bell-shaped Dialysers, of glass, Fig. 1738, with two flanges.



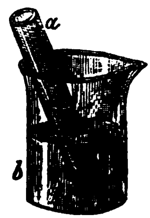
1738.

3 inch bore, 8d.,	corresponding papers, per dozen,	9d.
4 " 10d.	" "	9d.
5 " 1s.	" "	1s.

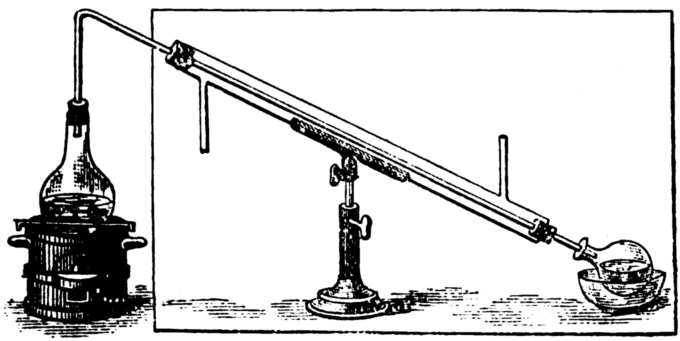
Cylindrical Jars suitable for these Dialysers are described at No. 1530.

In using these Dialysers, the parchment paper is strained over the wide end, and tied with a thread above the flange. The vessel is then suspended in a wide jar, containing the water into which the crystallisable substance is to be diffused. It can be suspended from a glass rod by a string tied round the neck of the Dialyser. The water in the jar must cover the face of the parchment paper, but not rise above the outer edge.

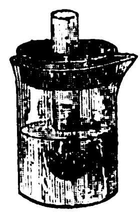
"The quality of parchment paper I have generally used is the third in point of thickness, and has three letters upon the sheet."—*Note from Mr. Graham.*



1738*a*.



1738*c*.



1738*b*.

1738A. Dr. Alfred S. Taylor, in testing for Mineral Poisons, such as Arsenic, Antimony, Mercury, Lead and Copper, uses an apparatus consisting of a Tube Form of Dialyser, over which a piece of fine gut skin is tied, as Fig. 1738*a*; where *a* is the tube containing the organic liquid and the poison, *b* is a beaker of distilled water.

1738B. Another form of Tube Dialyser is shown in Fig. 1738*b*, in which the tube can be raised to any height by passing it through a hole in a bung.

The gut skin, which Dr. Taylor prefers, can of course be applied to dialysers of the form of Fig. 1738, and others.

1738c. The apparatus used by Dr. Taylor for detecting phosphorus in vapour in minute quantity, according to the plan of Mitscherlich, is shown in Fig. 1738*c*. The dotted space represents the dark chamber into which the vapour is distilled; the flask containing the viscera and phosphorus being heated on the outside.

Such a condenser is described at 1881.

GLASS SHADES.

1739. **GLASS SHADES, round, oval, and square.**

LIST OF PRICES :—

Inches.	Price.						Inches.	Price.						Inches.	Price.				
	Round.		Oval.		Square.			Round.		Oval.		Square.			Round.		Oval.		Square.
	s.	d.	s.	d.	s.	d.		s.	d.	s.	d.	s.	d.		s.	d.	s.	d.	s.
10		6	1	0	1	6	30	2	0	3	8	4	2	50	6	3	7	8	11
12		7	1	2	1	9	32	2	1	3	11	4	5	55	8	4	11	4	16
14		8	1	4	2	3	34	2	3	4	1	4	8	60	12	6	16	0	22
16		10	1	8	2	7	36	2	5	4	4	4	11	65	18	0	23	0	32
18	1	0	2	0	2	10	38	2	8	4	7	5	3	70	26	0	33	0	43
20	1	2	2	4	3	1	40	3	0	4	11	5	7	75	36	0	45	0	58
22	1	4	2	8	3	4	42	3	4	5	3	6	0	80	46	0	55	6	74
24	1	6	3	0	3	7	44	3	10	5	7	7	0	85	60	0	78	6	94
26	1	7	3	2	3	10	46	4	6	5	11	8	3	90	86	0	106	0	118
28	1	10	3	5	4	0	48	5	3	6	6	9	3	95	116	0	136	0	148

The total number of inches in a shade is calculated as follows :—

Round Shades—Once the height added to three times the diameter.
Oval Shades—Once the height, twice the length, once the breadth.
Square Shades—Once the height, twice the length, once the breadth.

The height is never charged less than the length or diameter.

Examples—A Round Shade, 12 inches in height and 6 inches in diameter, is reckoned 30 inches, price 2s.; an Oval Shade, 12 inches in height, 8 in length, and 6 in width, is reckoned 34 inches, price 4s. 1d.

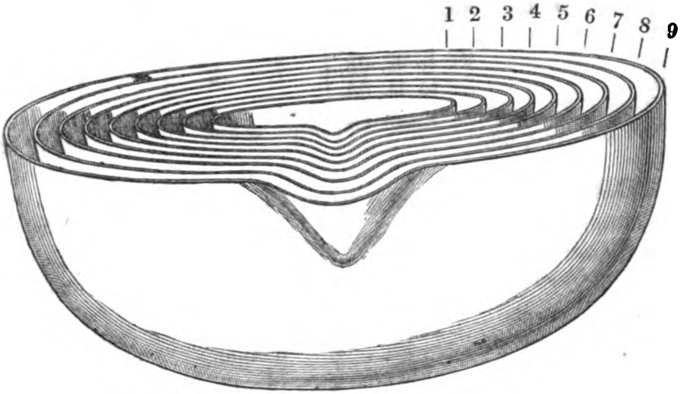
Shades of any required size can be supplied. The quotations in the above list are merely to show the range of prices.

1739A. POLISHED BLACK WOODEN FEET for Round Shades, *price according to diameter* :—

1. Under 7 inches, at 2d. per inch.
2. From 7 inches to 9½ inches, at 2½d. per inch.
3. Above 9½ inches, at 3d. per inch.

Polished Black Wooden Feet, for Oval or square Shades, according to length, 4d. per inch.

CHENILLE to put round the edges of shades to keep out dust, per yard, 2d.



1740.

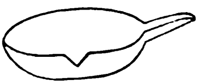
PLATINUM EVAPORATING BASINS.

1740. PLATINUM EVAPORATING BASINS, with Spout, form of Fig. 1740.

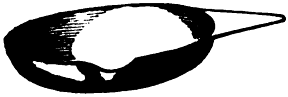
The following particulars are subject to considerable variation, and they are given only to afford a general idea of the probable cost of a basin of a given size. The exact cost may be less or more than the sum here stated. It depends on the market price of the metal, and on the thickness of the vessel. When a basin of a particular strength is required, it is requested that the desired thickness, as shown by the metal plate gauge on page 3, may be stated.

No.	Diameter.	Contents.	Weight.	Price.
1.	$1\frac{3}{8}$ inch,	$\frac{1}{4}$ ounce,	100 grains,	12s.
2.	$1\frac{1}{2}$ „	$\frac{3}{8}$ „	125 „	14s.
3.	$1\frac{3}{4}$ „	$\frac{1}{2}$ „	170 „	18s.
4.	2 „	$\frac{3}{4}$ „	240 „	25s.
5.	$2\frac{1}{4}$ „	1 „	360 „	38s.
6.	$2\frac{1}{2}$ „	$1\frac{1}{4}$ „	420 „	44s.
7.	$2\frac{3}{4}$ „	$1\frac{1}{2}$ „	520 „	55s.
8.	3 „	$2\frac{1}{4}$ „	630 „	66s.
9.	$3\frac{1}{4}$ „	$3\frac{1}{4}$ „	800 „	84s.
10.	$3\frac{1}{2}$ „	4 „	960 „	100s.

1741*a*.



1741*b*.



1741c.

1741*d*.

1741. **Platinum Evaporating Basins and Cups, small sizes and shallow form, Figs. 1741 *a*, *b*, *c*, *d*, serving also as covers to crucibles, and in lieu of blowpipe spoons.**

The small Platinum Cups supported by a pair of slight steel tongs, either with or without platinum points, will be found to answer the purpose of platinum spoons, while they are cheaper and more convenient. They are beaten very thin, to facilitate the production of a high temperature to act on the substances ignited in them. After a fusion, the cup can be separated from the tongs, and boiled, with its contents, in a proper solvent in a small flask, by which means a solution of the assay is procured, and the vessel cleaned at the same time.

No.	Diameter.	Depth.	Price.	No.	Diameter.	Depth.	Price.
1.	¼ inch,	⅛ inch,	9d. to 1s. 0d.	5.	1 inch,	¼ inch,	5s. to 6s.
2.	⅜ „	⅙ „	1s. to 1s. 6d.	6.	1½ „	¼ „	12s.
3.	½ „	¼ „	2s. to 3s. 0d.	7.	2 „	½ „	20s.
4.	¾ „	⅛ „	3s. to 4s. 0d.				

1742. Steel Tongs, for holding these Capsules before the blowpipe, or in a gas flame, No. 130, 6d.

PORCELAIN EVAPORATING BASINS.

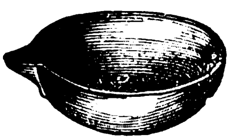
1743. Berlin Porcelain Evaporating Basins, or Capsules, with spout, Fig. 1743, glazed inside and outside, but not on the edge. *Depth of the Capsules = one-third of their diameter.*

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
00.	2¾ inch,	2 ounces,	4d.	6.	6 inch,	16 ounces,	2s. 0d.
0.	3¼ „	2½ „	6d.	7.	7¼ „	1 pint,	2s. 6d.
1.	3½ „	3 „	9d.	8.	8½ „	2 „	3s. 0d.
2.	3¾ „	4 „	10d.	9.	10 „	4 „	5s. 0d.
3.	4 „	6 „	1s. 0d.	10.	12 „	7 „	8s. 0d.
4.	4½ „	8 „	1s. 3d.	11.	14 „	10 „	9s. 0d.
5.	4¾ „	10 „	1s. 8d.	12.	15½ „	18 „	25s. 0d.

1749. Berlin Porcelain Evaporating Basins, or Capsules, white glazed, nearly flat bottomed, with spout, Fig. 1749.

Depth about one-fourth of their Diameter.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
1.	2¾ inch,	1½ ounce,	5d.	5.	4½ inch,	8 ounces,	1s. 2d.
2.	3 „	2 „	9d.	6.	5 „	12 „	1s. 9d.
3.	3½ „	3½ „	10d.	7.	6 „	18 „	2s. 0d.
4.	4 „	5 „	1s. 0d.				



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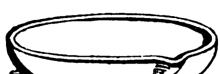

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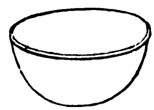
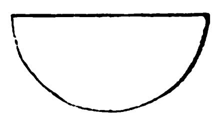


1751.



1752.

1751. Berlin Porcelain Hemispherical Evaporating Basins, form of Fig. 1751, sometimes with spout, glazed.

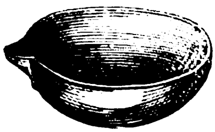
No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
1.	5½ inch,	17 ounces,	2s. 6d.	4.	8½ inch,	4 pints,	5s. 6d.
2.	6½ „	1½ pint,	3s. 6d.	5.	9½ „	5 „	6s. 6d.
3.	7½ „	2½ pints,	4s. 6d.				

1752. Berlin Porcelain Evaporating Basins, white glazed, nearly hemispherical, thin and uniform in the substance, without rim or lip, Fig. 1752, adapted for weighing in analytical experiments :—

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
000.	1 inch,	⅛ ounce,	2d.	3.	2 inch,	1 ounce,	7d.
1.	1½ „	½ „	5d.	4.	2¼ „	1½ „	10d.
2.	1¾ „	¾ „	5d.	5.	2½ „	2 „	1s. 0d.

1754. **Dresden (Meissen) Porcelain Evaporating Basins**, form of Fig. 1754, with spout, very thin in body, glazed inside and outside, except a small place on the bottom outside.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
000.	15½ inch,	16 pints	15s. 0d.	5.	7½ inch,	1½ pint,	2s. 6d.
00.	14½ „	12 „	13s. 0d.	6.	6½ „	1 „	1s. 9d.
0.	13½ „	9 „	10s. 0d.	7.	5½ „	10 ounces,	1s. 4d.
1.	12 „	7 „	6s. 0d.	8.	5 „	7 „	1s. 0d.
2.	11 „	5 „	5s. 0d.	9.	4¼ „	5 „	6d.
3.	10 „	3 „	4s. 0d.	10.	3¼ „	2 „	5d.
4.	8½ „	2 „	3s. 6d.	11.	2⅝ „	1 „	5d.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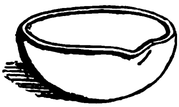
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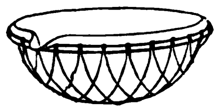
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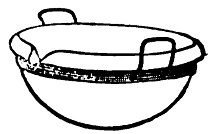

1757.

1755. **Thuringian Porcelain Evaporating Basins**, Fig. 1755, thin in body, very good spouts for pouring, glazed inside, biscuit outside.

No. 1.	6½ inch,	16 oz.,	1s. 0d.	No. 6.	3¾ inch,	4 oz.,	8d.
2.	5¾ „	14 „	10d.	7.	3¼ „	3 „	6d.
3.	5¼ „	10 „	10d.	8.	2¾ „	2 „	6d.
4.	4½ „	6 „	8d.	9.	2½ „	1 „	4d.
5.	4 „	5 „	8d.				

1756. Thuringian Porcelain Evaporating Basins, large size, with good spouts, glazed within, biscuit without, with ridge to suit the metal fittings of a water-bath, as shown by Figs. 1757 and 1758.

No. 00.	15 inch,	16 pints,	12s. 0d.	No. 3.	10 inch,	4 pints,	3s. 3d.
0.	14 „	12 „	8s. 6d.	4.	9 „	3 „	2s. 9d.
1.	12 „	7 „	5s. 6d.	5.	8 „	2 „	2s. 3d.
2.	11 „	6 „	4s. 6d.	6.	7½ „	1½ „	1s. 9d.

1757. Thuringian Porcelain Evaporating Basins, like No. 1756, but with iron handles, Fig. 1757.

No. 00.	15 inch,	16s.	No. 0.	14 inch,	13s.

1758. Thuringian Porcelain Evaporating Basins, like No. 1756, but covered with a netting of iron wire, to receive a luting, Fig. 1758.

No. 00.	15 inch,	13s.	No. 0.	14 inch,	10s.

1759. Thuringian Porcelain Evaporating Basin, flat, thin and light, glazed on both sides; diameter, 2½ inches; contents, 1 ounce; Fig. 1759, 4d.

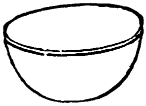
1760. Thuringian Porcelain Evaporating Basins, hemispherical form, without spouts, glazed inside, biscuit outside, Fig. 1760.

No. 1.	4½ inch,	10 oz.,	1s. 0d.	No. 5.	2½ inch,	2 oz.,	6d.
2.	4 „	8 „	10d.	6.	2 „	1 „	5d.
3.	3½ „	6 „	9d.	7.	1½ „	½ „	3d.
4.	3 „	4 „	8d.	*The set of Seven Basins*,			4s. 5d.

1761. Thuringian Porcelain Evaporating Basins, very thin and shallow, with sharp spouts, glazed within and without, Fig. 1761. *The set of Four Basins*, 2s. 6d.

No.	Diameter	Contents	Price	No.	Diameter	Contents	Price
1.	3¼ inch,	2 oz.	10d.	3.	2¾ inch,	1 oz.	6d.
2.	3 „	1½ „	8d.	4.	2½ „	½ „	6d.

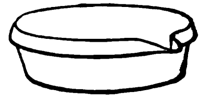
1759.



1760.

1761.

1762.



1763.

1762. Thuringian Porcelain Evaporating Basins, cylindrical form, flat bottoms, steep sides, with spouts, glazed within, biscuit without, Fig. 1762.

No.	Diameter	Contents	Price	No.	Diameter	Contents	Price
1.	4 inch,	4 oz.,	10d.	3.	3 inch,	2¼ oz.,	8d.
2.	3¼ „	3½ „	10d.	4.	2½ „	2 „	8d.

The set of Four Basins, 3s.

1763. Thuringian Porcelain Evaporating Basins, flat bottomed and shallow, with vertical sides and spouts, glazed inside, biscuit outside, Fig. 1763.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
000.	16½ inch,	13 pints,	12s. 0d.	1.	11 inch,	4 pints,	4s. 6d.
00.	13½ „	10 „	10s. 0d.	2.	10 „	2 „	3s. 6d.
0.	12 „	6½ „	6s. 6d.	3.	6½ „	1 „	1s. 9d.

1764. Thuringian Porcelain Shallow Evaporating Basins, or Pans, flat bottoms, and nearly vertical sides, with spout, glazed inside and outside, Fig. 1764.

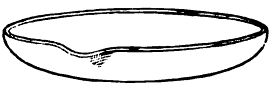
No.	Diameter.	Depth.	Contents.	Price without Handles.	Price with Two Handles.
1.	11½ inch,	4 inch,	6 pints,	4s. 6d.	5s. 6d.
2.	11 „	3½ „	5 „	3s. 6d.	4s. 6d.
3.	9½ „	3¼ „	4 „	2s. 6d.	3s. 6d.
4.	8½ „	3 „	3 „	1s. 9d.	2s. 9d.

1765. Thuringian Porcelain Crystallising Pan, consisting of an evaporating basin, with a closely-fitting cover; diameter, 18 inches; contents, 14 pints, 15s.

BERLIN SEMI-PORCELAIN EVAPORATING BASINS.

1766. Berlin Semi-Porcelain Evaporating Basins, very stout, with hard porcelain glaze, form of Fig. 1766, shallow, with spout.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
00.	3½ inch,	2 ounces,	5d.	6.	11¼ inch,	4½ pints,	3s. 0d.
0.	4¼ „	4 „	6d.	7.	12 „	5 „	3s. 6d.
1.	5¼ „	8 „	6d.	8.	12½ „	7 „	4s. 6d.
2.	6½ „	16 „	8d.	9.	13¼ „	9 „	6s. 0d.
3.	8 „	1½ pints,	1s. 0d.	10.	14¼ „	11 „	7s. 0d.
4.	9 „	2½ „	1s. 6d.	11.	16 „	14 „	8s. 6d.
5.	10½ „	3½ „	2s. 0d.	12.	18 „	18 „	14s. 0d.



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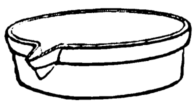

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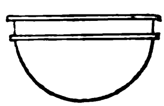


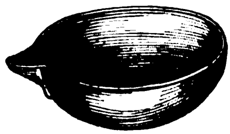
1767.

1770.

1767. Berlin Semi-porcelain Evaporating Basins, with hard porcelain glaze, deep form, hemispherical, Fig. 1767, with an extra rim for fitting a hole over a water bath.

Diameter.	Contents.	Price.	Diameter.	Contents.	Price.
6 inches,	1 pint,	1s. 3d.	11 inches,	6½ pints,	7s.
7 ,,	2 pints,	1s. 9d.	12 ,,	8½ ,,	8s.
8 ,,	3 ,,	2s. 6d.	13 ,,	10 ,,	9s.
9 ,,	4 ,,	3s. 6d.	14 ,,	14 ,,	12s.
10 ,,	5 ,,	4s. 6d.			

1768. Berlin Semi-porcelain Evaporating Basins, deep, with spout, with hard porcelain glaze, Fig. 1768. A set of six basins, Nos. 1 to 6, 2¼, 2¾, 3¼, 3¾, 4¼, 4½ inch diameter; per set, 2s. 3d.



1768.

1769.

1769. Berlin Semi-porcelain Evaporating Basins, shallow, without spout, watch-glass form, Fig. 1769, with hard porcelain glaze; per set of six basins, Nos. 1 to 6, 2 to 4 inches diameter, 2s. 3d.

1769A. Wedgwood Evaporating Basins, similar to Fig. 1768, glazed inside, biscuit without.

1 inch,	2½d.	9 inches,	2s. 8d.	17 inches,	12s.
2 inches,	3d.	10 ,,	3s. 6d.	18 ,,	14s.
3 ,,	4d.	11 ,,	4s. 6d.	19 ,,	16s.
4 ,,	7d.	12 ,,	5s. 0d.	20 ,,	20s.
5 ,,	11d.	13 ,,	6s. 0d.	21 ,,	24s.
6 ,,	1s. 4d.	14 ,,	7s. 0d.	22 ,,	30s.
7 ,,	1s. 9d.	15 ,,	8s. 0d.	23 ,,	36s.
8 ,,	2s. 4d.	16 ,,	10s. 0d.	24 ,,	42s.

Saltglazed Stoneware Evaporating Basins.

1770. Brown Saltglazed Stoneware Evaporating and Crystallising Basins, made very thin at the bottom, and with spreading rim, without spout, Fig. 1770. Can be heated securely over hot sand, over a charcoal fire, or, with precaution, over a spirit-lamp or a rose gas burner; useful for crystallising, in consequence of the slight roughness of the surface; also for the evaporation of quantities of saline solutions, which can be carried to dryness if the evaporation is slow. They do not stand a red heat, and are too rough for analytical operations. They are not acted upon by diluted acids.

Depth, one-third of width.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
1.	2½ inch,	1½ ounce,	3d.	7.	5½ inch,	12 ounces,	5½d.
2.	3 ,,	2½ ounces,	3d.	8.	6 ,,	16 ,,	6d.
3.	3½ ,,	3½ ,,	3½d.	9.	7 ,,	20 ,,	7d.
4.	4 ,,	4½ ,,	4d.	10.	8 ,,	32 ,,	9d.
5.	4½ ,,	6 ,,	4½d.	11.	9 ,,	40 ,,	10d.
6.	5 ,,	8 ,,	5d.	12.	10 ,,	60 ,,	1s. 2d.

1771. The Set of Twelve Basins, 6s.

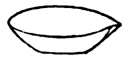
Enamelled Iron Evaporating Basins.

1772. Thin Cast-iron Evaporating Basins, lined with glazed earthenware, with spout, Fig. 1772.

6 inch,	1s. 0d.	12 inch,	3s.	22 inch,	24s.
8 ,,	1s. 6d.	15 ,,	6s.	26 ,,	30s.
10 ,,	2s. 0d.	18 ,,	10s.	29 ,,	35s.

1773. Thin Cast-iron Hemispherical Basins, lined with glazed earthenware, with two handles, Fig. 1773.

6 inch,	1s.	18 inch,	10s.
8 ,,	1s. 6d.	22 ,,	24s.
10 ,,	2s. 0d.	28 ,,	30s.
12 ,,	3s. 0d.	32 ,,	42s.
15 ,,	6s. 0d.		

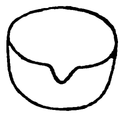

1772.


1773.

Thin Cast-iron Hemispherical Basins, of the form of Fig. 1773, without enamel, of any size from 6 to 15 inches diameter. See No. 1228.

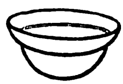
GLASS EVAPORATING BASINS.

1774. Bohemian Glass Evaporating Basins, hemispherical form, with spout, cut edges, the substance uniformly thick throughout; best hard white glass, without punty mark on the bottom, Fig. 1774.


1774.

No. 1.	2½ inch,	2 ounces,	5d.	No. 7.	6 inch,	1¼ pint,	1s.
2.	3 ,,	3 ,,	6d.	8.	7 ,,	1½ ,,	1s. 3d.
3.	3½ ,,	5 ,,	6d.	9.	8 ,,	2 pints,	1s. 6d.
4.	4 ,,	8 ,,	7d.	10.	9 ,,	3½ ,,	2s. 0d.
5.	4½ ,,	11 ,,	8d.	11.	10 ,,	4 ,,	2s. 6d.
6.	5 ,,	16 ,,	9d.				

1779. Bohemian Glass Evaporating Basins, without spout, but with expanding edge, to adapt them to openings in water baths, &c., best hard white glass, Fig. 1779, four sizes, 3, 4, 5, and 6 inches diameter; price per set, 2s.


1779.


1780.

1780. Bohemian Glass Basins, for Evaporation and Crystallisation, serving also as pans, trays, troughs, &c., fine white hard glass, flat bottoms, vertical sides, ground edges, uniformly thick, without spouts, Fig. 1780.

No.	Wide.	Deep.	Contents.	Price.	No.	Wide.	Deep.	Contents.	Price.
1.	2 inches,	1¾ inch,	2½ oz.,	3d.	8.	5½ inches,	3 inches,	1¾ pint,	10d.
2.	2½ ,,	2 inches,	4½ ,,	3d.	9.	6 ,,	3¼ ,,	2¼ pints,	1s. 0d.
3.	3 ,,	2 ,,	8 ,,	4d.	10.	8 ,,	5 ,,	6 ,,	2s. 0d.
4.	3½ ,,	2¼ ,,	10 ,,	5d.	11.	9 ,,	5½ ,,	8 ,,	2s. 6d.
5.	4 ,,	2½ ,,	14 ,,	6d.	12.	10 ,,	6 ,,	10 ,,	3s. 6d.
6.	4½ ,,	2⅝ ,,	1 pint,	7d.	13.	15 ,,	7 ,,	28 ,,	12s. 6d.
7.	5 ,,	2¾ ,,	1¼ ,,	8d.	14.	18 ,,	10½ ,,	66 ,,	25s. 0d.

1784. Shallow Glass Evaporating Basins (watch-glass form), hard pale green glass. Per dozen:—

3 inch, 4s. | 4 inch, 5s. | 5 inch, 6s. | 6 inch, 8s.

1785. Shallow Glass Evaporating Basins (watch-glass form), white French glass, 1½ inch and 2 inches, 1s. per dozen.

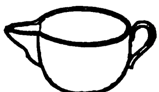
1786. Hard Bohemian Glass Evaporating Basins, shallow form, ground on the edges to fit in pairs, 1½ inch, 2 inches, 2½ inches, 3s. per dozen.

1787. Clips for holding watch-glasses, in pairs, to protect substances from the air while being weighed. See page 134.

PORCELAIN EVAPORATING BASINS WITH HANDLES.

Ladles, Pourers, etc.

1788. Dresden Porcelain Evaporating Basins (Cups or Pourers), with ring handle and large spout, Fig. 1788, serving also for ladling acids, pouring mercury into tubes, &c., glazed both inside and outside.



1788.

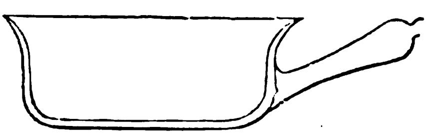
No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
1.	6 inch,	26 ounces,	3s. 6d.	4.	2¾ inch,	3 ounces,	8d.
2.	4½ „	16 „	1s. 3d.	5.	1¾ „	½ ounce,	7d.
3.	4 „	7 „	1s. 0d.				

Berlin Porcelain Evaporating Capsules, with spout and handle, in one piece.

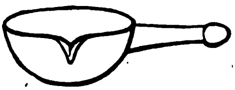
		Diameter.	Contents.	
1790.	No. 0. Fig. 1790.	1½ inch,	¼ ounce,	3d.
1791.	„ 1. „ 1791.	2 „	1 „	10d.
1792.	„ 2. „ 1791.	2¾ „	2½ „	1s. 0d.
1793.	„ 3. „ 1791.	3½ „	4 „	1s. 3d.

1791.

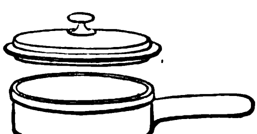
Fig. 1790 represents the actual size of the Capsule.



1790.



1794.



1796.

1794. Thuringian Porcelain Evaporating Basins, with handle in one piece (ladles), glazed inside and outside, with sharp spouts, Fig. 1794.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
00.	8 inch,	3 pints,	6s. 6d.	3.	5½ inch,	18 ounces,	3s. 6d.
0.	7 „	2 „	5s. 6d.	4.	4½ „	12 „	3s. 0d.
1.	6½ „	1½ „	4s. 6d.	5.	4 „	8 „	2s. 6d.
2.	6 „	1¼ „	4s. 0d.	6.	3½ „	6 „	1s. 9d.

1795. Berlin Semi-Porcelain Evaporating Basins, or Ladles, with spout and handle, in one piece, Fig. 1795, glazed within and without.

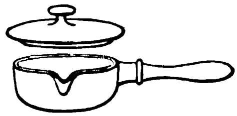
1795.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
00.	3 inch,	4 ounces,	9d.	2.	4½ inch,	12 ounces,	1s. 6d.
0.	3½ „	6 „	10d.	3.	5¼ „	20 „	2s. 0d.
1.	4 „	8 „	1s. 0d.	4.	6½ „	32 „	3s. 6d.

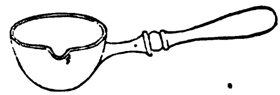
1796. **Thuringian Porcelain Evaporating Basins, cylindrical form, with handle and cover, without spout (stout pans), Fig. 1796.**

No.				No.			
1.	7½ inch,	2 pints,	5s.	3.	6½ inch,	1 pint,	3s. 6d.
2.	7 „	1½ „	4s.	4.	5½ „	¾ „	2s. 9d.

1797. Berlin Semi-Porcelain Evaporating Basins or Pans, with cover and wooden handle, Fig. 1797.



1797.

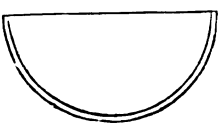


1798.

No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
00.	3 inch,	4 ounces,	1s. 0d.	2.	4½ inch,	12 ounces,	2s. 0d.
0.	3½ „	6 „	1s. 3d.	3.	5¼ „	20 „	2s. 6d.
1.	4 „	8 „	1s. 6d.	4.	6½ „	32 „	3s. 6d.

1798. Thuringian Porcelain Evaporating Basins, with spout, and turned wooden handle (ladles), glazed, Fig. 1798. Two sets as follow :—

1798 Small Set (4 B).				1799. Large Set (6 E).			
No.	Diameter.	Contents.	Price.	No.	Diameter.	Contents.	Price.
1.	4 inch,	5 ounces,	1s. 8d.	1.	8 inch,	40 ounces,	4s. 6d.
2.	3½ „	4 „	1s. 8d.	2.	7¼ „	32 „	4s. 0d.
3.	3¼ „	3½ „	1s. 6d.	3.	6¼ „	20 „	3s. 6d.
4.	2¾ „	2½ „	1s. 2d.	4.	5½ „	12 „	3s. 0d.
5.	2½ „	1½ „	1s. 0d.	5.	4¾ „	9 „	2s. 6d.
				6.	4¼ „	6 „	2s. 0d.



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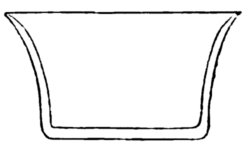

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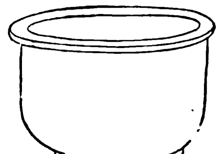

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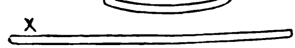

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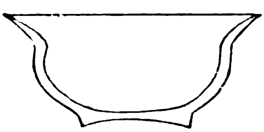

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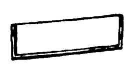
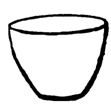


10.

11.

12.



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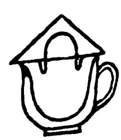


14.

PORCELAIN CUPS.

1800. **Berlin Porcelain Cups**, glazed on both sides, serving both for evaporations and ignitions.

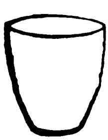
Any single piece, 3*d*. *The dozen of one kind, or assorted*, 2*s*. 6*d*.

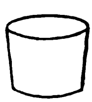
The thin varieties—such as Nos. 1, 2, 3, 13, 14—may be heated to redness like crucibles. The other kinds are intended only for moderate temperatures, such as the evaporation of solutions to dryness, &c.

No. 1. Hemispherical Capsule, without spout, thin, size of Fig. 1.

See No. 1752 for other sizes of this form of cup.

No. 2. Capsule, size and form of Fig. 2, thin.
3. Small Crucible, size and form of Fig. 3.
4. Crucible of the form of Fig. 3, but of the diameter of Fig. 4.
5. Basin of the size and form of Fig. 5.
6. Basin of the form of Fig. 5, but $2\frac{1}{4}$ inches in diameter.
7. Shallow Capsule of the size and form of Fig. 7.
8. Small flat plate of white glazed porcelain, with raised rim, for testing solutions which give coloured precipitates, $1\frac{1}{4}$ inch diameter.
9. A similar plate, $1\frac{1}{2}$ inch diameter.
10. Flat-bottomed pans, like Fig. 10, from $1\frac{1}{3}$ inch to $1\frac{3}{4}$ inch diameter, for evaporations, or for use as trays for gas tubes.
11. Round-bottomed Capsules, like Fig. 11, or a form between Figs. 10 and 11, thick in substance, for slow evaporations, size $1\frac{1}{2}$, $1\frac{3}{4}$, and 2 inches diameter.
12. Evaporating Capsules, flat bottoms outside, round inside, thick in metal, Fig. 12, for use in slow evaporations to dryness, size $1\frac{1}{4}$, $1\frac{1}{2}$, and $1\frac{3}{4}$ inch.
13. Very thin Crucible, without cover, Fig. 13, 1 inch wide and 1 inch deep, for ignitions.
14. Cup and cover, form and size of Fig. 14, for exposing to ignition substances liable to decrepitation.
15. Small Porcelain Bottle, for carrying solution of nitrate of cobalt among blowpipe apparatus.


1, 2, 3.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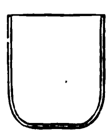
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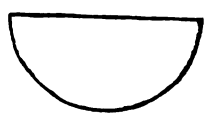
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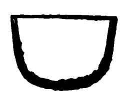
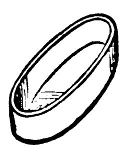

7.

1801. **Dresden Porcelain Cups**, serving either for evaporations or ignitions, some of them very thin for weighing, glazed, all without covers.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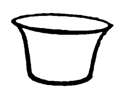

12.

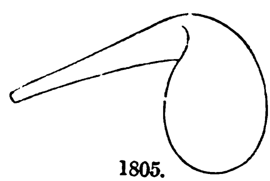
No. 1. Crucible, form of Fig. 1, very thin, diameter 1 inch, contents 40 grains of water, 3d.
2. Similar, diameter $\frac{5}{8}$ inch, contents 15 grains, 3d.
3. Similar, diameter $\frac{1}{2}$ inch, contents 10 grains, 3d.
4. Plattner's Cup, Fig. 4, very thin, $1\frac{1}{2}$ inch diameter, 1 inch high, contents $\frac{1}{2}$ ounce, 4d.

5. Deep Cups, Fig. 5. See "Dresden Digesters," No. 1491, 5 sizes.
6. Cup of the form of Fig. 6, $\frac{3}{4}$ inch deep and 2 inches diameter, contents $\frac{3}{4}$ ounce, 5d.
7. Thin Cup for ignitions, form of Fig. 7, but shallow, $1\frac{1}{2}$ inch deep, 3 inches diameter, holds $2\frac{1}{2}$ ounces, 9d.
8. Similar to 7, 1 inch deep, 2 inches diameter, holds 1 ounce, 4d.
9. Similar to 7, $\frac{5}{8}$ inch deep, $1\frac{1}{4}$ inch diameter, holds $\frac{1}{4}$ ounce, 3d.
10. Plattner's Shallow Pan, for blowpipe experiments, oval form, Fig. 10, 2 inches long, $1\frac{1}{4}$ inch wide, $\frac{1}{2}$ inch deep, holds 3 drachms, 4d.
11. Similar to 10, $1\frac{1}{2}$ inch long, $\frac{3}{4}$ inch wide, $\frac{1}{4}$ inch deep, holds 1 drachm, 3d.
12. Plattner's Digester, for preparing and evaporating solutions of minerals for analysis by the blowpipe, Fig. 12, $1\frac{1}{4}$ inch deep, mean diameter $1\frac{3}{4}$ inch, across the mouth $2\frac{1}{4}$ inch, contents $1\frac{1}{4}$ ounce, 7d.
13. Similar to 12, 1 inch deep, mean diameter $1\frac{1}{2}$ inch, across the mouth $1\frac{3}{4}$ inch, contents $\frac{1}{2}$ ounce, 6d.

Distillation.

RETORTS.

In general the form of the Retorts is that represented by Figs. 1805 and 1809; but the globular form A, Fig. 1810, can also be supplied. The globular form being only required for liquids that rise at a very high temperature, is not so much in request as Retorts of the form represented by Fig. 1805, which sort is consequently the one that is commonly kept in stock.



1805.

1805. RETORTS, Plain, Fig. 1805, fine white French glass, free from lead. *Price per dozen,*

1 ounce,	1s. 2d.	6 ounces,	2s. 6d.	16 ounces,	5s.	2 pints,	9s. 6d.
2 „	1s. 4d.	8 „	3s. 0d.	1 pint,	6s.	$2\frac{1}{2}$ „	10s. 6d.
3 „	1s. 6d.	10 „	3s. 6d.	$1\frac{1}{4}$ „	7s.	3 „	12s. 6d.
4 „	2s. 0d.	12 „	4s. 0d.	$1\frac{1}{2}$ „	8s.		
5 „	2s. 3d.	14 „	4s. 0d.	$1\frac{3}{4}$ „	9s.		

ACID FUNNELS for filling Retorts with liquids without soiling the necks. See 10, 11, 12, Fig. 1598, and Nos. 1942 to 1947.

1806. Retorts, Plain, Fig. 1805, hard white German glass, same quality of glass as the fine white Boiling Flasks. *Price:—*

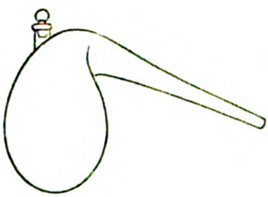
	Per dozen.		*Per dozen.*		*Each.*
2 ounces,	2s. 9d.	14 ounces,	7s. 0d.	$2\frac{1}{2}$ pints,	1s. 2d.
3 „	2s. 9d.	16 „	8s. 0d.	3 „	1s. 3d.
4 „	2s. 9d.	1 pint,	9s. 0d.	4 „	1s. 6d.
6 „	3s. 0d.	$1\frac{1}{4}$ „	10s. 0d.	6 „	2s. 6d.
8 „	3s. 6d.	$1\frac{1}{2}$ „	10s. 6d.	8 „	3s. 0d.
10 „	4s. 0d.	$1\frac{3}{4}$ „	11s. 0d.	12 „	4s. 6d.
12 „	6s. 0d.	2 „	12s. 0d.	16 „	7s. 6d.

1807. Retorts, Plain, of hard white Bohemian glass, the same quality as the beaker glasses. Price per dozen :—

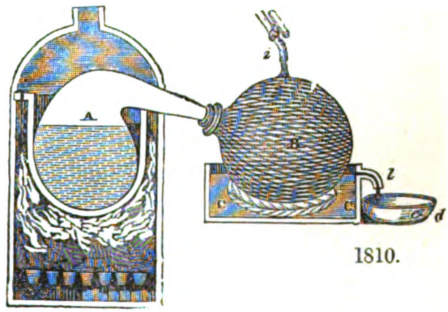
1 ounce,	4s. 0d.	5 ounces,	4s. 6d.	10 ounces,	7s.	2 pints,	12s.
2 „	4s. 0d.	6 „	5s. 0d.	16 „	8s.	4 „	15s.
3 „	4s. 0d.	7 „	5s. 0d.	1 pint,	9s.	6 „	18s.
4 „	4s. 6d.	8 „	6s. 0d.	1½ „	10s.		

1809. Retorts Tubulated and Stoppered, Fig. 1809, best hard white German or Bohemian glass, same quality as the fine Boiling Flasks and Beakers. Price per dozen :—

2 ounces,	6s.	12 ounces,	11s.	2 pints,	20s.
3 „	7s.	14 „	11s.	2½ „	21s.
4 „	7s.	16 „	12s.	3 „	23s.
5 „	8s.	18 „	13s.	4 „	26s.
6 „	9s.	1 pint,	15s.	6 „	33s.
7 „	9s.	1¼ „	16s.	8 „	42s.
8 „	10s.	1½ „	18s.	12 „	60s.
10 „	10s.	1¾ „	19s.	16 „	90s.



1809.

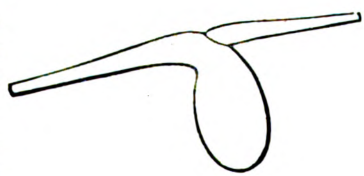


1810.

1812. Tubulated and Stoppered Receivers are supplied at the same prices as Retorts of equal capacity. See No. 1847.

1813. Liebig's Retort, with an extra neck, for passing gases over a substance while heated for distillation ; best hard white Bohemian glass.

10 oz.,	1s. 6d.	40 oz.,	2s.	80 oz.,	3s. 6d.
20 „	1s. 6d.	60 „	3s.	100 „	4s. 0d.



1813.

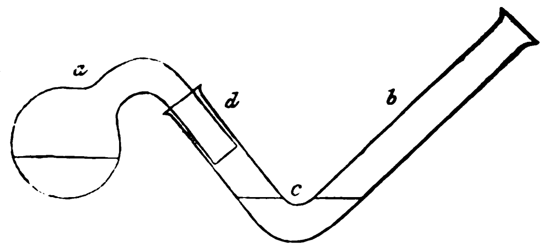
1814. Retort of the most infusible Bohemian glass, for exposing substances to a red heat, as for preparing oxygen gas from red oxide of mercury.

a. 5 ounces, 1s. | *b.* 10 ounces, 1s. 6d.

1814.

TUBE RETORTS.

1815. Clark's Retort and Receiver, for the distillation and condensation of small quantities of acids, &c.; hard glass; diameter of bulb 2 inches, capacity 1¼ to 2 ounces, width of neck ¾ inch, length 8 inches. Per dozen, 10s.



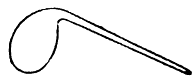
1815.

This apparatus will be found very useful in the distillation of small quantities of liquids, or the preparation of small portions of acids for testing, &c. The retort and the receiver fit closely at *d*. *c* is the distilled liquor.

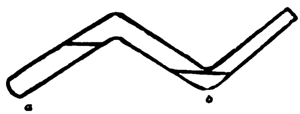
1817. Faraday's Retort and Receiver, in one piece, hard glass, 12 inches long, ⅝ inch wide, 6d.

1818. Gay Lussac's Bent Tube Retort, for use when a solid is to be heated in a gas confined over mercury.

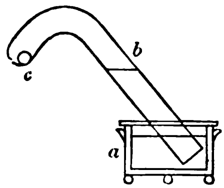
a. 10 inches long, ½-inch diameter, 6d.
b. 12 „ ¾ „ 8d.



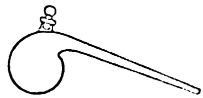
1820.



1817.



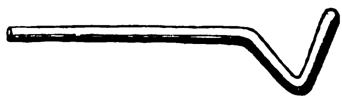
1818.



1820*a*.

1819. Oxide of Mercury Tube Retort, as used by Hofmann, Fig. 1819, 8d.

1820. Tube Retorts of hard German glass, slight, either round or pear-shaped form, with narrow necks, useful when the free access of atmospheric air is to be avoided.



1819.

	Contents.	Plain, Fig. 1820.	Tubulated.	Stoppered, Fig. 1820*a*.
a.	½ to 2 ounces,	2½d.	3½d.	6d.
b.	2½ to 3 „	3d.	4d.	7d.
c.	4, 5, 6 „	3½d.	4½d.	9d.

For corresponding Receivers, see No. 1853.

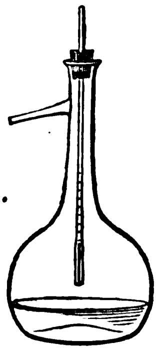
1821. Tube Retorts, tubulated and stoppered, with Receivers adapted to the neck by grinding.

2 ounces, 1s. | 3 ounces, 1s. | 4 ounces, 1s. 3d. | 6 ounces, 1s. 6d.

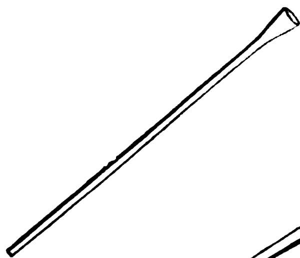
FRACTIONAL DISTILLATION.

1822. Retorts for Fractional Distillation, small size, of hard German glass, with wide tubulure for thermometer, and bent neck, Fig. 1822.

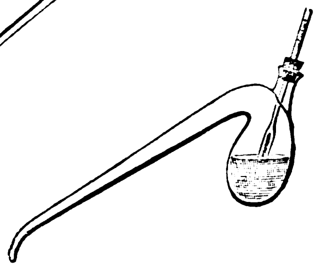
½ ounce, 4d. | 1 ounce, 5d. | 2 ounces, 6d. | 3 ounces, 7d.



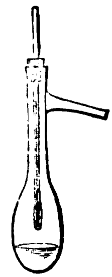
1823.



1825.



1822.



1824.

1823. Flask for fractional distillation, with long neck to contain an entire thermometer, and a side neck which can be adapted to a Liebig's Condenser, best hard Bohemian glass, Fig. 1823.

a. Contents 1 pint, 1s. 6d. | *b.* Contents 2 pints, 2s.

1824. Oval Flasks for the fractional distillation of small quantities of liquid organic preparations, form of Fig. 1824; the bulb of various capacities, the neck for the thermometer 5 inches long, ½ inch wide; the inclined neck for the Distillate 4 inches long, ¼ inch wide.

a.	The bulb about	1	inch diameter, or	½	ounce contents,	3d.
b.	„	1½	„	1	„	4d.
c.	„	2	„	3	„	5d.

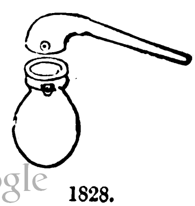
1825. Condenser for the above distilling apparatus, Fig. 1825, 5d.

This condenser consists of a glass tube, 15 inches long, ⅓ inch diameter, with a wide neck, to which the delivery tube of the distilling flask is to be connected by a cork. This tube forms a sufficient condenser for some bodies; for others, it can be cooled with a cover of wet calico or filtering paper.

PORCELAIN RETORTS.

1826. Retorts of Berlin porcelain, biscuit outside, glazed inside, five sizes.

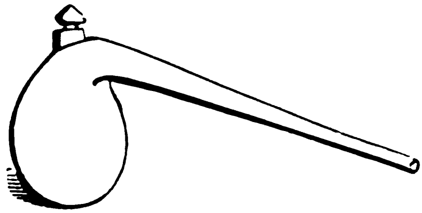
	Contents.	Price, Plain.	Price, Stoppered.
No. 1.	1½ ounces,	2s. 6d.	3s. 6d.
2.	3 „	3s. 6d.	4s. 6d.
3.	6 „	4s. 6d.	6s. 0d.
4.	9 „	5s. 0d.	7s. 0d.
5.	12 „	6s. 0d.	8s. 0d.



1828.

1827. Retort of Berlin Porcelain, globular form, tubulated and stoppered, contents 5 pints, 10s.

1828. Berlin Porcelain Retort, with loose head, to be fixed on with wire and cement (stucco), for the preparation of ammonia, &c., contents 12 ounces, Fig. 1828, 5s.



1829.

1829. Retorts of Dresden Porcelain, Fig. 1829.

	Contents.	Price, Plain.	Price, Stoppered.
No. 1.	6 ounces,	5s.	6s.
2.	3 „	3s.	4s.

1831. Retorts, Berlin Semi-Porcelain, stoppered.

2 ounces, 2s. 0d.	16 ounces, 3s. 6d.	32 ounces, 5s. 6d.
4 „ 2s. 3d.	24 „ 4s. 6d.	48 „ 6s. 0d.
8 „ 2s. 6d.		

FIRECLAY RETORTS.

1833. Retorts of Infusible Fireclay, London made, similar to Fig. 1833.

	Plain.	Tubulated.		Plain.	Tubulated.
¼ pint,	1s. 0d.	1s. 6d.	2 quarts,	5s.	7s.
½ „	1s. 0d.	1s. 9d.	3 „	6s.	8s.
1 „	1s. 9d.	2s. 6d.	4 „	7s.	9s.
1½ „	2s. 9d.	3s. 6d.	6 „	11s.	13s.
2 „	3s. 6d.	4s. 6d.	8 „	14s.	17s.
3 „	4s. 0d.	6s. 0d.	16 „	21s.	25s.

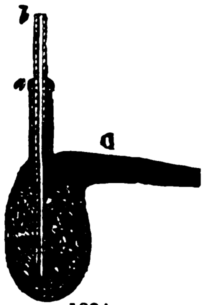
If with a long tubulure it is intended to receive a long tube, as shown in Fig. 1834, which represents the apparatus for preparing sulphide of carbon.

1833.

METAL RETORT.

1837. Retorts of Copper or Iron, for preparing oxygen gas. See section on "Gas Bottles," Nos. 2015, 2022, and 2025.

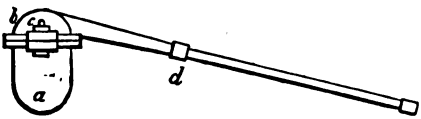
Iron Retorts, for distilling organic matters at a red heat, mercury, &c., with loose head, secured by bolts, with long iron necks to screw on, Fig. 1838, three sizes :—



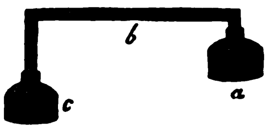
1834.

Measurement of the body of Retort inside :—

	Width.	Depth.	Contents.	Price.
1838.	4 inch,	3½ inch,	1 pint,	7s. 6d.
1839.	6 „	7½ „	5 „	18s. 0d.
1840.	7 „	9 „	9 „	25s. 0d.



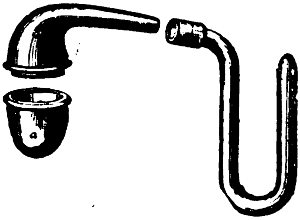
1838.



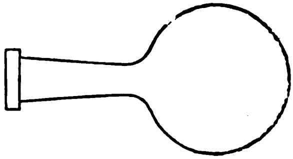
1841.

1841. Lead Retort and Receiver, for the preparation of hydrofluoric acid, form of Fig. 1841; the retort *a* and receiver *c*, each 3½ inches diameter; the tube *b*, 16 inches in length, 9s.

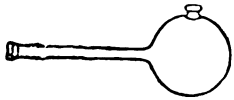
1842. Lead Retort and Receiver, larger size, form of Fig. 1842, 30s.



1842.



1846.



1848.

1843. Lead Capsule, 4 inches wide, flat bottom, 1s.

RECEIVERS.

1846. Plain Receivers, globular, Fig. 1846, with short wide neck, slightly conical, with welted mouth, ground smooth, French white glass, free from lead.

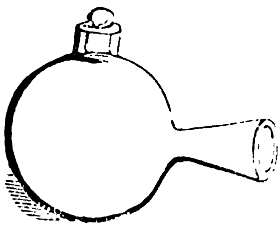
The Sizes and Prices are given under the head of "French Ballons" at No. 1405.

1847. Receivers, globular, with short conical neck, and a Tubulure and ground Stopper, placed at right angles to the neck, Fig. 1847, *a*, *b*, and *c*; hard white German or Bohemian glass.

The Sizes and Prices are the same as the sizes and prices of hard white German and Bohemian stoppered Retorts. See No. 1809.

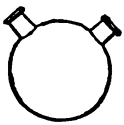
1848. Receivers, globular, with one long neck, and a Tubulure, form of Fig. 1848; French or German glass.

These can be supplied at any size, and at prices not much differing from those of the Short-necked Receivers, No. 1847; but these with long necks are not always kept ready in stock, being rarely demanded.

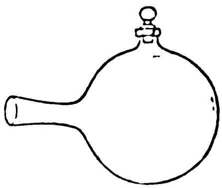


1847*a*.

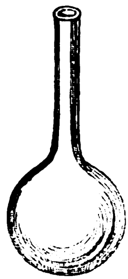
1847*b*.



1849.



1847*c*.



1850.

1849. Receivers, with two short necks, for use in distillations, in which the products are a condensible liquid, and a gas; see Fig. 1849, *b* in Fig. 1849*a*, and Fig. 1849*b*; hard white Bohemian glass.

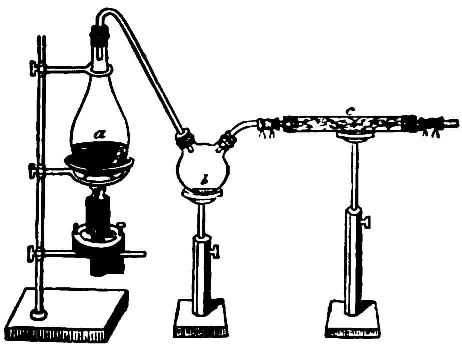
2 ounces,	4d.	6 ounces,	8d.	1 pint,	1s. 3d.
3 „	5d.	8 „	9d.	2 „	1s. 6d.
4 „	6d.	10 „	10d.	3 „	2s. 0d.
5 „	7d.	15 „	1s. 0d.	4 „	2s. 6d.

1850. Receivers, globular, with long cylindrical necks, form of Fig. 1850; German glass, white or green.

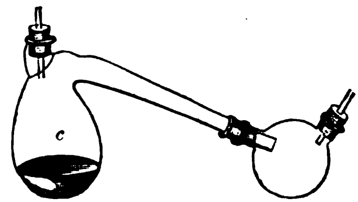
For Prices and Sizes, see article "Bolt Heads," Nos. 1411 and 1412.

1851. **Quilled Receiver**, for use in the distillation of Nitric Acid, &c.; hard white Bohemian glass, stoppered, Fig. 1851.

½ pint, 2s. 0d.	3 pints, 3s. 6d.	7 pints, 5s. 6d.
1 „ 2s. 6d.	4 „ 4s. 0d.	8 „ 6s. 0d.
2 „ 3s. 0d.	5 „ 4s. 6d.	10 „ 7s. 0d.
2½ „ 3s. 3d.	6 „ 5s. 0d.	12 „ 8s. 0d.



1849*a*.

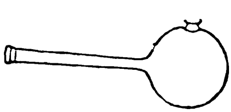


1849*b*.

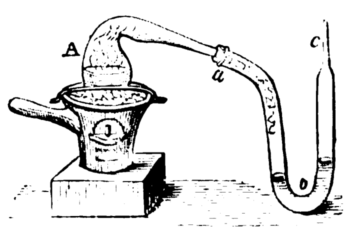
1852. Quilled Receiver of slight blown glass, to use with tube retorts, 1 ounce size, 6d.

1853. Receivers, of slight blown glass, adapted to the slight tube retorts, No. 1820, the bulbs either oval or round :—

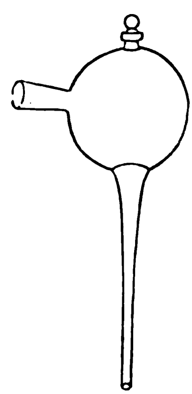
	Contents.	Plain, Fig. 1419.	Tubulated, Fig. 1853.	Stoppered.
a.	½ to 2 oz.	2½d.	3½d.	6d.
b.	2½ „ 3 „	3d.	4d.	7d.
c.	4, 5, 6 „	3½d.	4½d.	9d.



1853.



1854.



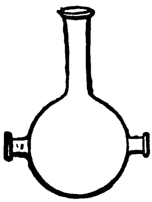
1851.

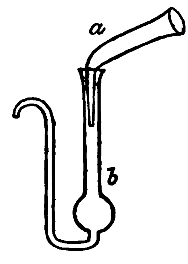
1854. Bent Glass Tube Receiver, form of *a*, *b*, *c*, Fig. 1854; total length 22 inches, diameter 1 inch; 1s.

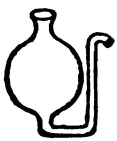
Many varieties of bent glass Tube Receivers will be described in the section relating to apparatus for the Collection and Condensation of Gases.

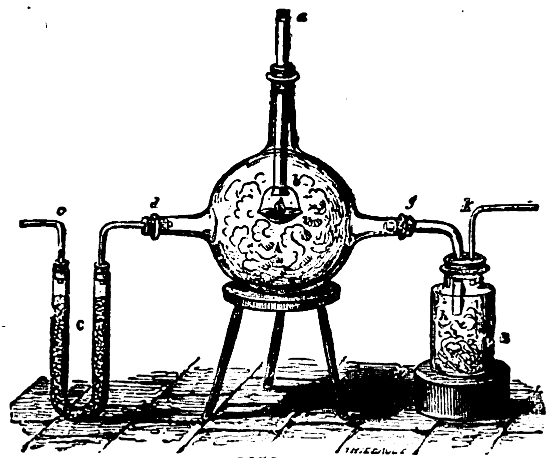
1855. Spherical Receivers, with three necks, Fig. 1855 and *a* Fig. 1856; fine white Bohemian or French glass.

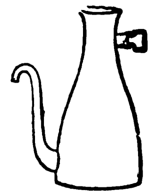
½ pint, 1s. 4d.	2½ pints, 2s. 0d.	6 pints, 3s. 0d.
1 „ 1s. 6d.	3 „ 2s. 3d.	18 „ 10s. 6d.
1½ „ 1s. 8d.	4 „ 2s. 6d.	24 „ 12s. 6d.
2 „ 1s. 10d.	5 „ 2s. 9d.	28 „ 15s. 0d.


1855.


1859.


1858.


1856.


1862.

1856. The apparatus represented by Fig. 1856 is arranged for preparing Anhydrous Phosphoric Acid—see "Chemical Recreations," page 641. It consists of a spherical flask, or receiver of about 25 pints' capacity, with three necks, connected with a 30 ounce bottle, and a large U shaped chloride of calcium tube, 25 inches long by 1 inch diameter; a stool, 8 inch top, 14 inch legs, a straw crown, a set of wooden blocks, porcelain cup, connected by wires of platinum to a glass tube, and various connections; price 31s. 6d.

1857. Receiver, similar in form to the last, but with the addition of a quill, or conical neck below, making in all four necks; contents 18 pints, white glass, 12s. 6d.

FLORENTINE RECEIVERS.

For use in the distillation of Volatile Oils, and their separation from Water.

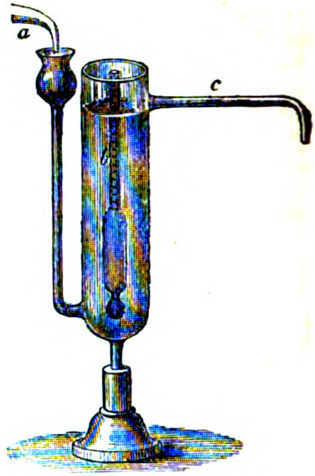
1858. Florentine Receivers, for use in the distillation of small quantities, Fig. 1858, 2 ounces, 6d.

1859. Florentine Receiver, another form, suitable for small quantities, *b* Fig. 1859; 4 ounces, 9d.

1860. Ditto, with the adapter *a*, complete, Fig. 1859, 1s. 2d.

1862. Florentine Receiver, fine white Bohemian glass, Fig. 1862, stoppered.

1 pint, 2s. 0d.	2 pints, 3s. 0d.	4 pints, 4s.
1½ „ 2s. 6d.	3 „ 3s. 6d.	6 „ 5s.



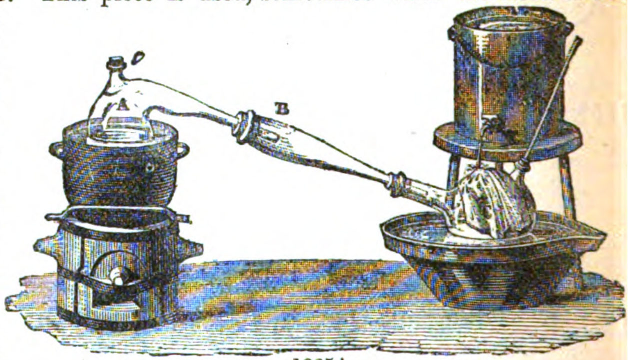
1864.

1864. **Mohr's Still-Watcher**, for indicating the progress of a distillation by the density of the liquid given over. The liquor is delivered from the condenser by the bent adapter *a*. It accumulates in the still-watcher, and its density is tested by the hydrometer *b*. When it rises to the tube *c* it overflows into another vessel. The distillation is stopped when the hydrometer *b* shows that the proper period is reached. On polished wooden foot, 3s.

1864a. The same, without the hydrometer, 1s. 6d.

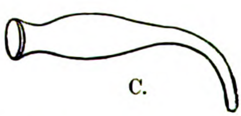
ADAPTERS.

1865. The annexed figure represents a retort A, connected to a receiver C, by means of an adapter B. This piece is used, sometimes when the neck of the retort is too wide to enter the neck of the receiver; and sometimes to place the receiver at a distance from the heat of the furnace. Adapters are made either bent, like Figs. C and D, or straight, like Figs. A and B; and either with neck, like Figs. A and C, or without neck, like Figs. B and D. These differences in form do not affect the price, which is fixed by the capacity of the receiver, or the width of its wide end, as below:—

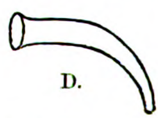


1865A.

A.



C.



D.

1 inch, 7d.	2 inch, 10d.	3 inch, 1s. 6d.
1½ „ 9d.	2½ „ 1s. 0d.	

1866. Bent Tube Adapter, D Fig. 1865, *a* Fig. 1859, and *a* Fig. 1866; about 1 inch wide, and 8 or 9 inches long, used to collect the distillate from the point of a condenser *f*, No. 1873, 6d.

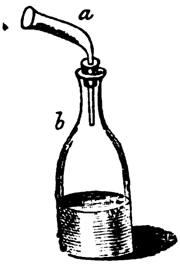
ALEMBICS.

1867. ALEMBIC, hard German glass, Fig. 1867, head and body in one piece, the head tubulated :—

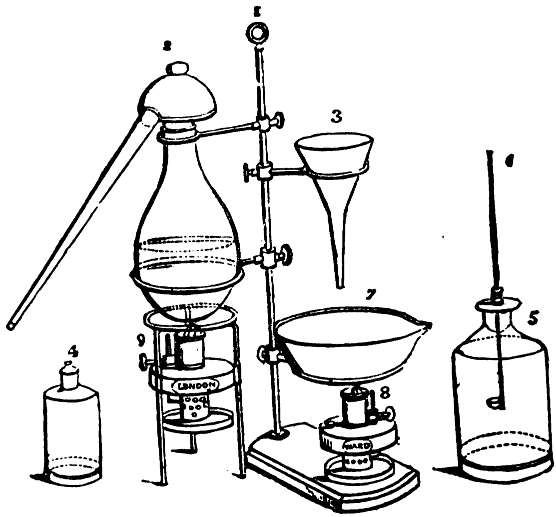
2 ounce, 8d.	3 ounce, 9d.	4 ounce, 10d.

1868. Ditto, in two pieces, the head fitted by grinding, the lower part useful separately as a flask, the head tubulated :—

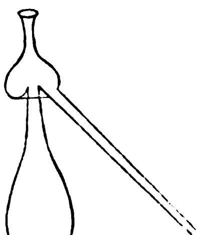
2 ounce, 1s.	3 ounce, 1s. 1d.	4 ounce, 1s. 3d.



1866.



1869.



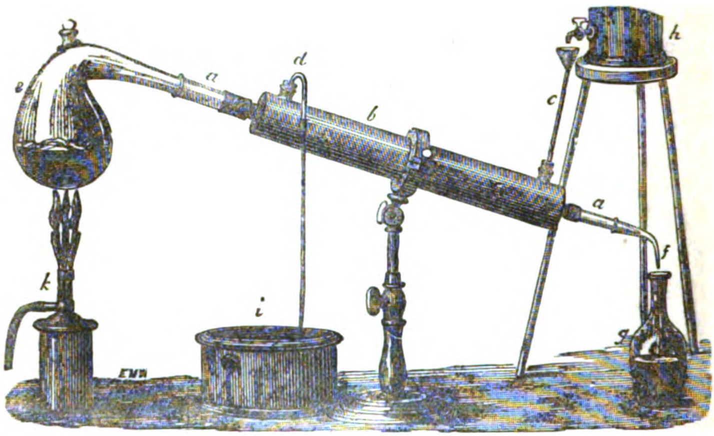
1867.

1869. Alembics, with separate heads, ground to fit, hard white Bohemian glass, No. 2, Fig. 1869.

$\frac{1}{4}$ pint, 2s. 6d.	2 pints, 6s. 0d.	5 pints, 8s.
$\frac{1}{2}$ „ 3s. 6d.	3 „ 7s. 0d.	6 „ 9s.
1 „ 5s. 0d.	4 „ 7s. 6d.	8 „ 10s.

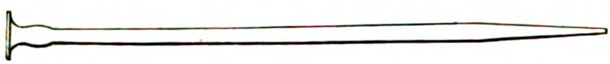
GLASS CONDENSERS FOR USE WITH RETORTS.

When a condenser is used in distillation, the steam given off by a retort or still passes into a long glass tube, which is surrounded by a wide metal tube, through which runs a constant current of cold water. By this means the steam is condensed into a liquid very conveniently and completely. Wherever it is possible, the pipe marked *c*, Fig. 1873, should be connected with a large water cistern, and the pipe *d* with a waste pipe or drain. The condensation then proceeds in the most effective manner, without demanding much attention from the operator. When a constant flow of cold water is not at command, the operator must use water bottles, as represented in the figure.



1873.

1873. Apparatus for the distillation of acids, of alcohol from wines, &c., consisting of a 40 ounce stoppered retort, a glass Liebig's condenser, measuring 36 inches by 1 inch, round japanned tin case, black wood support with universal joint, and an adapter, 14s., Fig. 1873, *a, b, c, d, e, f*.



1874.

The prices of the above apparatus, separately, are as follow :—

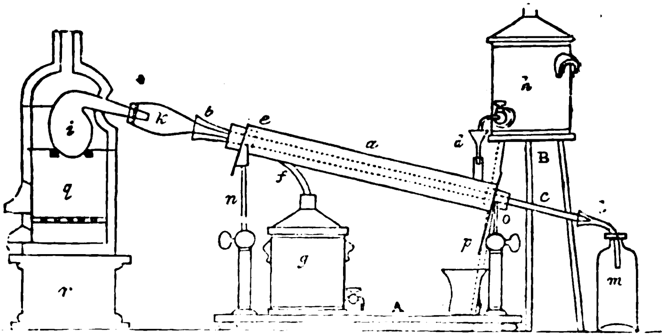
1874. The Glass Condensing Tube, *a a*, Fig. 1873 and Fig. 1874. The following sizes :—

a.	30 inches long,	$\frac{3}{4}$	inch diameter,	1s. 3d.
b.	36 „	$\frac{1}{2}$	„	1s. 3d.
c.	36 „	1	„	1s. 6d.
d.	40 „	$1\frac{1}{2}$	„	2s. 0d.
e.	40 „	2	„	2s. 6d.

1875A. The Glass Condensing Tube, with its metal case, Fig. 1873, *a* to *d*, 6s.
1875B. If the metal case is made of copper, 10s.
1876. The Support, with universal joint, polished black wood, 6s.
1877. The Support, of mahogany, polished, 9s. 6d.
1878. The other parts of this apparatus have been priced elsewhere.

f. Bent Tube Adapter, No. 1866.
g. Vertical Receiver, No. 1406.
h. Stoneware Water Bottle, No. 246.
i. Pneumatic Trough, cylindrical form, No. 2066.
k. Bunsen's Gas Burner, 3 jets, No. 959.

The Gas Burner is supported on a round wooden block, No. 393.
The Water Bottle is supported on a stool with three legs, No. 406, 2.



1879.

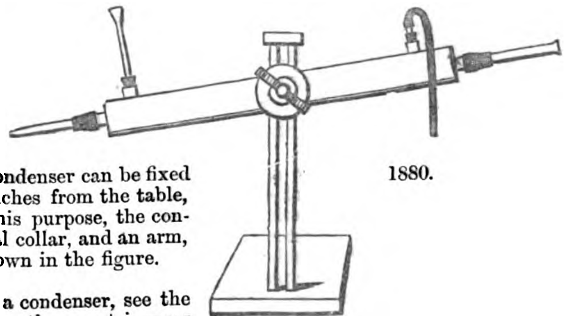
1879. Glass Condenser, mounted in a large triangular metal case, which contains a considerable quantity of water, and ensures more perfect condensation, Fig. 1879.

a. Price of the Condenser, *a, b, c, d, e, f,* 8s. } complete, 16s.
b. Price of the Support, A, *n, o,* 8s.

Description of figure.—*a.* Condenser tube, japanned zinc, 28 inches long; *b, c,* glass tube, 36 inches long; *d,* funnel by which cold water runs in from the water bottle *h*; *e,* pipe by which warm water escapes through *f* into the bottle *g*; *i,* retort; *k,* adapter (see No. 1865), connecting the retort with the condenser; *l,* adapter, connecting the condenser with the bottle *m*; A, black wooden tressel, with movable arms, *n, o,* for supporting and adjusting the height of the condenser; B, wooden stool for supporting the water bottle (the legs unscrew for travelling); *q,* table furnace; *r,* support for the furnace; *p,* gutter for carrying off water that overflows the funnel *d,* and preventing its escape along the pipe *c.*

The prices of the other articles will be found under their respective heads—viz., *g, h,* water bottles, No. 246; *i,* plain retort, No. 1805; *k,* adapter, No. 1865; *l,* adapter, No. 1866; *q,* furnace, No. 790; *r,* furnace foot, No. 798; B, stool, No. 406.

1880. Condenser, with Müller's Support, of the form of Fig. 1880, 14s.



1880.

Description.—This Support consists of two square parallel bars, made of polished black wood, mounted on a wooden base. The condenser can be fixed by it at any height not above 18 inches from the table, and at any required angle. For this purpose, the condenser tube is furnished with a metal collar, and an arm, and the thumbscrew and fitting shown in the figure.

For other methods of supporting a condenser, see the Iron Collar, No. 285, and various other contrivances in the section on "Supports." The methods described in this section are such as are best adapted for frequent use.

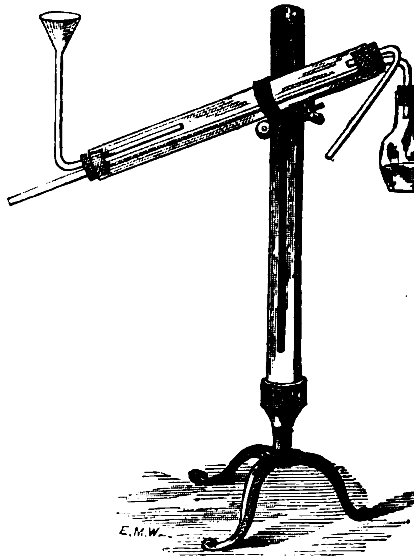
1881. Condenser tube, hard German glass, fitted in a glass envelope, Fig. 1881. The inner tube 36 inches long, ½ inch diameter. The outer tube 24 inches long, 1 inch diameter. The apparatus complete, fitted with corks, but without caoutchouc tubes, 3s. 6d.

1881.

The necks on the outer tube are made very short in order not to be readily broken off. It is convenient to have one of these necks fitted to a water pipe with a constant supply, and the other connected with a waste pipe, the connections being made with caoutchouc tubes.

1881a. Condenser Stand, Fig. 1881*a*, similar to Müller's Support, Fig. 1880, but slighter, made of mahogany, on iron tripod stand, with clamp for glass condenser, such as No. 1881, 7s.

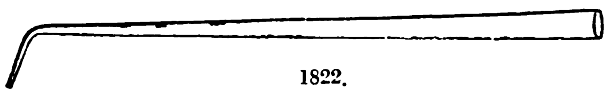
Stand and Condenser, Fig. 1881, 10s. 6d.
Stand, with Condenser, &c., as Fig. 1881*a*, 10s.



1881.

1882. Condenser Tube, hard German glass, form of Fig. 1882, either bent or straight, diameter at wide end from 2 to 3 inches.

4 feet,	2s. 6d.
5 „	3s. 0d.
6 „	3s. 6d.

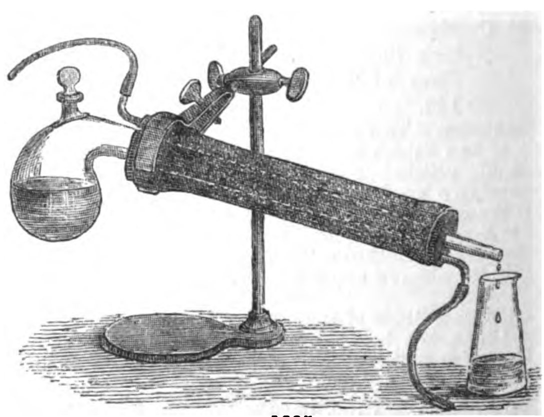


1822.

1883. Japanned zinc case, for above tubes, similar to that represented by *b, c, d*, Fig. 1873; size of case about 32 inches, diameter 3 or 3½ inches, price 5s.

1885. India-rubber Condenser, designed by Mr. William H. Wills, of the Inland Revenue Laboratory, Somerset House, Fig. 1885.

It is very portable, easily adjusted, and not liable to be broken. It consists of two rubber corks, fixed on to the neck of the retort, and connected by a thin rubber tube, which folds together for portability. At a test trial with steam, the condenser being only 12 inches long, the distillate was found to have a temperature of 57° Fahr., whilst the condensing water from the tube was at 54° Fahr.



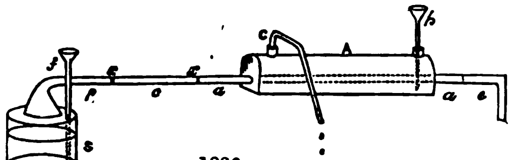
1885.

Price complete, as in Fig. 1855, but without the stand, with a 40 ounce Retort, 9s.
The Rubber Tube alone, per foot 2s. 6d.

METAL STILLS AND CONDENSERS.

Revenue Standard Wine Stills, and various other forms of stills, condensers, and apparatus for testing wines, spirits, and beers, will be found in the Chapter on "Wine Testing."

1886. Tinplate Still, for preparing pure water, half-gallon size, adapted to an ordinary kitchen fire-place, with Liebig's condenser, containing a block-tin pipe, 12s.

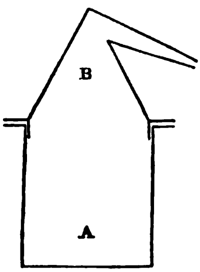


1886.

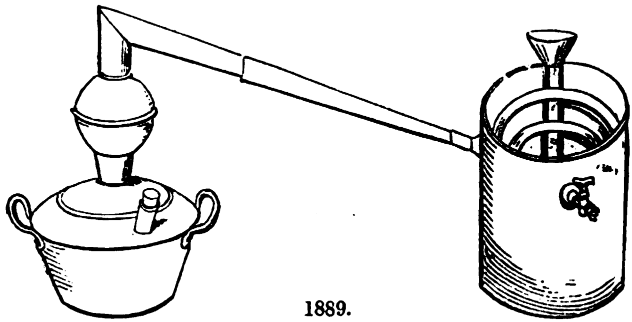
Description.—S, a tinplate still of the capacity of two quarts; *p*, *a*, *e*, a block-tin pipe; A, a japanned tinplate or zinc condenser, into which water is to be run constantly by the pipe *h*, and from which the warm water escapes by the water pipe *c*. The cold water may be supplied from a water-bottle, No. 246. Whenever steam issues from the funnel *f*, more water must be poured into the still.

1887. Tinplate Still, for the distillation of water, alcohol, or volatile oils; one pint capacity, Fig. 1887, adapted to the cylinder *b*, Fig. 1191, of Griffin's Lamp Furnace, 2s.

1888. The same in a single piece, tubulated at the top, 1s. 6d.



1887.



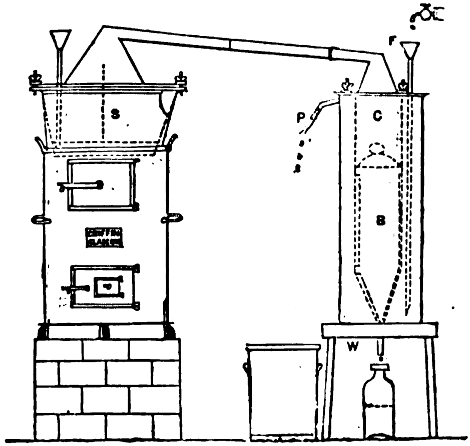
1889.

1889. Tinplate Still, for the distillation of water, with worm tub complete, one-gallon size, Fig. 1889, 14s.

1890. Ditto, two gallons, with worm tub, 22s.

1891. Stills, adapted to Portable Charcoal Furnaces, such as Luhme's Furnaces, No. 772.

Description.—The apparatus represented by Fig. 1891 is applicable, not only to the distillation of water, but to that of volatile oils, rose water, lavender water, &c. It presents the great advantage over many forms of distilling apparatus, that every part of the interior, both of the Still and the Condenser, can be readily got at for the purpose of thorough cleaning. The Still, s, has a movable head, which can be fastened on by five screws, a washer of many folds of filtering paper being placed on a broad flange between the head and the Still. There is also a movable pierced false bottom, which is only used in the distillation of volatile oils, the use of it being to prevent rose leaves, &c., from touching the bottom of the Still, to sodden in the water, or to suffer from burning. The heat is supplied by a Portable Iron Furnace, fed with charcoal. An iron jacket is put upon the furnace round the still to prevent the loss of heat by radiation. The carbonic acid of the fire escapes by a large hole in the upper part of this jacket.



1891.

The CONDENSER, C, consists of a hollow cylindrical body, the two concentric walls of which form a space that is kept continually full of cold water. This is supplied from a Water Bottle, No. 246, by the funnel F, and the warm water flows away by the waste pipe P The head of the condenser is separate from the body, and fastened on by screw nuts, in the same manner as the head of the Still. The steam passes from the Still directly into the cavity C of the Condenser, where it comes into contact with the circular cistern containing the cold water, close against which it is pressed by the solid block B, which allows only one quarter of an inch of space all round for the steam to pass by; and as the steam comes at the bottom into contact with the coldest water issuing continually from the lower end of the long funnel F, it is effectually condensed, and flows out of the pipe W in the state of water, more or less warm according to the more or less effective state of the condensing power. In adjusting the apparatus for use the Condenser is first mounted on a three-legged stool, having a hole in the centre of the top for the reception of the delivery pipe W. The furnace is then brought to a proper level by means of a stack of loose bricks. With this apparatus several gallons of distilled water may be prepared in a day. When a distillation is ended all the vessels should be emptied, washed, and dried without delay, to prevent their becoming rusty. The outside of the Condenser is japanned.

Prices of the Stills:—

1892. One Gallon, tinplate, 10s. | 1894. Two Gallons, tinplate, 20s.
1893. „ copper, 25s. | 1895. „ copper, 40s.

Iron Jacket to suspend the Still over the Furnace :—

1896. For a One-Gallon Still, 4s. | 1897. For a Two-Gallon Still, 6s. 6d.

1898. VERTICAL CONDENSERS, for use with the One-Gallon and Two-Gallon Stills, so constructed that they can be opened and cleaned inside. See Fig. 1891, and description of that article.

1898. Condenser for use with the One-Gallon Still, 14s.
1899. „ „ Two „ 17s.

1900. Wooden Stool for the Condenser, see W, Fig. 1891, 2s. 6d.

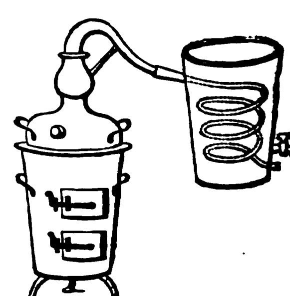
PORTABLE FURNACES, with this DISTILLING APPARATUS COMPLETE, comprehending Luhme's Furnace, No. 773, second size, Fig. 772*b*, with a One-Gallon Still and Jacket, the Condenser, No. 1898, and a Stool.

1901. With a Tinplate Still, £4, 13s. 6d. | 1902. With a Copper Still, £5, 8s. 6d.

GAS FURNACE, with Distilling Apparatus complete. Similar to Fig. 1891, but heated by gas instead of by Luhme's Furnace, consisting of Still and Condenser, Jacket on legs, containing gas burner, and Wood Stool for the Condenser.

Prices according to the size and metal of the still :—

1905. The Still of Tinplate, one gallon, 40s.
1906. „ Copper, one gallon, 55s.
1907. „ Tinplate, two gallons, 60s.
1908. „ Copper, two gallons, 80s.

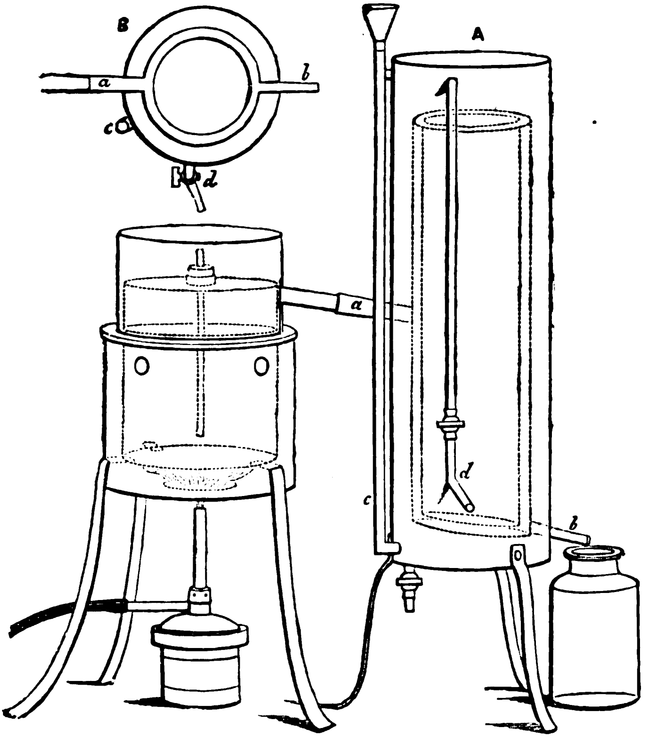

1909.

1909. PORTABLE STILL, with FURNACE, form of Fig. 1909, substantially made. The stills of copper, with block-tin head, the worm of block-tin, the furnace of iron, and the worm-tub of galvanised iron, fitted with in-flow funnel and draw-off tap.

The following sizes :—

1 gallon, £7.	4 gallons, £10, 0s.	8 gallons, £16, 0s.
2 gallons, £8.	5 „ £11, 11s.	10 „ £18, 18s.
3 „ £9.	6 „ £13, 13s.	12 „ £22, 0s.

1914. Distillation of Water by means of a Still, heated by a Gas Burner. The Still, Furnace, and Condenser, as represented by Fig. 1914. Price 45s.



1914.

Description.—The Still or Boiler is a cylinder of tinplate, measuring 9 inches in height, and 8 inches in diameter. It has a wide neck at the top, which can be closed by a cork carrying a glass tube that dips nearly to the bottom of the still, and is open at both ends. The steam pipe issues from the side of the still near the top, as represented at *a* in the figure. The Still is suspended on brackets in a stout plate-iron furnace, mounted on legs. The diameter of the furnace is 10 inches, its height is 7 inches, and its legs are 13 inches high. The still is covered by an iron dome, which serves to prevent the too early condensation of the steam. The capacity of the still is 13 pints, but it should not be worked with more than 8 pints of water at once. It is convenient to distil off 6 pints, and then to put 6 more pints into the Still, and continue the process. The quantity of water contained in the Still can at any time be found by using the glass tube as a pipette. The Still can be cleaned by inserting a bottle brush through the neck at the top.

The Heat is supplied by one of the Gas Burners, No. 973, 974, or 975, used without the rose. A round opening in the bottom of the furnace admits the flame, which is to be made to play directly upon the bottom of the Still. The necessary draught is obtained by several holes punched near the upper edge of the iron furnace, two of which holes are represented in the figure.

The Condenser consists of a double cylinder of tinplate, mounted within a cylinder of zinc, which acts as the water cistern. Fig. A is a perspective view of the Condenser, and Fig. B is a cross section. The zinc cylinder measures 26 inches in height and 8 inches in diameter. The legs are 9 inches high. The double tinplate steam cylinder is 21 inches high, 6 inches across outside, and 5 inches inside. The space between the two cylinders is half an inch. There is an inch of cold water between the outside of the steam cylinder and the zinc cylinder, and the 5-inch space in the middle of the steam cylinder is full of cold water, this space being open at both ends. The steam passes from the still to the condensing cylinder by the pipe *a*, and the distilled water escapes by the pipe *b* into the bottle placed to receive it. The Still and Condenser are placed about 10 inches apart.

The condensing water is supplied by the pipe *c*, being poured into the funnel at the top of that pipe, and entering the zinc cylinder at the bottom. In proportion as the water is heated by the steam it rises to the upper part of the cistern, the tall form of which is favourable to that object. The zinc cistern is filled with cold water to the top, and when the water is warm it is run off by the pipe *d*, which is provided with a stopcock at the lower end. If, at any time, warm water is required, it can be obtained from this source, cold water being supplied at the same time by the funnel-pipe *c*. There is a cover to keep dust out of the cistern.

With this apparatus the product of distilled water depends upon the amount of heat supplied, and the due supply of condensing water:—

The Burner No. 973 distils 1 Pint of Water per Hour.
The Burner No. 974 ,, 2½ Pints ,, ,,
The Burner No. 975 ,, 5 ,, ,, ,,

When No. 973 is used, the condensing water does not require to be changed. With No. 974, it must be changed at least once in the hour. With No. 975, it must be changed every half hour. When the operator has at command a constant flow of water, the supply pipe may be attached to the condenser pipe *c*, after removing the funnel, and the discharge pipe *d*, may be connected with a drain. In that case, the condensation will be very effectual, and the largest gas burner may be used. But to provide against any accidental stoppage of the pipes, the top of the zinc cistern, A, should be closed water-tight; otherwise a troublesome overflow of water may occur.

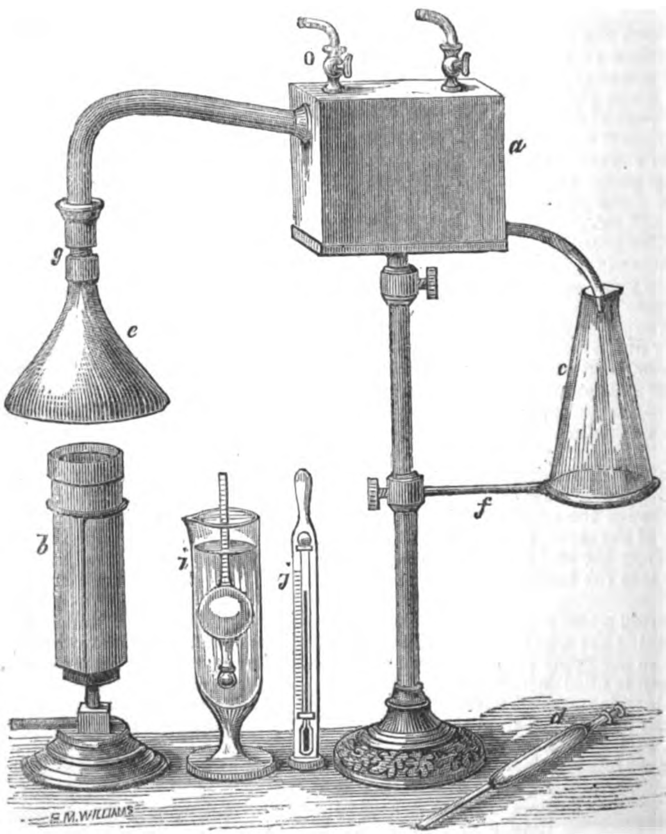
The small stopcock represented at the bottom of the Condenser is for drawing of the condensing water, and is especially useful when the apparatus is to be cleaned.

As the Boiler of this apparatus can be easily separated from the Condenser, the steam it supplies can be used for Boiling, Evaporating, and other processes. The entire apparatus, as represented by Fig. 1914, occupies a table space of 15 inches by 30 inches. It may, with little attention, be kept in constant action, and it can be readily dismounted, dried and put aside.

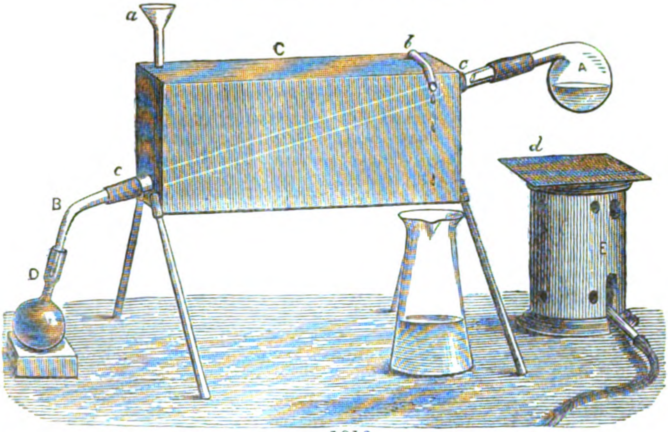
1915. Distilling Apparatus, similar to No. 1914, but in which the boiler and steam cylinder are made of copper instead of tin-plate; the other parts as described above. Price £4.

1915A. A Similar Apparatus, but of much smaller capacity, and having a glass still, is described and figured at No. 2877. 21s.

1916. Griffin's Wine Still, as adopted and used by the Customs Department—United States of America—the simplest, cheapest, and most portable form of still, is fully described in "The Chemical Testing of Wines and Spirits," by John J. Griffin. Crown 8vo, price 5s.
Price of Still, see Fig. 1916, 18s.



1917.



1916.

1917. The Revenue Standard Still, similar to that used by Her Majesty's Board of Customs. Price of the Still, Condenser, and Stand, £3, 10s.

The principle of the action of this Still is the same as that of Griffin's Wine Still, described at No. 1916.

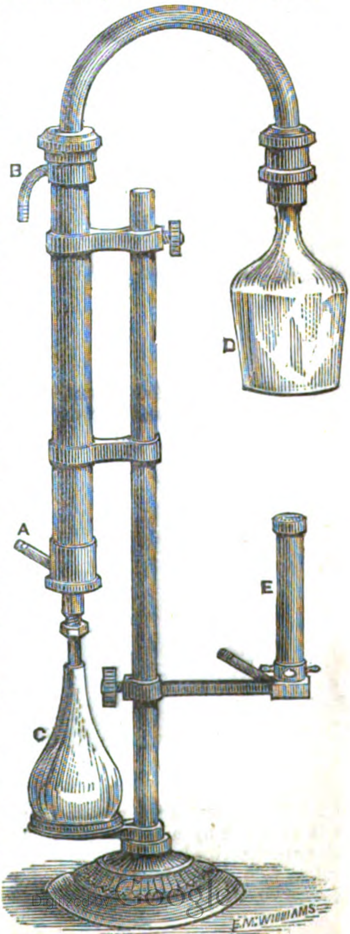
For the mode of using wine stills and the precautions necessary to be observed, the reader is referred to "The Chemical Testing of Wines and Spirits," by John J. Griffin, F.C.S. Crown 8vo. Price 5s.

1918. Keene's Still, for testing Wines, Beers, and Spirits, consists of a conical glass Still Flask, the same as used in the Revenue Still No. 1917, and a vertical Liebig's Condenser. Price £4, 4s.

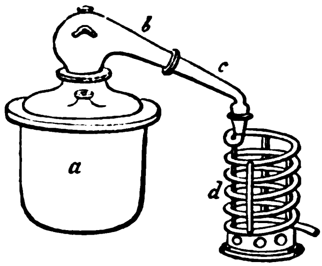
1919. Distilling Apparatus for Pharmaceutical Laboratories—of German Manufacture of the most modern and superior construction — for distilling water, the preparation of extracts, and all the numerous operations of like kind required by the pharmaceutical chemist, at prices according to completeness, from £20 to £35.

1920. Retorts, Stills, and Receivers, for the distillation of mineral acids, chlorine gas, and other corrosive chemicals in large quantities, made of saltglazed stoneware, warranted to resist the strongest acids. They can be made of any desired capacity.

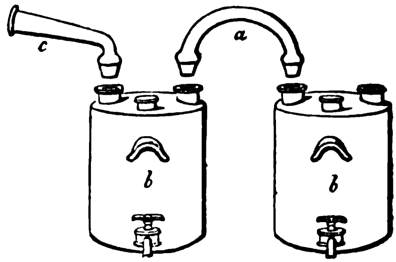
Fig. 1920 represents an Acid Retort *a*, with a Still Head *b*, Dip-arm *c*, and Worm *d*. Fig. 1920*a* represents two Receivers, *b*, *b*; a Connecting pipe *a*, a Dip-arm *c*, and stopcocks in the Receivers. Fig. 1920*b* is a Chlorine gas retort. Fig. 1920*f*, a Jar for storing acids. Fig. 1920*c*, a False arm. Fig. 1920*d* a Stopcock.



1918

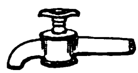


1920.

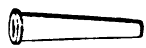


1920a.

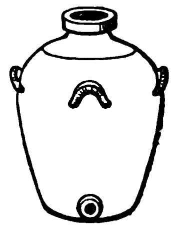
1920b.



1920d.



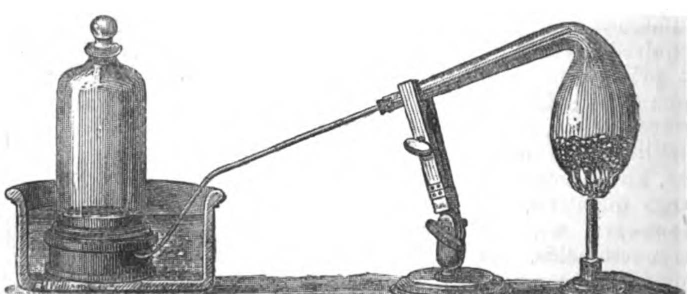
1920c.



1920f.

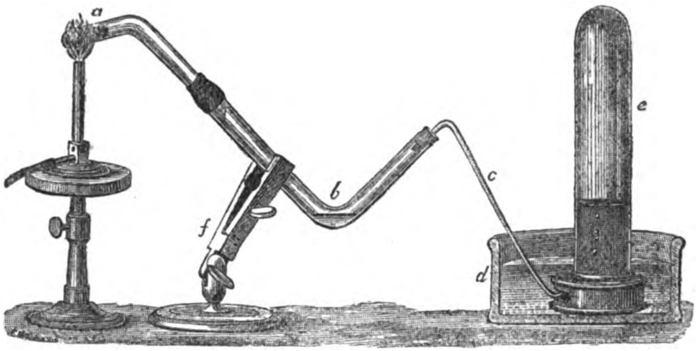
The Preparation and Examination of Gases.

1935. The following four figures exhibit several of the peculiarities which demand attention in the selection and adjustment of apparatus for the preparation and collection of gases.



1935.

Fig. 1935 represents the preparation of oxygen gas, by heating a dry powder in a retort. The heat is supplied by a gas burner. The retort is supported by a wooden holder. These two articles are described under their proper heads. The gas is delivered by a conducting tube from the retort into a beehive shelf placed under water in a pneumatic trough. It rises thence into a glass receiver which stands on the beehive shelf.

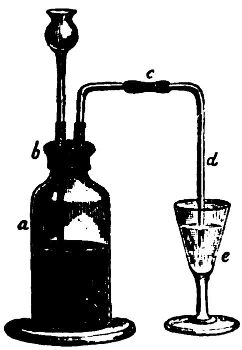


1936.

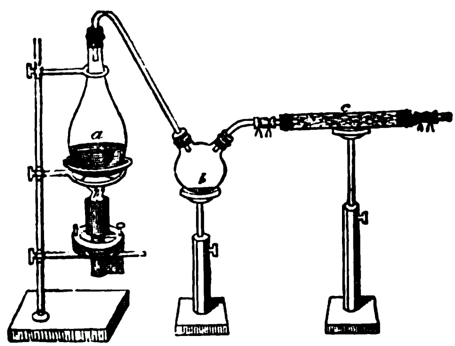
Fig. 1936 represents the preparation of coal gas by the distillation of coal. The retort used here, *a*, is a bent tube of hard glass. This is connected with another bent tube *b*, in which the gas deposits a liquid which distils with it from the coal. The gas is then carried by the tube *c* into the receiver *e* through the trough *d*. The tube *a* is connested to *b* by a caoutchouc tube, and *b* is connected to *c* by a perforated cork.

Fig. 1937 represents the production of a gas (sulphuretted hydrogen) without the application of heat, by the action of a liquid acid upon a solid substance placed in the bottle *a*. To regulate the action, water is first put into the bottle, and then the acid is added, a little at a time, by the tube funnel. The gas passes by the tubes *c*, *d*, into the liquid contained in the test glass *e*, upon which the gas is to exercise its chemical action. At *b* is shown a caoutchouc cap which is large enough to cover the neck of the bottle, and which has two tubes for the passage of the glass tubes. At *c* is a short caoutchouc tube for the connection of the two gas-leading tubes.

Fig. 1938 represents the production and purification of chlorine gas. The gas is produced in the flask *a*, where heat is applied to a suitable mixture. It is then passed into the intermediate receiver *b*, where it deposits any liquid acid that it may carry over with it mechanically. It then passes through the tube *c*, which contains a substance that deprives the gas of moisture, so that the gas issues from that tube in a pure and dry state.



1937.



1938.

From these figures it will be seen that this subject requires the consideration of the proper forms of gas bottles to be used with or without the application of heat, and of gas-leading tubes, caoutchouc and other fittings, gas receivers, pneumatic troughs, gas holders, vessels to contain purifying and drying substances, vessels to measure gases, &c.; all of which articles will now be classed in groups and described. As the different kinds of supports for the apparatus, and the methods of producing and applying heat, have been already described, those subjects will be passed over without notice.

GAS BOTTLES AND THEIR FITTINGS.

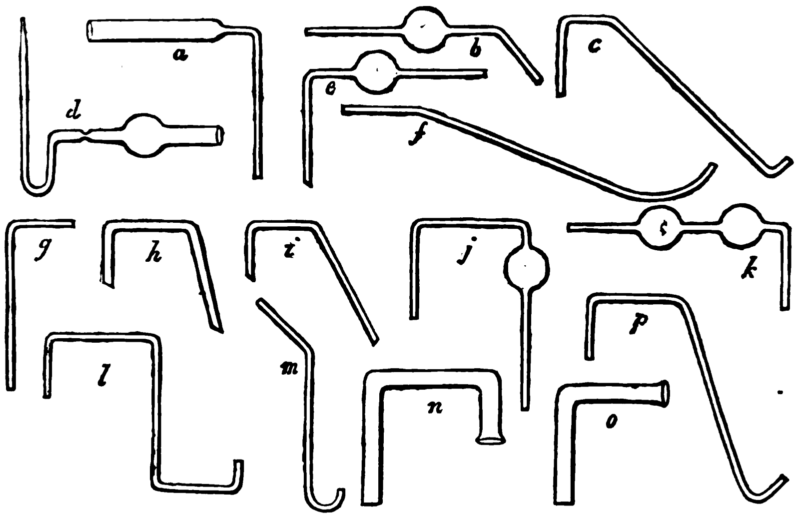
CHOICE OF FLASKS FOR PREPARING GASES.

1939. Any of the flasks described between Nos. 1400 and 1427 may be used for preparing gases, provided the mouths are sufficiently round to be securely closed by corks or caoutchouc caps. Of course, when two or three tubes have to pass through one cork, the flask must be chosen with a wide mouth. In cases where heat is not to be applied, cylindrical wide-mouthed bottles, such as those described at No. 1575, may be used. Wide-mouthed bottles are also desirable, when large quantities of solid materials have to be put into them, or when the residue of the operation is solid or subject to crystallise readily. In many operations it is useful to employ Woulff's bottles, with two or three necks, all of which can be closed very accurately with corks or caoutchouc stoppers, carrying acid funnels, gas-leading tubes, and the like. Woulff's bottles are particularly useful when gases have to be passed through several liquids in succession, either to wash and purify the gases, or to prepare solutions of them.

GAS-LEADING TUBES.

1940. Glass Tubes, suitable for Gas-leading tubes, in lengths of 3 or 4 feet, and of any desired diameter and strength, soft glass, free from lead, and easy to bend, per lb., 1s. 2d. See particulars at page 19.

1941. Bent Tubes for Gas Bottles. The following figures comprehend the forms in most frequent use :—



1941.

a. Connector, with wide tube, to receive water rising with gas from a gas bottle; wide tube, 6-inch by $\frac{5}{8}$-inch ; narrow tube, 11 inches by $\frac{1}{3}$ inch, 6d.

b. Connector, with one bulb and bent tube, 14 inches by $\frac{3}{8}$ inch, 4d.

c. Connector, long branch, 16 inches by $\frac{3}{8}$ inch, 6d.

d. Bulb tube, with bent gas jet in one piece, 9d.

e. Connector, with one bulb, to collect water which rises with gas from a gas bottle, 4d.

f. Connector for oxygen gas tube retort, long branch, 18 inches by $\frac{5}{8}$ inch, 6d.

g. ˥-shaped Tubes for connecting Woulff's Bottles, 5-inch, 2d. ; 8-inch, 2d. ; 12-inch, 2d. ; 16-inch, 3d.

h. Connector to adapt an upright gas bottle to a U-shaped tube receiver, Fig. 2056, ground ends, 16-inch by ⅜ inch, 4d.

i. Connector to adapt an upright gas bottle to a V-shaped tube receiver, Fig. 2057, ground ends, 16-inch by ⅜ inch, 4d.

j. Connector to carry hydrochloric acid gas into a solution flask. The lower end should dip but slightly into the water, so that no more can be driven back than can be contained in the bulb, 8d.

k. Connector, with two bulbs, for receiving the water which rises with gas from a gas bottle, 6d.

l. Bent gas-leading tubes Fig. *l*, of a great variety of sizes and curves, in price from 2d. to 1s. each.

m. Connector, long branch, 7 inches by ⅜ inch, 6d.

n. Wide Connector, for use with narrow testing tubes, as in applying sulphide of hydrogen, &c., small size, ⅜ inch wide, 3d.

nn. Connector, larger size, ½ inch wide, 4d.

o. Another form of Connector for sulphide of hydrogen, ½ inch diameter, 3d.

oo. Ditto, with point ground aslant, 4d.

p. Connector, long branch, 16 inches by ⅜ inch, 6d.

pp. Ditto, slight, 10 inch, 3d.

SAFETY TUBES AND ACID FUNNELS.

1942. *a.* Thistle Acid Funnels, with long necks, for fitting Gas Bottles, &c., Fig. *a*, and Figs. 8, 9, 10 in the group of funnels, No. 1598, made of German glass tube, with one-inch funnel.

4 to 14 inches, 2d. each. | 15 to 24 inches, 3d. each.

PER DOZEN.

No. 1.	Neck,	4 to 8 inch. long,	1s. 4d.	No. 4.	Neck,	13 to 14 inch. long,	2s. 0d.
2.	„	9 to 10 „	1s. 6d.	5.	„	15 to 18 „	2s. 6d.
3.	„	11 to 12 „	1s. 8d.	6.	„	24 „	2s. 9d.

b. Acid Funnels, with long neck, strong tube, conical funnel, per dozen,

1.	Tube,	9 to 10 inches long,	funnel	1½ inches wide,	4s.
2.	„	11 to 12 „	„	2½ „	5s.
3.	„	13 to 15 „	„	3 „	6s.
4.	„	16 to 20 „	„	4 „	8s.

5. Any of these Tube funnels, bent in the neck, for putting acids into retorts (see Figs. 11, 12, group of funnels, No. 1598), at 2d. each extra.

c. 1. Safety Tube with bend, without bulb, 12 to 14 inches, 4d.
2. Ditto, larger size, about 21 inches, 6d.

d. 1. Safety Tube, with bend and one bulb, 15 inches, 5d.
2. Ditto, larger size, about 21 inches, 7d.

e. Safety Tube, with two bulbs, short form, 6d.

f. 1. Safety Tube, with two bulbs, long form, 7d.
2. Ditto, larger size, 20 inches, 8d.

g. Safety Tube, with three bulbs, long form, 1s.

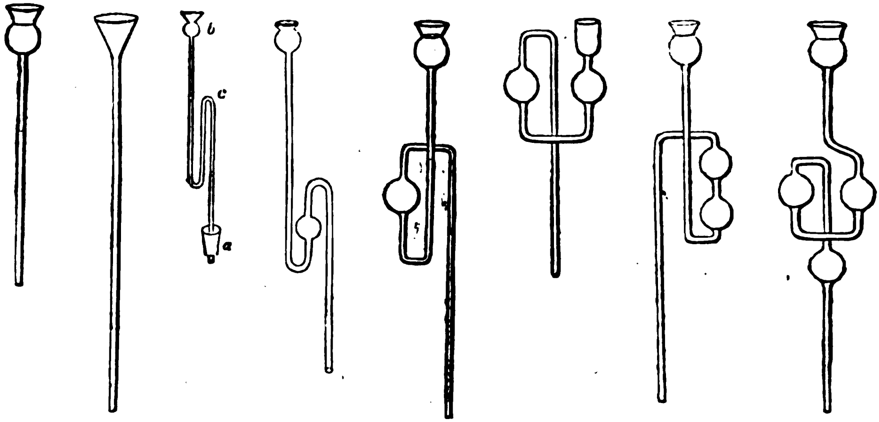
h. Safety Tube, with three bulbs, short form, 1s.

i. Safety Tube, with four bulbs, short form, 1s.

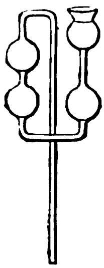
j. Safety Tube, with cylindrical funnel, 22 inches, 1s.

k. Safety Tube, with two ground glass valves, 1s. 6d.

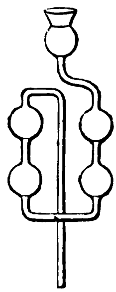
l. Welter's Safety Tube, for connecting Woulff's Bottles, 1s.



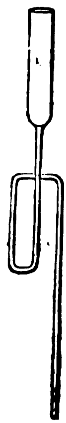
a. *b.* *c.* *d.* *d.* *e.* *f.* *g.*



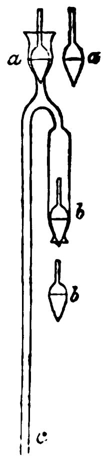
h.



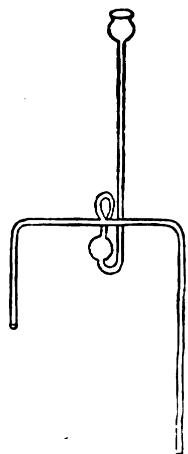
i.



j.



k.



l.

1943. Acid-dropping Funnels for Gas Bottles, strong, made at the Glass-house, with ground stopper, Fig. 1943, 1s. 3d.

1944. Ditto, with stopcock in the neck, large size, Fig. 1944, Bohemian glass, 4s.

1945. Ditto, with glass stopcocks, for regulating the supply of acid, of light glass, blown before the lamp, funnels 2 inches diameter, tubes 12 inches long, Fig. 1945, 2s.

1946. Acid-dropping Funnel, with stopcocks, reservoir, and ground stopper, form of Fig. 1946, bulb 2 inches, tube 12 inches, 2s. 3d.

1948. Plain Straight Glass Tubes, for fitting into gas bottles, as acid tubes, ½ inch wide, 8 or 10 inches long, 1d. *each.*

1943.

1944.

1945.

1946.

CAOUTCHOUC FITTINGS.

1950. **Vulcanised Caoutchouc Caps**, for fitting glass tubes to gas bottles, &c., well made, stout necks; diameter of necks ¼ inch to ⅜ inch.

1950.

Width of the Cap.	With 1 Neck.	With 2 Necks.	With 3 Necks.	Width of the Cap.	With 1 Neck.	With 2 Necks.	With 3 Necks.
¾ inch	3d.	4d.	—	1¾ inch	5d.	6d.	7d.
1 "	3½d.	4d.	—	2 "	6d.	7d.	8d.
1¼ "	4d.	4½d.	5d.	2¼ "	7d.	8d.	9d.
1⅜ "	4½d.	4½d.	5d.	2½ "	8d.	9d.	10d.
1½ "	4½d.	5½d.	6d.	3 "	9d.	10d.	12d.

1953. **Vulcanised Caoutchouc Tubes**, Grey, Red, or Black, for conveying gases, joining glass tubes, &c., made in lengths of 60 feet, but any shorter length may be had. Price per foot, according to the Internal Diameter:

1/16 inch, 2d.	¼ inch, 6d.	½ inch, 1s. 0d.
⅛ " 3d.	5/16 " 7d.	⅝ " 1s. 3d.
3/16 " 5d.	⅜ " 8d.	¾ " 1s. 6d.

1954. **Glazed Gas Tubes**, without odour, and not liable to choke when bent, but requiring a brass connector to be cemented at each end:—

Price per Foot, according to the External Diameter,

¼ inch, 5d.; ⅜ inch, 6d.; ½ inch, 9d.; ⅝ inch, 1s.; ¾ inch, 1s. 3d.

Caoutchouc Stoppers. See No. 193.

1957. Caoutchouc (not vulcanised) in sheets, 1/20 inch thick, for forming tubes, covering jars, &c.; piece of 100 square inches, 1s. 6d.

1958. Ditto, per lb., 9s.

1959. Caoutchouc in a liquid (pasty) state, for varnishing, waterproofing, making air-tight joints in complex apparatus, &c.; per lb., in a canister, 3s.

1960. Ditto, small canister, 1s. 9d.

Miscellaneous Fittings for Gas Apparatus.

Corks. See No. 168.
Cork Borers. See No. 169.
Files. See No. 177.
Stopcocks of Glass. See No. 144.
Stopcocks of Brass. See No. 697.
Pinchcocks. See No. 156.

FITTED GAS BOTTLES.

1961. Gases, the production of which demands the aid of heat, must be prepared in vessels that will not spoil when heated. When they are of glass, they must therefore be thin at the bottom, otherwise they split when heated. Good German and Bohemian hard glass flasks with thin bottoms, such as are described at pages 144 to 147, answer very well.

When heat is not required, it is best to choose vessels with flat strong bottoms, which do not readily break when placed on a table, nor overturn when rendered top-heavy by tall acid funnels and other necessary fittings. Bottles that serve for gases with heat serve equally well in the cold, only they are needlessly fragile. Among the gases that are made in the cold, those most frequently required are hydrogen, carbonic acid, and sulphuretted hydrogen. Among those that require heat, those most in request are oxygen, chlorine, ammonia, muriatic acid, and sulphurous acid.

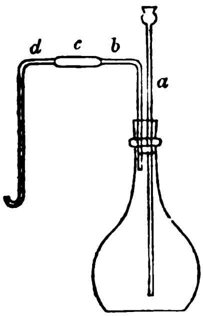
Apparatus suitable for the preparation of these gases is described in the following list.

HYDROGEN GAS BOTTLES.

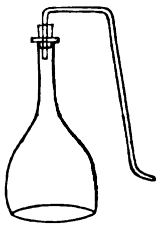
1962. Hydrogen Gas Bottle, Hard German Glass, fitted, 30 ounce size, with long acid funnel and gas delivery tube, with flexible connector, Fig. 1962, 2s.

1963. Ditto, 16 ounce, without acid funnel, Fig. 1963, 1s.

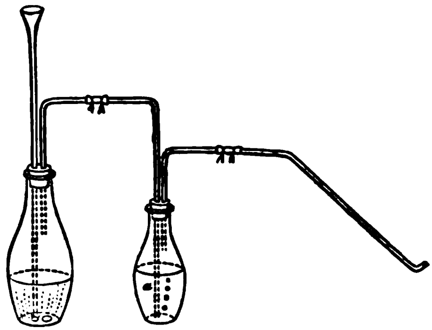
1964. Hydrogen Gas Bottles, quart size, with 30 ounce washing bottle, with funnel, connecting tubes, and caoutchouc caps, Fig. 1964, 4s.



1962.



1963.



1964.

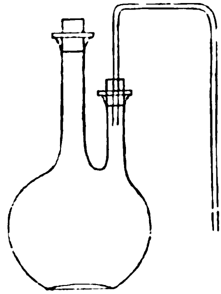
1965. Fitted with caoutchouc cap and one gas-leading tube with flexible joint, Fig. 1965, ½ pint size, 1s. 3d.

1966. Pint size, 1s. 6d.

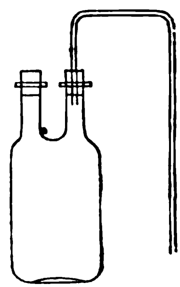
1967. Two pint size, 1s. 9d.

1968. Light Flask of hard German glass, with two necks and bent tube, Fig. 1968, 1 to 2 ounce, either round or flat bottom, 6d.

1965.



1968.



1969.

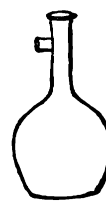
1969. Woulff's Bottle, slight blown glass, 3 ounce, two necks, with cork and tube, Fig. 1969, 1s.

1970. Woulff's Bottle, 3 ounce, three necks, with tube, 1s. 3d.

1971. Gas Bottle for preparing gases, either with or without heat, with tubulure for attaching a gas-leading tube, hard white Bohemian glass, Fig. 1971.

The following sizes:—

½ pint,	1s. 4d.	2 pints,	2s. 0d.	4 pints,	2s. 9d.
1 ,,	1s. 6d.	2½ ,,	2s. 3d.	5 ,,	3s. 0d.
1½ ,,	1s. 8d.	3 ,,	2s. 6d.	6 ,,	3s. 3d.



1971.

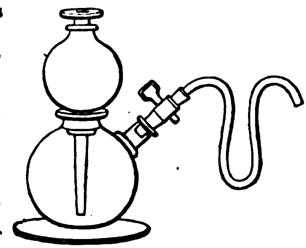
1972. The preceding Gas Bottle, with a long acid funnel, adapted to the mouth by a cork, and a bent gas delivery tube attached to the side-neck by a caoutchouc cap:—

½ pint, 2s. 6d. | 1 pint, 2s. 9d. | 1½ pint, 3s. | 2 pints, 3s. 6d.

1973. Vogel's Gas Bottle, with combination of acid funnel and gas delivery tube, 30 ounce flask, Fig. 2035, the parts marked *a*, A, 2s. 6d.

1974. Gas Bottle for the continuous supply of any gas that can be prepared without heat, Fig. 1974, massive cut Bohemian glass, five pieces ground together, 18s.

The lower globe is 5 inches in diameter, the funnel globe is 4 inches in diameter. They are ground together at the neck. The ground stopper is perforated, so that it can be closed by a cork that carries a bent acid funnel. The glass stopcock and the bent tube are fitted together and into the globe by grinding. If the solid materials required to produce a gas are put into the lower globe and acid into the funnel, the lower globe is speedily filled with gas, and the acid driven back into the upper globe. When gas is required it is drawn from the bent tube, the stopcock being opened. The acid then descends from the funnel into the globe, and replenishes it with gas. In the production of hydrogen gas, a zinc plate can be coiled round the neck of the funnel. The bent tube is to be filled with materials for drying or purifying the gas.



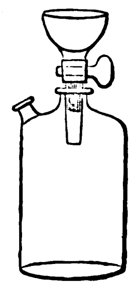
1974.

Berzelius's Gas Bottle, for the preparation of hydrogen, carbonic acid, and other gases that do not require the aid of heat; the bottle of two pints capacity, with funnel for the gradual supply of acid; two sorts—namely, one with a long stopper ground into the funnel neck, Fig. 1976, the other with a glass stopcock in the funnel neck, Fig. 1975; fine white Bohemian glass, the joints well fitted by grinding.

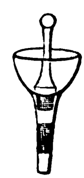
1975. The Gas Bottle with the stopcock, 12s.

1976. The Gas Bottle with the long stopper, 8s.

1978. Berzelius's Gas Bottle, with acid funnel and long stopper, the bottle like Fig. 1975, the funnel like Fig. 1976, excepting that the tube is long enough to reach to the bottom of the bottle; German glass, capacity 4 to 6 ounces, 1s. 6d.



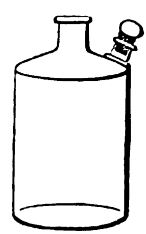
1975.



1976.

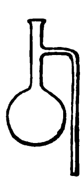
1979. Berzelius's Gas Bottle, not fitted, form of Fig. 1979, with two necks, both ground inside, one fitted with a stopper, fine white German glass:—

1 pint, 3s. | $1\frac{3}{4}$ pint, 3s. 6d. | $3\frac{1}{2}$ pints, 5s.

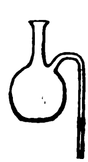


1979.

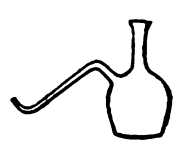
1980. Micro-Chemical Gas Bottles, with narrow gas delivery tubes in one piece, hard white German glass, slight, used for preparing and delivering small quantities of hydrogen or other gas with avoidance of atmospheric air. Figs. 1980 to 1986, all of 3 ounces capacity, with bulbs 2 inches diameter. Price 5s. per dozen, or 6d. each.



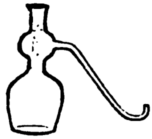
1980.



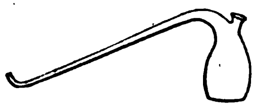
1982.



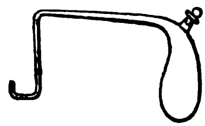
1983.



1984.



1985.



1986.

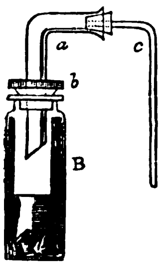
BOTTLES FOR SULPHURETTED HYDROGEN GAS.

A. With one Bottle, without a Washing Bottle.

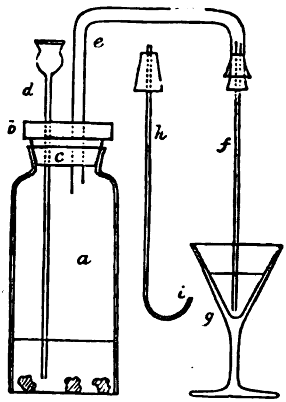
1994. Cylindrical Bottle, 5 ounce size, with wide bent tube, and narrow gas delivery tube, Fig. 1994, 1s.

1995. Cylindrical Bottle, 10 ounce size, with wide bent tube, narrow delivery tube, and acid funnel, as represented in Fig. 1995, 2s.

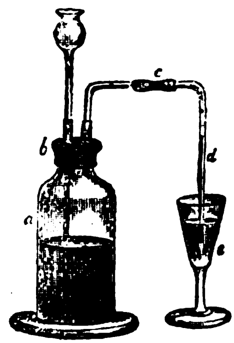
1996. Bottle, with solid glass foot, as shown by Fig. 1996, 10 ounce size, with an acid funnel and wide bent tube, fitted by a cork, and a narrow delivery tube, 2s.



1994.



1995.



1996.

1997. Bottle, with solid glass foot, 20 ounce size, fitted as shown by Fig. 1996, with caoutchouc cap, acid funnel, flexible bent tube, 2s. 6d.

The above gas bottles are all chosen with a wide neck for the convenience of inserting the lumps of sulphide of iron. When the gas has been prepared, the acid should be poured off, the remaining sulphide of iron washed with water, and the bottle left partly filled with water, ready for the next operation.

1998. Slight bulb flask, for preparing a small quantity of sulphuretted hydrogen gas, in testing for arsenic, &c., with delivery tube attached, 3 ounce size, form of Fig. 1980, 6d.

1999. Ditto, 8 ounce size, 8d.

2000. Very portable apparatus, for the same purpose, suitable for travelling sets of apparatus, made of glass tubes, Fig. 2000, 1s.

2001. Bottle, for Sulphuretted Hydrogen Gas, after Berzelius, slight blown gas, fitted as shown by Fig. 2001, contents 3 to 4 ounces, 1s. 6d.

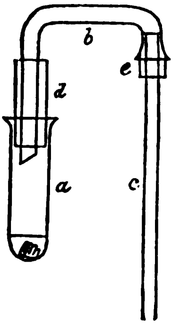
B. With Washing Bottle, and mounted on a Wooden Block.

2002. Sulphuretted Hydrogen Apparatus, consisting of a Woulff's Gas Bottle, 20 ounce size, with 10 ounce washing bottle, 7s. 6d.

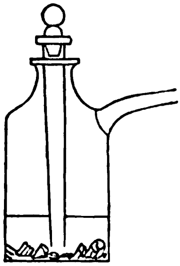
2003. Ditto, 40 ounce size, with 16 ounce washing bottle, 10s. 6d.

2004. Wide necked bottle, 40 ounce size, with 16 ounce washing bottle, on a block, 5s. 6d.

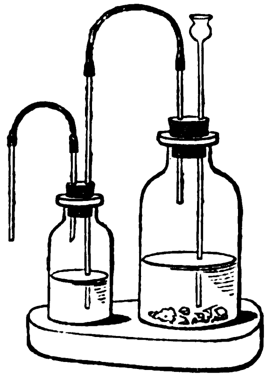
2005. Sulphuretted Hydrogen Gas Bottle, with a washing bottle attached, on a wooden block (as used at the Royal College of Chemistry), Fig. 2005, a 20 ounce gas bottle and 8 ounce wash bottle, 3s. 6d.



2000.



2001.



2005.

Kipp's Apparatus for affording a constant supply of Sulphuretted Hydrogen Gas, consisting of three glass globes, as represented by Fig. 2005.

To arrange the apparatus for use.—Put a piece of sheet lead round the neck of the funnel at *a*, to partially close the passage into the lower globe, and prevent the sulphide of iron from running down, but not to prevent the rising of the acid; put in the sulphide of iron by the neck *d*, and the diluted acid by the upper neck. The gas gathers in the middle globe, and passes out by the stopcock at *d*.

2006. Largest size, about 6-inch globes with solid glass stopcock, ground into the neck *d*, fine Bohemian glass, with cut stoppers, 25s.

2006A. Largest size, globes about 6 inches, as above, but made of German glass, the stoppers not cut, Fig. 2005, 16s.

2007. Middle size, of German glass, globes about 5 inches diameter, Fig. 2005, 12s.

2008. Small size, of German glass, 4-inch globes, Fig. 2005, 8s.

2008A. New Sulphuretted Hydrogen Gas Bottle. Price, *without the Stand*, 10s.

Description of a New Gas Bottle and arrangements of Apparatus for applying Sulphuretted Hydrogen without Smell, and avoiding its Escape:—

It often occurs that the study of chemistry has been prevented in consequence of the disagreeable and noxious vapours of Sulphuretted Hydrogen, which is one of the chief reagents employed in the ordinary course of analysis. Few private houses contain rooms which can be furnished with the regular fittings of the laboratory, including the expensive chamber for conveying away noxious fumes. In order to obviate this difficulty I have devised the following apparatus:—A Gas Bottle, consisting of three glass bulbs, one somewhat larger than the other two. These bulbs are connected by necks of about a quarter of an inch internal diameter; the larger bulb is furnished with a neck, tightly closed with an india-rubber plug, and the centre bulb is fitted with a stopcock. To charge this Gas Bottle it is necessary to fill the smaller bulb with diluted sulphuric acid. About one part of acid to five parts of water will be found a convenient strength; if the acid be either too strong or too weak the evolution of the gas is hindered.

A piece or so of sound sulphide of iron—previously washed to remove powder and small pieces which might fall through the necks—are then placed in the large bulb, and to produce the gas the bottle is reversed, so as to cause the acid to flow from the small bulb into the large one containing the sulphide of iron, which will then have the neck containing the rubber plug downwards, and hermetically sealed by the layer of liquid above it. When reversing the bottle it is necessary to avoid allowing the acid to run into the glass tap connected with the centre bulb. The production of gas can be stopped by restoring the bottle to its original position, which will cause the acid to flow away from the sulphide of iron. It will be found convenient to fix the bottle by a piece of copper wire twisted around its necks, and fastened in a cork to some stand or support upon which it may be easily reversed.

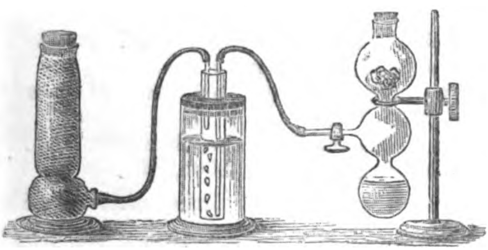
The Gas Bottle is connected by rubber tubing with a cork—preferably a rubber one—containing two glass tubes, and fitting into the mouth of a very stout test tube, about 7 inches in length and 1 in diameter. It is necessary that the test tubes should be stout, or they will be liable to break upon corking and uncorking, and it is advisable to procure several which will fit the cork, bearing the gas delivery-tubes—one of which, connected by the india-rubber tube with the Gas Bottle, passed to the bottom of the test tube, and serves to convey the sulphuretted hydrogen through the liquid to be tested, and the other just penetrates the cork, and is also attached to a rubber tube, which conveys the excess of gas to the receiver in which it is to be absorbed. The test tube is loosely fitted by means of a bung into a jar which contains hot water, as the precipitates formed by sulphuretted hydrogen are produced most favourably when the liquid assayed is kept warm. This jar also serves as a stand for the test tube, and prevents it being upset by the twist of the india-rubber tubes. Small flasks can be used instead of the test tubes, but on the whole the latter are preferable, not being so liable to upset.

The absorber consists of an upright cylinder on a foot, with a neck near the base, usually called upright chloride calcium jar, and is connected with the second glass tube in the cork of the test tube. This cylinder is filled with sawdust mixed with coarsely-powdered sugar of lead, and it is as well if, before being used, it is moistened with a saturated solution of sugar of lead. The top of the cylinder is loosely closed with a cork. When not in use it may be corked up at top and at the neck at the foot. A small brush, such as is ordinarily used for cleaning tobacco-pipes, will be found useful for cleaning the glass tube which leads the sulphuretted hydrogen into the test tube, and it is convenient to have several pieces of such tubing of equal length and diameter. When sufficient gas has been passed through an assay the Gas Bottle is reversed, the tap turned off, and the rubber tube disconnected from the glass tap; a piece of the glass tubes mentioned above can then be slipped into the end of the rubber tubing, and the remnant of the gas above the assay in the test tube blown into the absorption cylinder.

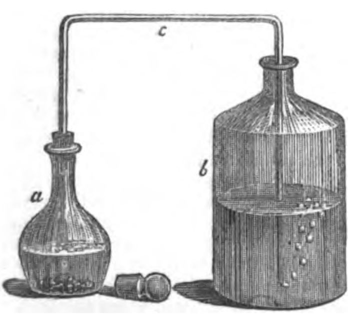
Digestions with sulphide of ammonium can be made with the test tube and the absorption cylinder alone.

The Gas Bottle, for cheapness, can be made without the glass stopcock, when the rubber tube between it and the test tube should be of two portions connected over a piece of glass tubing. When an operation is over and the Gas Bottle reversed, the piece attached to the bottle is slipped off the connecting glass tubing, and its orifice is closed with a piece of solid glass rod or a pinch tap.

William Griffin.

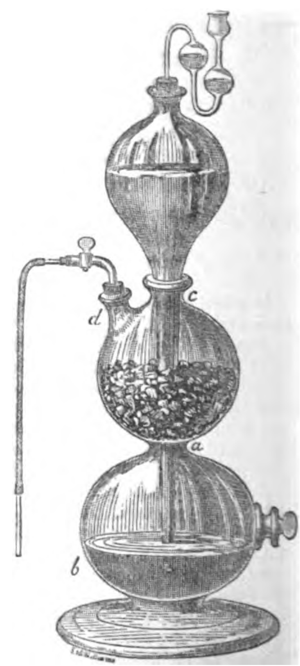


2008*a*.



2009.

2010.



2005.

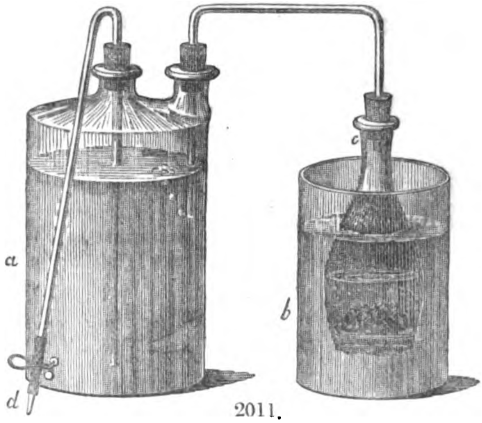
2009. **Simple Apparatus for the Preparation of Liquid Hydrosulphuric Acid,** Fig. 2009, flask 6 ounce, solution bottle, stoppered, 20 ounce, 1s. 6d.

From time to time the delivery tube is withdrawn, and the bottle is closed and shaken. If, after shaking the bottle, you perceive, on loosening the stopper, that air rises into the bottle, the water is not quite saturated with the gas. The entrance of air is best seen by holding the bottle in the position shown by Fig. 2010.

Mohr's Apparatus for the constant supply of Liquid Hydrosulphuric Acid (*Solution of sulphuretted hydrogen gas in water*).

2011. Pint size, complete, as represented in the figure, 5s.
2012. Quart size, complete, 6s.

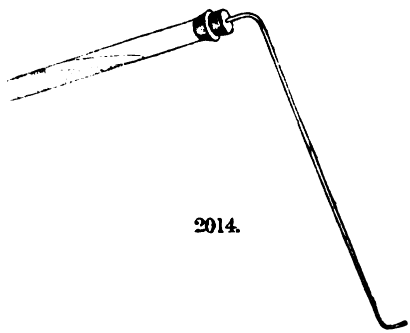
The jar *b* is to contain the diluted sulphuric acid, and the flask *c*, the sulphide of iron used for producing the gas. The bottle *a* contains the water that is to absorb the gas, and the solution when prepared, is to be drawn off by the jet on the syphon *d*. See "Chemical Recreations," page 621.



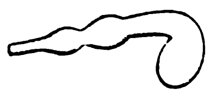
2011.

OXYGEN GAS BOTTLES.

2014. Oxygen Gas Tube Retort, for preparing oxygen gas by the distillation of chlorate of potash with peroxide of manganese, Fig. 2014, consisting of a stout hard Bohemian glass tube, 6 inches long, 1 inch wide, with long delivery tube, ½ inch wide, 1s.
2015. Similar apparatus, in which the distilling tube is made of copper, size 8 inches by 1½ inches, with metal delivery tube, 3s. 6d.
2016. Bohemian hard glass Retort, Fig. 1935, about 20 ounce size, fitted with glass delivery tube, 2s.


2014.

2017. **Retort of the most infusible white Bohemian glass, very stout, for preparing oxygen and other gases that require the application of a high temperature, 5 ounce size, 1s.**
2018. **Ditto, 10 ounce size, 1s. 6d.**
2019. **The same retort when fitted with a gas-leading tube, 5 ounce size, 2s.**
2020. **Ditto, 10 ounce size, 2s. 6d.**


2017.

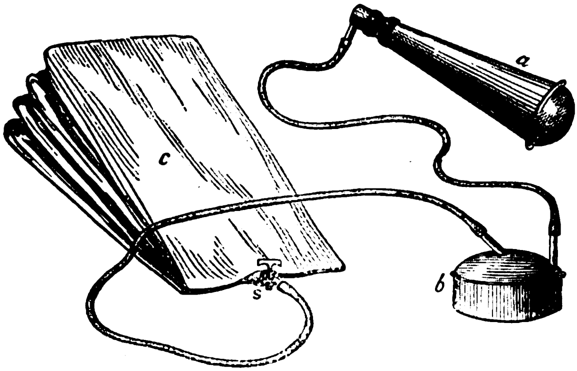
2021. **Flask of strong hard German glass, globular form, with wide neck. Similar to Fig. 1410, but fitted with caoutchouc cap and gas delivery tube.**

10 ounce, 1s. 9d. | 20 ounce, 2s. | 35 ounce, 2s. 6d.

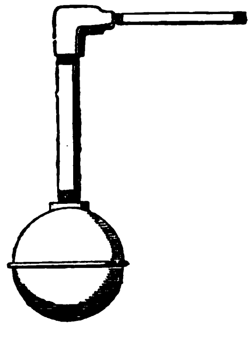
2022. Oxygen Retort, made of sheet iron with copper bottom, for preparing the gas in quantities of 5 or 6 cubic feet, for the magic lantern, &c., by heating chlorate of potash with manganese, with three feet of caoutchouc tube *a*, Fig. 2022, 9s.

For Prices of Gas Bags similar to *c*, Fig. 2022, see No. 2149.

2025. Oxygen Retort, consisting of a 5 inch copper globe with iron neck and long gas delivery tube, Fig. 2025, a strong and durable apparatus, 15s.



2022.


2025.

2026. Oxygen Retort, cast iron, for preparing oxygen gas by igniting peroxide of manganese, 6½ by 4 inches, containing 1½ pint, with long metal delivery tube, 7s.
2027. Ditto, 11½ inches by 5 inches, containing 5 pints, 9s.
2028. The Zinc pot, Fig. 2022*b*, contains water through which the gas is passed to wash and cool it, 4s. 6d.

CHLORINE GAS BOTTLES.

2033. Bottle for preparing gases that require heat, such as chlorine, 16 ounce size, with long gas delivery tube, Fig. 2033, 1s.
2034. Mohr's Bottle for the preparing of chlorine gas by an improved process, see "Chemical Recreations," page 663, a 40 ounce flask, with safety funnel and gas delivery tube, Fig. 2034, 3s.

Apparatus for preparing chlorine gas in the large way has been described at No. 1918.

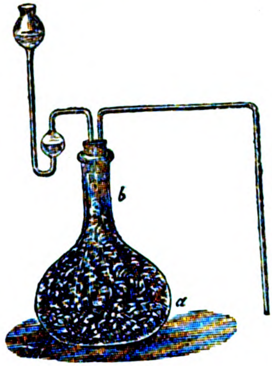
Wash Bottles for Gases.

2035. Vogel's Modification of Woulff's Apparatus, consisting of two 30 ounce one-necked flasks, one serving as a gas bottle, and the other as a wash bottle, connected by tubes so constructed as to make each bottle with one neck serve the usual office of a bottle with two necks, Fig. 2035, the pair, 5s.

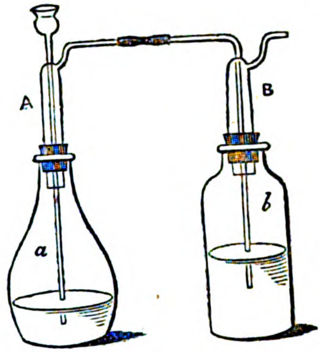
The Funnels of the Apparatus, No. 2035, *separately as follows:—*

2036. Vogel's Acid Funnel, A, Fig. 2035, 1s.
2037. Vogel's Gas Leading Tube, B. Fig. 2035, 1s.
2038. Sets of Woulff's Apparatus, of any number of bottles or any size of bottles, fitted up to order, either in the style of Fig. 2038, or arranged in mahogany trays.

2033.

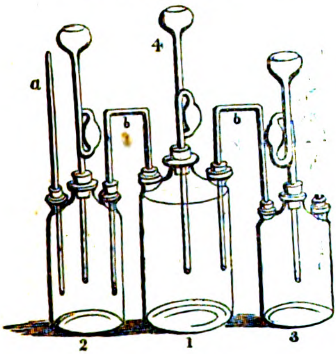


2034.



2035.

2039. Sets of Woulff's Apparatus, prepared with wide mouthed bottles and caoutchouc caps, either with two necks or three necks, as represented by Figs. 2039 and 2040. These caps are supplied separately; see No. 1950.



2038.

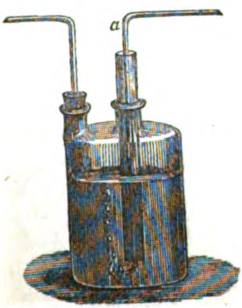
2039.

2040.

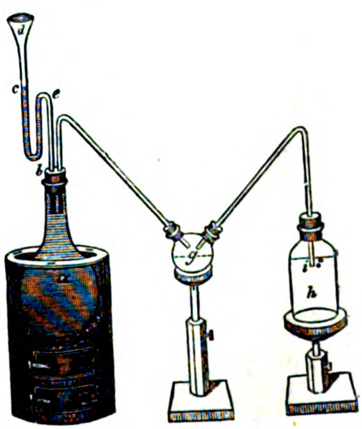
2041. Woulff's Bottles, fitted with wide tubes, which permit the gas delivery tubes to be readily withdrawn, and the solutions to be shaken to facilitate the absorption of the gas.

Fig. 2041.	20 ounce bottle,		1s. 3d.
"	30	"	1s. 6d.
Fig. 2042.	20	"	2s. 3d.
"	30	"	2s. 9d.

2041.



2042.



2045.

2045. INTERMEDIATE RECEIVERS, with two necks, through which gases are passed in the way between gas bottles and receivers, in order to deposit any acid or water which they may carry over mechanically, see *g*, Fig. 2045, and *b*, Fig. 1938.

See list of prices at No. 1849.

The apparatus represented by Fig. 2045 is for the preparation of liquid hydrochloric acid. The acid gas is prepared in the flask *a*, and the water to absorb it is placed in the bottle *h*. Another form of gas-leading tube, for use instead of the form *i*, is shown by *j*, Fig. 1941.

2046. APPARATUS FOR WASHING GASES, suitable for use when a large quantity of thoroughly washed gas is required, consisting of a circular glass cistern, 7 inches deep, and 12 inch diameter, mounted on a wooden base, with a system of five concentric brass cylinders, which dip into the water, and force the gas to take a long passage through it, 60s.

Apparatus for Drying Gases.

2047. When gases issue from flasks in which they are prepared with the assistance of aqueous acids, they are necessarily saturated with water in the state of vapour. If they are required to be in a dry state it is usual to pass them through vessels that contain substances that strongly absorb water, such as dried or fused chloride of calcium, broken into small lumps, or fragments of pumice stone, or filaments of asbestos, that have been saturated with oil of vitriol. The vessel to contain these desiccating substances must be chosen, as to form and size, in accordance with the particular plan of each experiment. If the quantity of gas is small and the weight of the absorbed water is to be ascertained—a process of great importance in organic analysis—the chloride of calcium is put into a very small and light glass tube capable of being weighed on a delicate balance. If on the other hand, a large quantity of gas is to be dried, and no account is to be taken of the abstracted water, then the drying substance is used in a greater quantity and in a more bulky vessel. Various forms of apparatus suitable for these purposes are represented by the following figures.

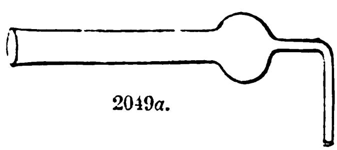
CHLORIDE OF CALCIUM TUBES FOR DRYING GASES.

A, consisting of a wide tube and a narrow tube, having a bulb between them.

2048. *With straight neck, form of Fig.* 2048.

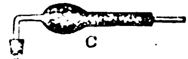
a.	Tube	$3\frac{1}{2} \times \frac{3}{8}$	inch,	1	bulb, neck	$2 \times \frac{1}{5}$	inch,	2d.
b.	„	$5 \times \frac{1}{2}$	„	1	„	$2 \times \frac{1}{5}$	„	2d.
c.	„	$8 \times \frac{1}{2}$	„	1	„	$3 \times \frac{1}{4}$	„	3d.
d.	„	$5 \times \frac{7}{8}$	„	1	„	$3 \times \frac{3}{8}$	„	5d.
e.	„	$7 \times \frac{7}{8}$	„	1	„	$3 \times \frac{3}{8}$	„	6d.
f.	„	8×1	„	1	„	$3 \times \frac{1}{4}$	„	6d.

2048.


2049*a*.

2049. *With bent neck, form of Fig.* 2049, *a and b.*

a.	Tube	$6 \times \frac{1}{2}$	inch,	1	bulb, neck	$4 \times \frac{1}{4}$	inch,	4d.
b.	„	5×1	„	1	„	$4 \times \frac{3}{8}$	„	5d.
c.	„	8×1	„	1	„	$5 \times \frac{1}{2}$	„	6d.
d.	„	$8 \times \frac{1}{2}$	„	1	„	$5 \times \frac{1}{4}$	„	6d.



2049*b*.

B, Chloride of Calcium Tubes, consisting of a wide tube and a narrow tube, with two bulbs between them.

2050. *With straight neck, form of Fig.* 2050.

a. Tube 5 by $\frac{1}{2}$ inch, 2 bulbs, neck 3 by $\frac{1}{5}$ inch, 4d.

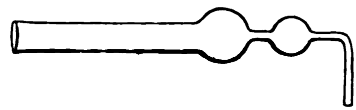
b. Tube 7 by $\frac{1}{2}$ inch, 2 bulbs, neck 5 by $\frac{1}{4}$ inch, 6d.


2050.

c. Tube 11 by $\frac{1}{2}$ inch, 2 bulbs, neck 6 by $\frac{3}{8}$ inch, 6d.

2051. *With bent neck, Fig.* 2051.

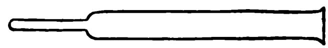
Tube 5 by $\frac{5}{8}$ inch, 2 bulbs, neck 5 by $\frac{1}{2}$ inch, 4d.



2051.

2052. *C,* consisting of a wide tube joined to a narrow tube without bulb, Fig. 2052.

Tube 9 by $\frac{5}{8}$ inch, no bulb; neck 2 by $\frac{1}{4}$ inch, 3d.



2052.

2053. *D,* consisting of a Cylindrical Tube, for a cork and short narrow tube at each end, letter *c*, Fig. 1938.

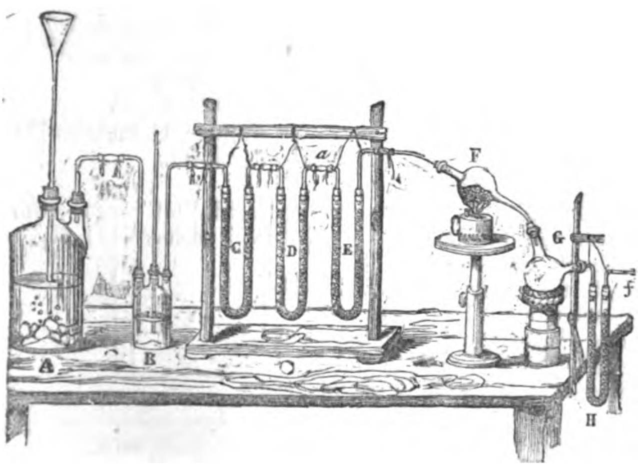
a. Large Tube, 9 inches long, $\frac{3}{4}$ inch wide, 10d.
b. „ 12 „ 1 „ 1s.

2054. *E,* consisting of a U-shaped tube of uniform bore and parallel branches, form of C, D, E, Fig. 2054, or Fig. 2056. The length given is about that of one branch only.

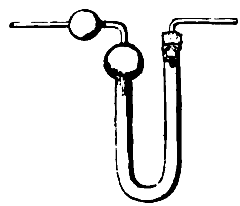
a. 6 inch by $\frac{1}{2}$ inch, 7d.
b. 6 „ by $\frac{5}{8}$ „ 9d.
c. 8 „ by $\frac{3}{4}$ „ 1s. 0d.
d. 9 inch by $\frac{1}{2}$ inch, 1s. 0d.
e. 9 „ by $\frac{5}{8}$ „ 1s. 3d.
f. 12 „ by 1 „ 1s. 6d.

Fig. 2054 represents Regnault's Apparatus for producing water by passing pure dry hydrogen gas over ignited oxide of copper. The apparatus and experiment are described in detail in *Chemical Recreations,* at page 220.

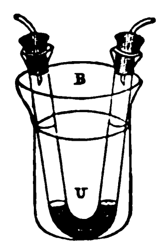
2055. *F,* Marchand's Form of Tube, consisting of a U-shaped tube with two bulbs, and connecting tubes, form of Fig. 2055, 10d.



2054.



2055.

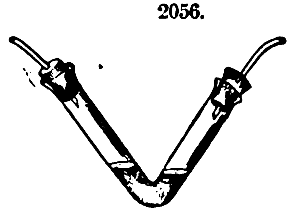


2056.

2057. *H,* V-shaped Tube, not fitted, form of Fig. 2057.

The lengths given are those of one limb only.

a. Large size, 6 inches long, $\frac{3}{4}$ inch wide, 8d.
b. Small size, $4\frac{1}{2}$ „ $\frac{5}{8}$ „ 4d.
c. V-shaped, with unequal legs (*b*, Fig. 1936). Total length, 10 inches by $\frac{3}{4}$ inch, 6d.

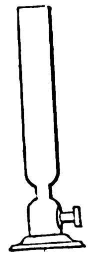


2057.

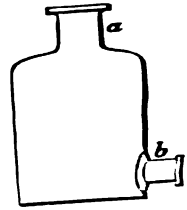
For connectors to fit the tubes Nos. 2056 and 2057, to gas bottles, see *h* and *i* in Fig. 1941.

2058. *I*, Cylindrical Jar, on foot, with a tubulure at the side near the bottom, form of Fig. 2058, sometimes with a neck at top like Fig. 2059.

a. Size of Body,	8 inches high,	$1\frac{1}{2}$ inch wide,		1s. 6d.
b. "	12 "	2 "		2s. 0d.
c. "	16 "	2 "		3s. 6d.
d. "	6 "	$\frac{5}{8}$ "	slight,	9d.



2058.



2059.

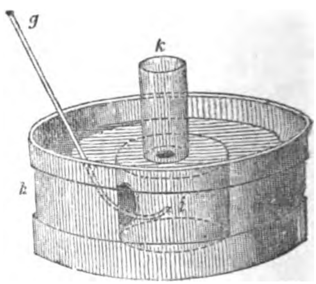
2059. *K*, Woulff's Bottle, with tubulure at the bottom, Fig. 2059, suitable for a large quantity of desiccating material.

10 ounce size, 10d. | 20 ounce size, 1s.

For other sizes, see No. 249.

PNEUMATIC TROUGHS.

I. GRIFFIN'S INCORRODIBLE STONEWARE PNEUMATIC TROUGHS.



2066.

2065. These consist of stoneware pans, in which are placed movable shelves, so formed as to collect the gases and convey them into the vessels placed to receive them. Figs. 2066 and 2070 represent two varieties of the trough, and Figs. 2071 and 2072 two varieties of the movable shelf, which are again represented as they appear when in use in Figs. 2066 and 2070. In consequence of the dome form of the interior of the shelf, it has received the name of the *beehive shelf*. As this piece of apparatus sinks in water, it is evident that a pan, trough, or tub of any form or material can be used as a pneumatic trough with the assistance of the beehive shelf. In France they use an instrument of a beehive form to collect gases, but they make the mistake of giving a spherical form to its outside as well as its inside, the consequence of which is, that glass jars cannot rest steadily upon the shelf. The flat-topped shelf represented in Fig. 2066 was first described in my work on *Chemical Manipulation*, published in 1838.

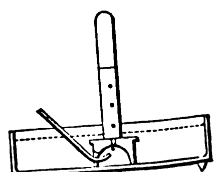
2066. Stoneware Pneumatic Trough, Fig. 2066, the trough circular, 11 inches wide and 5 inches deep; the beehive shelf, 4 inches wide, 2s. 8d.

2067. The Trough without the beehive shelf, 2s.

2068. Stoneware Pneumatic Trough, same form as Fig. 2066, but larger; the trough 15 inches wide and 8 inches deep; the shelf, 7 inches wide, 7s.

2069. The Trough without the beehive shelf, 5s. 6d.

2070. Flat Pneumatic Trough, for experiments with Tubes, form of Fig. 2070, the trough 12 inches wide and 2 inches deep, made of saltglazed stoneware; the shelf, form of Fig. 2072, 2 inches wide and 1 inch deep, of white porcelain; the trough 1s. 9d., the beehive 7d.

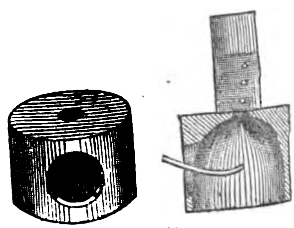


2070.

The porcelain and stoneware mercury troughs, Nos. 2085 to 2089, can also be used with water for experiments with tubes.

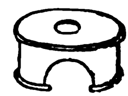
2071. Beehive Shelves, with which any pan, tub, or trough can be used as a Pneumatic Trough, form of Fig. 2071.

a. 4 inch diameter,		saltglazed stoneware,	8d.
b. 4	"	Wedgwood porcelain,	2s. 0d.
c. 5	"	saltglazed stoneware,	1s. 0d.
d. 6	"	"	1s. 3d.
e. 7	"	"	1s. 6d.



2071.

2072. **Beehive Shelf**, of the form of Fig. 2072, 2 inches wide, 1 inch deep, of stoneware, white Berlin or Wedgwood porcelain, 7d.



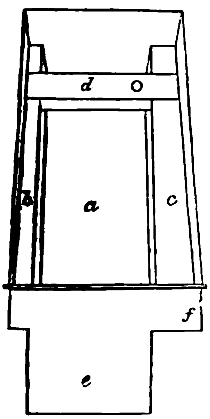
2072.

II. METALLIC TROUGHS FOR USE WITH WATER.

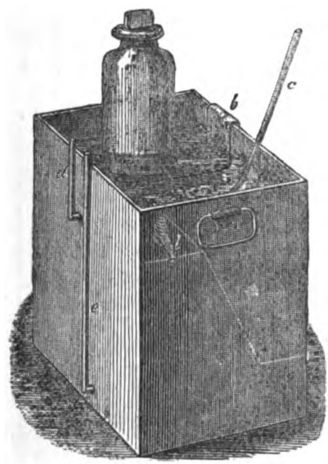
2073. **Pneumatic Trough of Japanned Tinplate**, with movable shelf, form of Fig. 2073; *d*, the movable shelf. The following four sizes are kept in stock—other sizes can be made to order:

2073.	10 inch by 6½ inch, 3s.		2075.	19 inch by 12½ inch,	8s. 0d.
2074.	14 „ 9½ „ 6s.		2076.	21½ „ 15½ „	10s. 6d.

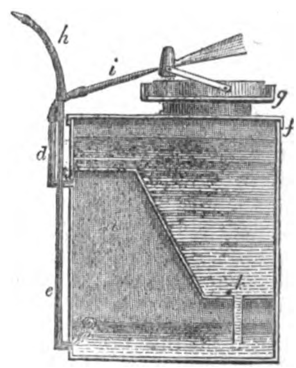
2077. **Tate's Pneumatic Trough combined with a Hydraulic Blowpipe**, for use in glass-blowing; the trough 16 inches by 12 inches, with a movable shelf and a cover, japanned tinplate. In Fig. 2077*a* it is represented as seen in use as a pneumatic trough; in Fig. 2077*b*, as a hydraulic blowpipe, japanned tinplate, 16s. 6d.



2073.

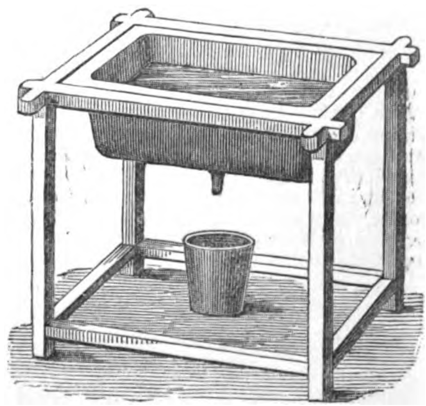


2077*a*.



2077*b*.

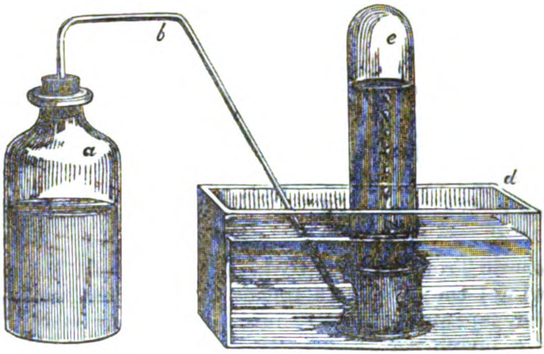
2077c. **Cast-Iron Pneumatic Trough**, enamelled inside, size 28 × 16 × 10 inches deep. It has a plug in the bottom to run off the water, and is mounted in a strong wooden frame, Fig. 2077*c*, £3.



2077*c*.

III. GLASS PNEUMATIC TROUGHS.

2078. **Pneumatic Trough of fine white solid Bohemian glass**, rectangular form, cast in one piece, the edges and entire surface cut and polished, may be used either with a 4 inch beehive shelf, as shown in *d*, Fig. 2078, or with a brass sliding shelf, like that represented in Fig. 2083.



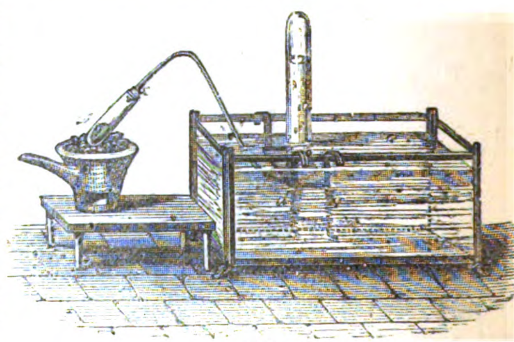
2078.

Price of the Glass Trough with a 4 inch white porcelain beehive shelf:—

2079. The Trough, 12 inches long, 6½ inches wide, and 5 inches deep, 30s.
2080. The Trough, 14½ „ 7½ „ and 5 to 6 „ 34s.
2081. The Trough, 17 „ 8½ „ and 7 „ 48s.
2082. If a brass sliding shelf is desired, in addition to the porcelain shelf, the extra cost will be 5s. 6d., or 3s. 6d. if without the porcelain shelf.

When a jar of greater width than 4 inches is to be filled with gas, the 4 inch beehive shelf may be covered with a sufficiently wide perforated glass plate, Fig. 1679.

2083. Pneumatic Trough, for use with water, made of stout plate glass, connected with massive brass framing and a glass bottom, with a sliding brass shelf for supporting gas jars, Fig. 2083; size 14 inches long, 8½ inches wide, and 8 inches deep, 55s.



2083.

Glass Pneumatic Troughs of a Circular Form.

The Conical Pans described at page 156, under the head of "Solution," and the Cylindrical Basins described at No. 1780, under the head of "Evaporation," can be used as Pneumatic Troughs, when supplied with a Beehive Shelf, No. 2071 or 2072. It is only necessary to select a vessel that is long enough and deep enough to permit the gas receiver that is to be filled to lie flat in it, and to be turned up conveniently when full of water. The beehive shelf must, of course, be as wide as the gas receiver that it is intended to support. In case of need, a small beehive shelf may be widened by having a perforated glass plate, No. 1679, placed on the top of it.

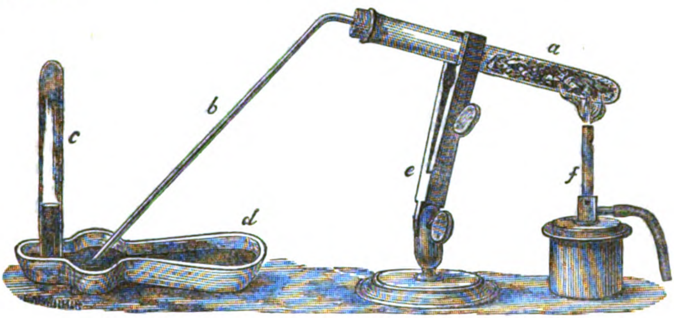
IV. PNEUMATIC TROUGHS FOR USE WITH MERCURY.

In describing the troughs for use with mercury, the length and width inside are stated, and the quantity of mercury, in avoirdupois pounds, that is required to fill each of them; first, to a quarter of an inch above the level of the shelf, and secondly, close up to the brim. These particulars will enable the reader to form a judgment as to the sizes of glass vessels proper for use with each trough, and the quantity of mercury necessary for convenient manipulation with it.

Griffin's Pneumatic Trough for Experiments with Tubes.

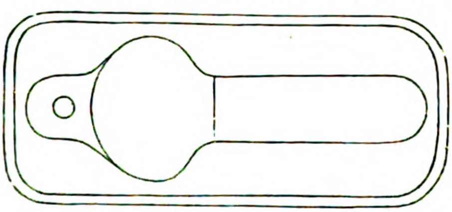
2085. In saltglazed stoneware, 1s. 3d.
2086. In Thuringian or Wedgwood porcelain, white glazed, 1s. 9d.

This trough is represented by *d*, in Fig. 2085. It is shown in section by Fig. 2088. It is 8 inches long inside, and it works with tubes of 6 inches long and 1 inch wide. It requires 4 lbs. to 5 lbs. of mercury to fill it.

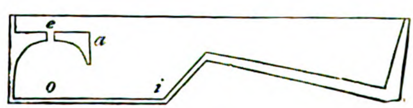


2085.

2087. Griffin's Mercury Trough for Tubes, of the same internal form as the above, but rather longer, and made with a border, which rises above it and prevents the overflow of the mercury; it is 9 inches long, and a little above 1 inch wide inside, and takes in tubes of nearly 7 inches long by 1 inch wide. It requires about 4 lbs. of mercury to fill it over the shelf, and 8 lbs. to fill it entirely. It is represented by Figs. 2087 and 2088, in horizontal and vertical sections. In one piece, saltglazed stoneware, 2s. 6d.



2087.

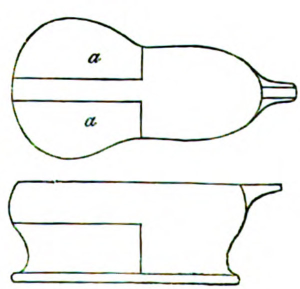


2088.

Pneumatic Trough, for Experiments with Tubes, Berlin pattern, Fig. 2089.

2089. In saltglazed stoneware, 2s. 6d.
2090. In Wedgwood porcelain, 3s. 0d.
2091. In Thuringian porcelain, 3s. 6d.

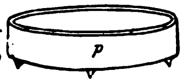
This trough is shown by Fig. 2089 in horizontal and vertical section. Extreme length, 7 inches; extreme breadth, 4 inches, inside measurement. It requires 9 or 10 lbs. of mercury to fill it to the shelf, and 18 lbs. to fill it entirely. This pattern of trough is used by Liebig, in the determination of nitrogen in organic analysis.



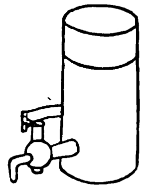
2089.

2093. Flat Pan, for use with small Mercury Troughs, to catch the overflowing mercury, saltglazed stoneware, 12 inches diameter, 2 inches deep, Fig. 2093, 1s. 9d.

2094. Mercury Box, with steel cock and regulating spring, for pouring mercury into very narrow tubes, &c., Fig. 2094, 8s.



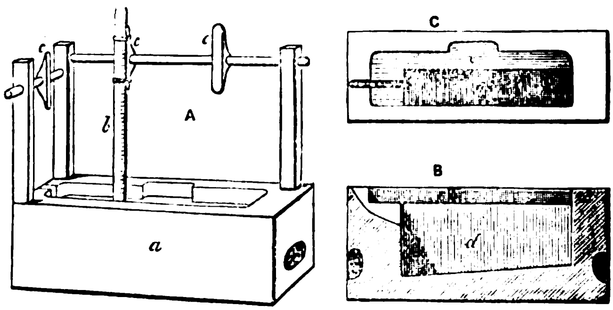
2093.


2094.

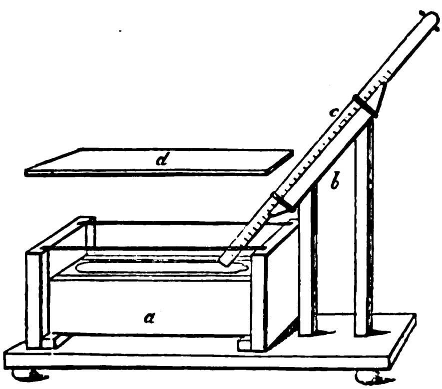
PNEUMATIC TROUGHS FOR MERCURY, OF LARGER SIZE :—

2095. Liveing's Pneumatic Trough, for use with mercury, Fig. 2095, 36s.

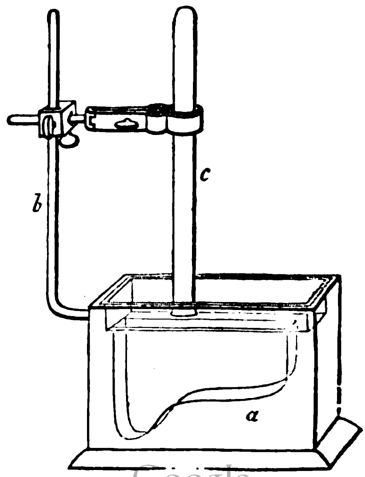
This trough is cut from a solid block of mahogany. It is represented by A in perspective, by B in longitudinal section, and by C in horizontal section. The three square upright rods are screwed into the body of the trough *a*. Into the middlemost of these uprights the round horizontal bars are screwed. The three grooved pieces, *c*, *c*, *c*, made of different widths, slide freely on these bars. The gas tube *b* is fastened to one of them by caoutchouc bands. *d* shows the form of the interior of the trough, and *e* the shelf. At each end cavities are cut in the solid to admit the fingers when the trough requires to be lifted. Dimensions of the cavity *d*, 12 inches long, 1½ inch wide; of the cavity level with the shelf, 14 inches long, 2¼ inches wide. Quantity of mercury required to cover the shelf, 30 lbs.; to fill the trough entirely, 40 lbs. The body of the trough is in one piece, so that leakage is impossible. The fittings unscrew for packing. The mahogany is French polished.



2095.



2096.



2097.

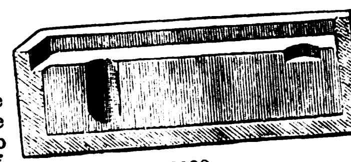
2096. Bunsen's Pneumatic Trough, for use with mercury, in the analysis of gases by eudiometrical operations, Fig. 2096, 30s.

This trough consists of a solid block of polished mahogany, with plate glass sides, and a mahogany base and frame for supporting eudiometers. Fig. 2096, *a*, represents the trough; *b*, the support for the eudiometers; *c*, an eudiometer fixed in position; *d*, a plate of glass to cover the trough when not in use, to keep the mercury clean. Interior dimensions of the upper part of the trough, 14 inches long and 3 inches wide; measurement of the sunk cavity, 11 inches long, 2¼ inches wide. It requires 20 lbs. of mercury to cover the shelf, and 45 lbs. to fill it entirely. The mahogany is French polished, and the edges of the plate glass are ground.

2097. Regnault's Pneumatic Trough, for use with mercury, Fig. 2097, without the tube marked *c*, but with the tube clamp, 36s.

This trough consists of a solid block of cast iron, which is enclosed in a stout mahogany case. The dotted lines show the form of the cavity and of the shelf. The rod *b* is screwed through the mahogany into the iron trough. By means of the block and the sliding iron vice, tubes, such as are represented by *c*, can be held over any part of the trough, and at any required height. Length of the cavity, 8¾ inches; breadth, 2¼ inches. Length of the cavity above the shelf, 10¾ inches; breadth, 5 inches. Quantity of mercury required to cover the shelf, 48 lbs.; to fill the trough entirely, 80 lbs.

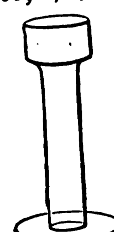
2098. Small Cast-Iron Pneumatic Trough, for use with mercury, Fig. 2098, 8s.


2098.

This trough consists of a solid block of cast iron. The section shows the cavities and the shelf. Length of the inside, 9½ inches; breadth 1 inch; depth, 2⅛ inches, to shelf. Quantity of mercury required to cover the shelf, 13 lbs.; to fill the trough entirely, 15 lbs.

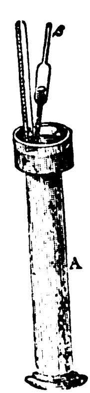
2099. Vertical Pneumatic Troughs, for use in tube operations on gases, consisting of glass jars with broad feet and expanded mouths. Fig. 2099, *a*, *b*, *c*.

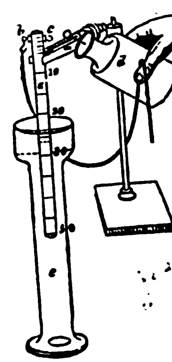
No. 1.	8 inches high,	2 inches wide,	mouth 3 inches,	1s. 0d.
2.	12 „	2 „	3 „	1s. 3d.
3.	16 „	2½ „	3½ „	1s. 9d.
4.	18 „	2½ „	3 „	1s. 9d.
5.	12 „	2½ „	3 „	1s. 6d.
6.	9 „	1½ „	2 „	1s. 0d.
7.	13 „	1½ „	2 „	1s. 3d.
8.	9 „	1½ „	3 „	1s. 0d.


2099*c*.

2100. Ettling's Gas Pipette, for taking gases from jars in such troughs, small size, 1s. 6d.; large size, 2s. *See also* Doyere's Pipette *in the Section on* "Apparatus for Analysis of Gases."

Fig. 2099*c*, represents the vertical trough with a broad mouth and broad foot, the latter intended to prevent the overturning of the apparatus when filled with mercury. Fig. *a* represents the trough as in use, when a liquid test, such as potash, is being passed up into a gas to absorb carbonic acid. Fig. *b* represents the mode of applying an electric spark to inflame mixtures of oxygen and hydrogen gas.


2099*a*.


2099*b*.

GAS RECEIVERS.

The Cubic Inches quoted throughout this section, as representing the Capacities of Glass Tubes, and of other glass vessels, are not to be considered as correct measurements, but only as numbers that approximately indicate the sizes of the respective vessels.

2101.

Deflagrating Jars, or Gas Receivers, open at bottom, welted and ground, with wide mouth, closed by a ground glass stopper, Fig. 2101, hard German glass.

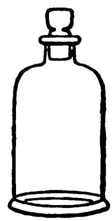
		Diameter.	Contents.	Price.
2101.	5 inches high,	3 inches,	about 35 cubic inches,	1s.
2102.	7 ,,	4 ,,	,, 90 ,,	2s.
2103.	9 ,,	5 ,,	,, 180 ,,	3s.
2104.	11 ,,	6 ,,	,, 300 ,,	4s.

2105. Deflagrating Jar, mounted with cap and gas-delivery tube, having a flexible joint secured by a pinchcock; used to collect a quantity of gas, and then deliver it into small tubes or other vessels as required; size of jar, 11 by 6 inches, 6s. 6d.

2106. Trays for holding Gas Receivers when filled with gas and removed from the Pneumatic Trough. (See page 14.)

2107. Bell Gas Receivers, welted and ground on the edge, narrow mouths, fine white Bohemian glass, with ground stoppers, generally cut ornamentally.

The following measurements are only approximate:—



2107.

2105.

No.	Height to Shoulder.	Diam.	Capacity.	Price.
1.	5 in.,	2 in.	15 cubic in.,	1s. 3d.
2.	5 ,,	3 ,,	35 ,,	1s. 6d.
3.	6 ,,	3 ,,	40 ,,	2s. 0d.
4.	6 ,,	4 ,,	80 ,,	2s. 6d.
5.	7 ,,	5 ,,	135 ,,	3s. 0d.
6.	8 ,,	4 ,,	100 ,,	3s. 0d.
7.	8 ,,	6 ,,	225 ,,	4s. 0d.

No.	Height to Shoulder.	Diam.	Capacity.	Price.
8.	8 ,,	7 in.	300 cubic in.,	5s. 0d.
9.	9 ,,	6 ,,	250 ,,	4s. 6d.
10.	9 ,,	7 ,,	340 ,,	5s. 6d.
11.	10 ,,	5 ,,	200 ,,	4s. 0d.
12.	10 ,,	8 ,,	500 ,,	6s. 0d.
13.	12 ,,	5 ,,	240 ,,	5s. 0d.
14.	13 ,,	5 ,,	250 ,,	5s. 6d.

2108. Bell Gas Receivers, cylindrical form, with knob at the top, and stout welt round the mouth, ground flat, Fig. 2108, fine white Bohemian glass, well annealed.

Approximate Measurements as follow:—

No.	Height inside.	Diam.	Capacity.	Price.
1.	5 in.,	2 in.,	15 cubic in.,	1s. 0d.
2.	5 ,,	3 ,,	30 ,,	1s. 6d.
3.	6 ,,	4 ,,	70 ,,	2s. 6d.
4.	7 ,,	5 ,,	130 ,,	3s. 0d.
5.	8 ,,	6 ,,	220 ,,	4s. 0d.

No.	Height inside.	Diam.	Capacity.	Price.
6.	8 in.,	7 in.,	300 cubic in.,	5s. 0d.
7.	10 ,,	8 ,,	500 ,,	6s. 6d.
8.	5 ,,	6½ ,,	160 ,,	4s. 0d.
9.	5 ,,	7½ ,,	200 ,,	4s. 6d.
10.	5 ,,	8½ ,,	280 ,,	5s. 6d.

2109. **Bell Gas Receivers**, with welted and ground mouth, and glass stopcock ground into the neck, fine white Bohemian glass, Fig. 2109.

No.	Height to Shoulder.	Diameter.	Approximate Contents.	Price.
1.	13 inches,	5 inches,	250 cubic inches,	12s.
2.	16 „	6 „	450 „	15s.

2110. **Glass Cylinders with Brass Caps**, for collecting gases, and conveying them into exhausted glass globes, balloons, &c., welted mouths, ground, Fig. 2110, *a* and *c*.

No.	Height.	Width.	Contents in cubic inches.	Price.	No.	Height.	Width.	Contents in cubic inches.	Price.
1.	7 in.,	4 in.,	100	3s. 0d.	6.	9 in.,	6 in.,	250	4s. 0d.
2.	8 „	5 „	160	3s. 0d.	7.	12 „	6 „	340	5s. 0d.
3.	9 „	4 „	100	3s. 0d.	8.	14 „	6 „	400	6s. 0d.
4.	10 „	5 „	200	4s. 0d.	9.	9½ „	7 „	370	6s. 0d.
5.	11 „	5 „	220	4s. 0d.					

2111. *If No.* 2110 *are graduated into cubic inches,* the extra price will be as follows:—

On Nos. 1 to 5, 3s. each. | On Nos. 6 to 9, 4s. each.

2112. Glass Cylindrical Gas Receiver, with spherical receiver, and intermediate brass fittings, as represented by Fig. 2110.

1. Price of the Cylinder according to the sizes, see the table, No. 2110.
2. Price of the Globe and brass fitting, marked *b*, *d*, *e*, *f*, *g*, 10s.

The brass fittings of this apparatus are charged separately as follows:—

704. Connector *f*, Fig. 2110, 1s.
697. Stopcocks *e* and *g*, Fig. 2110, 3s. each.
713. Caps *c* and *d*, Fig. 2110, 1s. each.

Glass Globes, with brass caps, suitabe for use with the capped cylinders, No. 2110, two varieties.

2113. Globe of Light Glass, for taking the specific gravity of gases, 4½ inch diameter, about 50 cubic inches capacity, with small stopcock, extra screw to adapt it to the air pump, and a hook for the balance; the capacity marked on the globe, 7s. 6d.

2114. Globe of Stout Glass, about 5 inch diameter, with brass cap, not graduated, *b*, *d*, Fig. 2110, 3s.

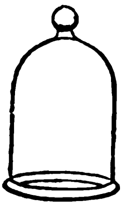
2115. Large Glass Globular Receivers, for collecting oxygen gas, see No. 2224.

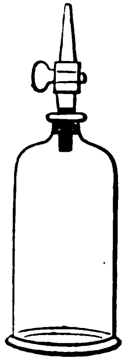
2116. Glass Globe, with ground glass stopcock and jet, fine hard white Bohemian glass, Fig. 2116.

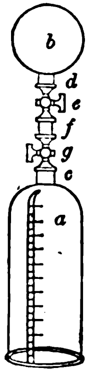
a. Contents about 70 cubic inches, 10s.
b. „ 100 „ 12s.
c. „ 140 „ 14s.

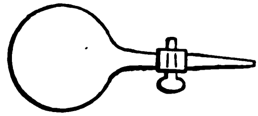
2117. Deflagrating Bottles, of the form of Fig. 2117, for collecting gases, for performing deflagrations in oxygen, &c., hard white Bohemian glass, thin but uniform in substance, the necks cylindrical, flat ground mouth, not welted. The following sizes:—

No.	Height to Shoulder.	Diameter.	Width of Mouth.	Contents.	Price.
1.	5 inches,	2½ inches,	1¾ inches,	25 cubic inches,	9d.
2.	6 „	3 „	2½ „	50 „	1s. 0d.
3.	7 „	4 „	3 „	80 „	1s. 3d.
4.	8 „	5 „	3½ „	160 „	1s. 6d.

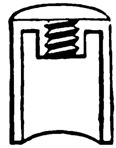




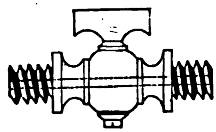


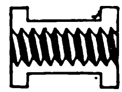


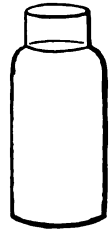
2116.



713.

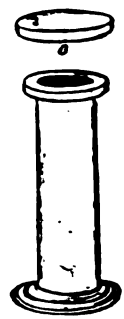






2108. 2109. 2110. 697. 704. 2117.

2118. Cylindrical Jars on feet, with strong flange at the mouth, Fig. 2118. The sizes and prices are given at No. 1534, page 154.



2118.

The prices of glass discs for covering jars, c, Fig. 2118, are given at Nos. 1677 and 1685.

If the jars described at No. 2118 are *ground at the mouth*, the price of each will be 2d. to 4d. extra.

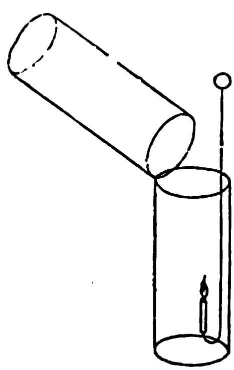
2119. Gas Receivers, in the form of wide-mouthed bottles, hard German glass, with ground stoppers, stout glass, Fig. 2119.

1 pint, 1s. 0d.	3 pints, 1s. 9d.	5 pints, 2s. 9d.
2 ,, 1s. 6d.	4 ,, 2s. 0d.	6 ,, 3s. 6d.

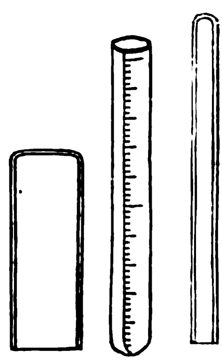
Fig. 2119 represents two such bottles put mouth to mouth, with two glass discs placed between them. If the bottles are respectively filled with muriatic acid gas and ammonia gas, each bottle being secured by a glass plate, the two gases mix together when the two glass plates are removed.

2119.

2122.



2121.



a. b. c.

2124.

2120. **Gas Receivers** in the form of bottles, with extremely wide necks (4 to 5 inch), hard Bohemian glass, thin in substance, with glass stoppers ground, but not accurately fitted :—

1 pint,	7d.	4 pints	1s. 4d.	12 pints,	3s. 0d.
2 „	10d.	6 „	1s. 3d.	15 „	4s. 0d.
2½ „	1s. 0d.	8 „	2s. 0d.	18 „	5s. 0d.
3 „	1s. 2d.	10 „	2s. 6d.	20 „	5s. 6d.

2121. **Cylindrical Jars** for collecting gases, flat bottoms, uniformly thin in glass, not ground on the mouth, form of the jars in Fig. 2121.

No. 1.	2½ inch by 1½ inch,	3d.	No. 5.	6½ inch by 3¼ inch,	8d.
2.	3 „ 1¾ „	4d.	6.	7 „ 3½ „	10d.
3.	4 „ 2 „	6d.	7.	8 „ 4½ „	1s. 4d.
4.	5 „ 2½ „	7d.	8.	The set of 7 jars,	4s. 0d.

No. 9. The set of four small sizes, No. 1 to 4, 1s. 6d.

Cylindrical Jars of stout glass, see Nos. 1516 and 1530.

2122. **Cylindrical Gas Tubes, or Eprouvettes**, for collecting hydrogen and other gases, stout white glass, Fig. 2122. Per dozen :—

No.	Length.	Width.	Contents.	Price.
1.	4 inches long,	1 inch wide,	2 cubic inches,	2s. 6d.
2.	5 „	1¼ „	5 „	3s. 6d.
3.	6 „	1½ „	8 „	4s. 6d.
4.	7 „	1½ „	10 „	6s. 0d.
5.	9 „	1¾ „	15 „	7s. 0d.
6.	12 „	2 „	30 „	10s. 0d.
7.	11 „	3 „	60 „	12s. 0d.

2123. *The above, if ground at the mouth,* 1d. to 2d. *each extra.*

2124. **Straight Tubes for collecting Gases**, in experiments with small quantities. The short sorts particularly adapted for use with the mercury troughs, No. 2085. With these tubes gases can be collected, mixed together, or be mixed with liquids, &c. Made of hard and strong German glass, closed at one end, not graduated. Fig. 2124 *a, b, c.*

The following measurements are not given as accurate, but merely to afford an idea of the approximate sizes and capacities of the Tubes.

Ground on the Mouth.					Not Ground on the Mouth.				
No.	Length, Inches.	Width, Inches.	Cubic Inches.	Price.	No.	Length, Inches.	Width, Inches.	Cubic Inches.	Price.
1.	1½	½	⅓	2d.	7.	3	½	⅔	2d.
2.	2	1	1¼	2d.	8.	6	½	¾	2d.
3.	3	⅝	1	2d.	9.	2	¾	¾	2d.
4.	6	¾	1¾	3d.	10.	4½	½	1	3d.
5.	4	1	2½	3d.	11.	6	¾	1¾	3d.
6.	6	1	3½	3d.	12.	8	⅝	2½	3d.
					13.	6	1	3½	3d.

2125. **Straight Tube for collecting gases.** The following tubes are more even in the bore than the foregoing. They are not ground on the mouth.

No.	Length, Inches.	Width, Inches.	Cubic Inches.	Price.	No.	Length, Inches.	Width, Inches.	Cubic Inches.	Price.
1.	6	$\frac{5}{8}$	$1\frac{1}{4}$	6d.	6.	12	1	7	9d.
2.	$9\frac{1}{2}$	$\frac{1}{2}$	$1\frac{1}{2}$	6d.	7.	12	1	8	9d.
3.	11	$\frac{5}{8}$	2	6d.	8.	13	$1\frac{1}{4}$	10	1s. 0d.
4.	12	$\frac{5}{8}$	$2\frac{1}{2}$	8d.	9.	19	$1\frac{5}{8}$	30	1s. 3d.
5.	10	1	6	8d.	10.	23	$1\frac{3}{4}$	40	1s. 6d.

2126. **Gas Tubes, graduated into cubic inches or centimetre cubes, are described in another section.**

For other sizes of Plain Glass Cylinders, see Nos. 2121 and 2122.

2127. Schrotter's Gas Receiver, Fig. 2127, made of hard German glass tube, bulb $1\frac{1}{2}$ inch, tube 5 inch by $\frac{5}{8}$ inch, 6d.

2128. Cooper's Receiver, for collecting Gases over Mercury, and for experimenting on the gases without the help of a Pneumatic Trough or of other Receivers, Fig. 2128.

No. 1. 8 inches long, $\frac{5}{8}$ inch wide, 8d.
2. 10 „ $\frac{3}{4}$ „ 10d.
3. 12 „ 1 „ 1s. 0d.

The following with a neck and stopper at the upper end :—

No. 4. 8 inches long, $\frac{5}{8}$ inch wide, 1s. 0d.
5. 12 „ 1 „ 1s. 3d.

2129. Cooper's Gas Receivers, graduated into cubic inches or centimetre cubes, at from 2s. to 4s. extra.

2130. **Gay Lussac's Bent Tube Receiver (cloche courbé), for applying heat to substances in gases, over mercury, hard glass tube.** Fig. 2130.

No. 1. 10 inches long, $\frac{1}{2}$ inch wide, 8d.
2. 12 „ $\frac{3}{4}$ „ 10d.

2131. Davy's Apparatus for the same purpose, Hard Glass Retort, Fig. 2131, 1s.

2132. Iron tongs, having hemispherical cavities at their points, for passing metals, such as potassium, through mercury into gases, contained in Receivers such as Nos. 2130 and 2131, 15 inches long, polished iron, 4s.

2132a. Potassium Spoon of Wire Gauze, for holding balls of potassium under gas tubes, Fig. 2132*a*, but with cover and long handle, 2s.

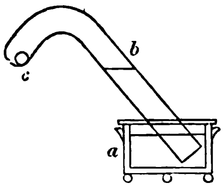
2132*a*.

2133. Kerr's Gas Tube, stoppered, for collecting and measuring the carbonic acid gas discharged when a carbonate is decomposed by an acid, Fig. 2133 :—

1. Plain Tube, 14 to 16 inches long, $\frac{5}{8}$ inch wide, 1s. 6d.
2. Ditto, graduated into cubic inches, 4s. 6d.
3. Ditto, graduated into centimetre cubes, 4s. 6d.

An acid being put into the branch *a*, and a solid (carbonate of lime) into the cavity *c*, the gas which is disengaged is collected in the branch *a*, where it is measured by the scale, and from which it can be transferred for examination.

2132.



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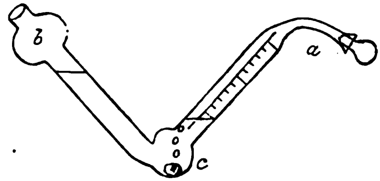

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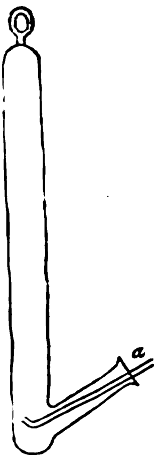

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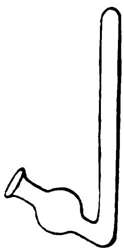

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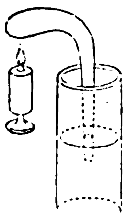

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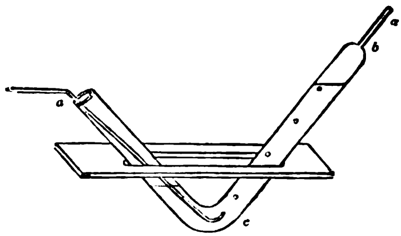


2134.

2134. Berzelius's Bent Tube Receiver, for collecting Gases over Mercury without a Trough, Fig. 2134, 1s.

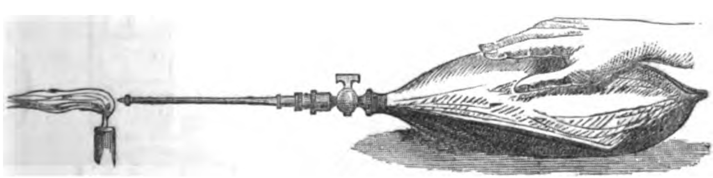
A gas delivery tube may be connected by a caoutchouc tube and pinchcock to the small end *a b* of the receiver, and the gas be thence transferred to other tubes, its place being occupied by mercury poured into the open end of the receiver.

2135. Plain Glass Cylinder, open at both ends, for experiments on ventilation, &c., 2 inches diameter and 10 inches long, 8d.

GAS BAGS.

Gas Bags and all preparations of Caoutchouc are subject to great variations in price.

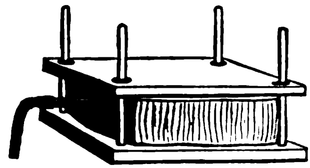
2136. Gas Bag, of Mackintosh's Waterproof Cloth, 18 inches by 13 inches, with brass ferule and female screw to fit the stopcock, No. 697, 10s.



2137.

2137. Ditto, with stopcock and blowpipe jet, as shown in Fig. 2137, 14s. 6d.

2139. Gas Bag of Waterproof Cloth, 15 inches long, 15 inches wide, and 5 inches deep, with brass ferule, and female screw at one end; mounted in a frame, consisting of a wooden base, four vertical iron rods, and a plate of cast iron weighing about 30 lbs., Fig. 2139, 24s.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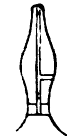

2143.

2140. The Gas Bag, No. 2139, with the ferule, but without the pressure frame, 14s.

To fill the bag, the iron pressure plate is lifted off, and the gas is forced into the bag in the usual way, and is secured by a stopcock. When the gas is wanted the pressure is applied by the iron plate, and increased if necessary by other weights. The vertical rods unscrew, so that the whole gas-holder can be packed in a small compass for travelling. The blast of air or gas given by this apparatus is extremely regular, and well suited for blowpipe operations.

2141. Bladders, bullocks', prepared for use, 6d.
2142. „ „ prepared for use, and mounted with brass collar, 2s.
2143. „ „ large size, prepared for use, with wooden mouthpiece, Fig. 2143, for use when nitrous oxide gas is to be breathed, 2s.

2145. Sheep's Bladders, cleaned, each 2d.

Bladders should be occasionally washed with a mixture of water and glycerine to prevent their cracking into holes.

2146. Gas Bag, soft and strong, made of goldbeaters' skin, but very thick, spherical, 11 inches diameter, fastened to a connector with female screw, 4s.
2147. Gas Bag, same as the preceding, but 15 inches in diameter, with socket, 6s.
2148. Gas Bags of Solid Vulcanised Caoutchouc, globular form when filled, with brass ferule and female screw. Sizes from 10 inches to 18 inches diameter. Price according to weight, at 10s. 6d. per lb.

a. Caoutchouc Bag, of 9 inches diameter, costs about 4s. 6d.
b. „ „ 13 „ „ 10s. 0d.

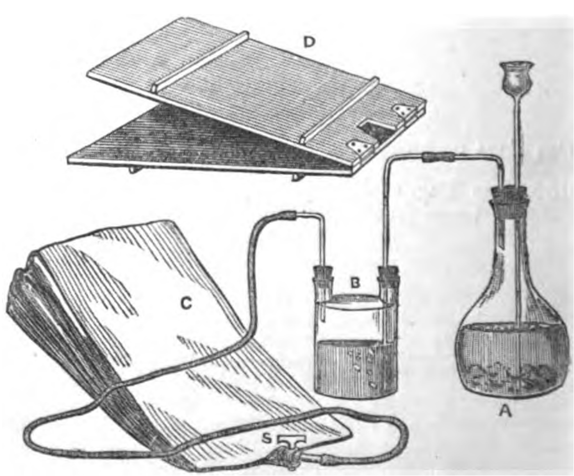
Stopcocks and Connectors for Gas Bags are described at page 66.

2149. Gas Bags of Large Size, for use at lectures with dissolving views or microscopes, wedge shaped form, C, Fig. 2149.

There are two qualities of Gas Bags, namely:—

1. Stout Black or Check Twill Sheet Rubber-lined Bags.
2. Drab Jeanette Bags of thinner material.

The prices of several sizes, from 2 to 19 cubic feet in capacity, are quoted in the following table; but these prices are subject to variation, according to the market price of the material.



2149.

Fig. 2149 represents an apparatus for preparing hydrogen gas in large quantity. A the gas bottle, B the wash bottle, C the bag receiver, D the pressure boards, No. 2150.
The Zinc Pot, No. 2028, can also be used.

No.	Inches long.	Inches wide.	Inches Wedge.	Contents in Cubic inches.	Contents in Cubic feet.	Black or Check Twill.	Drab Jeanette.
						£ s.	£ s.
1.	24	20	18	4,320	2½	2 10	1 14
2.	30	20	20	6,000	3½	3 0	2 2
3.	30	24	20	7,200	4⅙	3 8	2 5
4.	36	24	20	8,640	5	3 15	2 10
5.	36	30	20	10,800	6¼	4 5	2 15
6.	44	25	20	11,000	6⅓	4 15	3 0
7.	40	32	20	12,800	7½	4 16	3 0
8.	44	34	20	15,750	9⅛	5 8	3 10
9.	40	36	24	17,280	10	5 15	3 15
10.	48	36	30	25,920	15	7 7	4 15
11.	60	36	36	32,400	18¾	8 8	5 5

The Prices include One Stopcock to each Bag.

2150. Pressure Boards, D, Fig. 2149. These need to be made about 2 inches wider and larger than the bags. In use they are pressed by large iron weights or stones, which are supported by the bars placed across the upper board D, Fig. 2149.

4. Price of Boards for No. 4 Bag, 12s. 6d.
5. ,, No. 5 ,, 16s. 0d.

GAS HOLDERS.

2161. Griffin's School Gas Holder, japanned zinc, cylindrical, 18 inches high, 10½ inches diameter; contents 1500 cubic inches, with stopcock, large funnel on an 18-inch tube, 3 feet of vulcanised rubber tube, for delivering the gas, and a wide gauge pipe. The gas holder graduated into spaces of 50 cubic inches, Fig. 2161, 28s.

The fittings of the gauge pipe are so constructed that, if the glass tube should happen to be broken, it can be easily replaced by another, the screw *h* being movable.

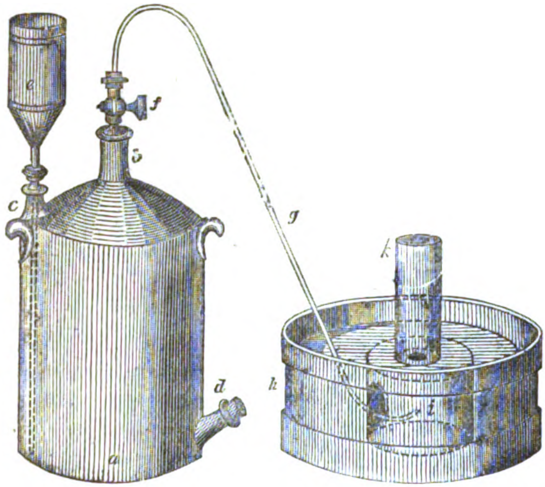
2162. Stopcock, with large bore, to use with the above gas holder, for hydraulic experiments. There is an opening near the bottom of the gas holder, provided with a screw fitted to this stopcock, 4s.

See "Chemical Recreations," page 175 and Fig. 2161, *e*, *i*, and *k*. The stopcock *e* is also useful when the apparatus is to be used as an aspirator, the vessel through which air is to be drawn being then put into connection with the stopcock *g*.

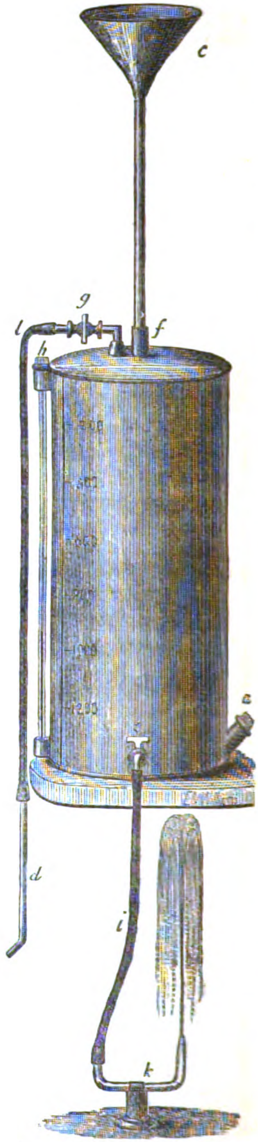
2163. Griffin's School Gas Holder, the model and size of No. 2161, but made of copper, 45s.

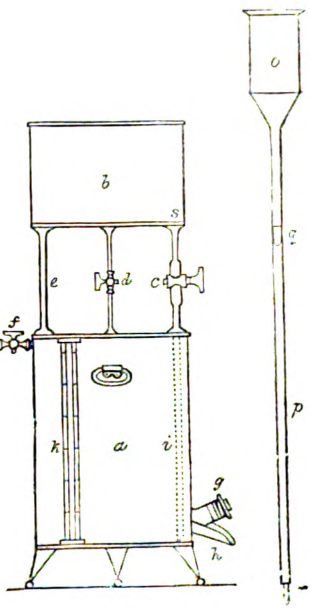
2164. Incorrodible Saltglazed Stoneware Gas Holder; contents 1½ gallon, with japanned funnel, brass stopcock, soft metal gas pipe, and connectors, as represented by Fig. 2164, letters *a* to *g*, 10s.

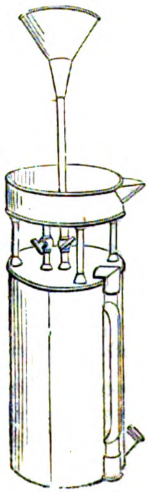
2165. Ditto, larger size; contents 3 gallons, 15s.



2164.







2166. 2168. 2161.

2166. Pepys's Gas Holders, Fig. 2166. This differs from No. 2161, by having a deep trough fitted above it and put in communication with it. Contents of the gas holder, about 2000 cubic inches, with gauge pipe graduated to show hundreds of cubic inches, a pressure funnel, and three brass stopcocks, 50s.

Size of the receiver *a*, 16 by 12 inches; of the trough *b*, 9 by 12 inches; total height, 3 feet without funnel.

With the funnel *o*, *r*, screwed into *s*, there is pressure of nearly 6 feet of water; or with *o*, *q*, a pressure of 4 feet; the stopcock *c* is ½ inch bore; the glass gauge *k*, is sunk into the body of the receiver to protect it from breaking, and is graduated into cubic inches.

2167. Pepys's Gas Holder, form and size of No. 2166, but made of copper, £5.

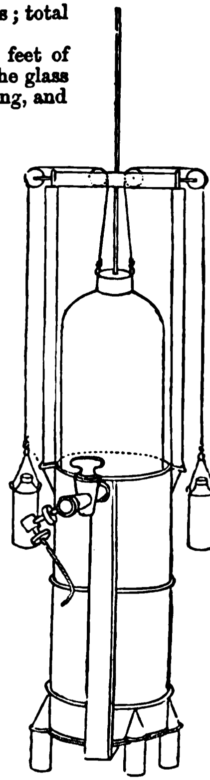
2168. Pepys's Gas Holder, 4 gallons, shallow trough, japanned tinplate, Fig. 2168, 30s.

2169. Pepys's Gas Holder, small size, contents 1200 cubic inches, with funnel and stopcock, without trough, or gauge, 12s.

2170. Bell-shaped Gasometer, similar to Fig. 2170, which takes asunder for packing; size of the bell receiver, 12 by 11 inches, with stopcocks, and connectors, japanned tinplate, without the jet shown in figure, £2, 10s.

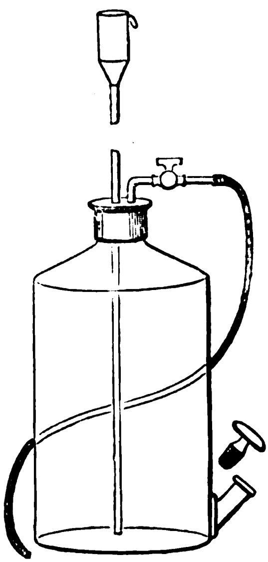
2171. Bell-shaped Gasometer, general form of Fig. 2170, made of japanned galvanised-iron, with frame, which takes asunder for packing, and cover to press down the bell when in action; the lower receiver with expanded mouth to prevent the overflow of water; dimensions of the bell receiver 20 inches wide, 36 inches high, contents about 6½ cubic feet, or 40 gallons, price £10.

This Gasometer will contain oxygen gas sufficient to supply two large magic lanterns during a long entertainment. It is suitable for export to hot climates, where the bags made of waterproof cloth cannot be depended upon.

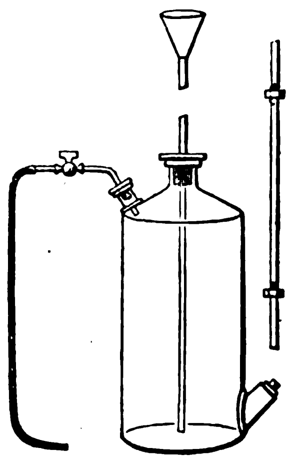


2170.

2175.



2172.



2173.

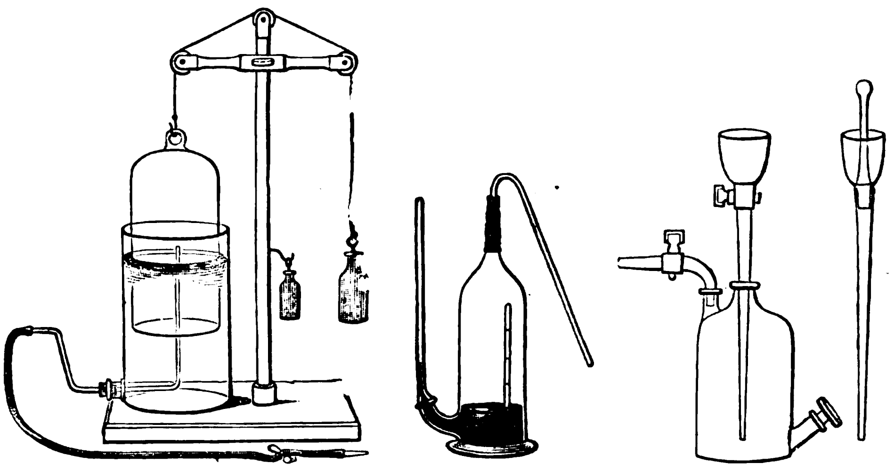
2172. Glass Gas Holder; Bohemian glass, contents about 6 gallons, size 16 inches high, 12 inches diameter, with brass cap and fittings, japanned tin funnel and long pressure pipe with brass stopcock, and 3 feet caoutchouc gas delivery tube, Fig. 2172, £2, 12s. 6d.

Glass Gas Holder, Fig. 2173, white French glass, the pressure funnel fixed on a long metal tube with two union joints, brass stopcock, and vulcanised caoutchouc gas delivery tube. *Two sizes*:—

2173. Reservoir 15 inches high, 8 inches wide; contents 20 pints, 26s.
2174. Reservoir 18 inches high, 10 inches wide; contents 36 to 40 pints, 33s.
2175. Williams's Gas Holder and Retort for preparing oxygen gas, combined; 60 ounce bottle, 3s. 6d.

Described in "Chemical Recreations," page 176. The purpose of it is to collect the gas in the receiver in which the experiment is to be made, without using a trough. To effect this, the receiver is first filled with water, which is run off by a syphon as the gas is received.

2176. Bohemian Glass Bell Gas Receiver, form of Fig. 2176. Size of outer cylinder, 12 inches by 6½ inches; size of bell, 8 inches by 6 inches, with wooden frame, 3 pulleys, and counterpoises, 3 feet of caoutchouc tube, and a pinchcock, as represented in the figure, 30s.



2176. 2177. 2178.

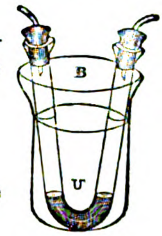
2177. Bunsen's Glass Gas Holder, for mercury, Fig. 2177, graduated. Size of receiver 2 inches diameter, and 6 inches high to shoulder, scale extending to 100 millimetres. See Bunsen and Roscoe's "Gasometry," page 20. Price, with tubes, 6s.

If desired, similar gas holders can be supplied, with graduations to show internal capacity, expressed in centimetre cubes or cubic inches.

Schrotter's Gas Holder for Chlorine, for use when substances are to be heated (in tubes) in a continuous current of chlorine gas. The liquor to be used for expelling the gas is a solution of chloride of calcium. The flow of it is regulated either by a glass stopcock on the neck of the funnel, or a long glass stopper ground into the funnel; both of these are shown in Fig. 2178. With glass stopcock on the out-flow tube, and stoppered neck at the side. Size of the gas holder, 13 inches high and 9 inches wide; contents about 25 pints, or 800 to 900 cubic inches.

2178. With the ground stopper in the funnel, 30s.
2179. With a glass stopcock to the funnel, 35s.

CONDENSATION AND ABSORPTION OF GASES.



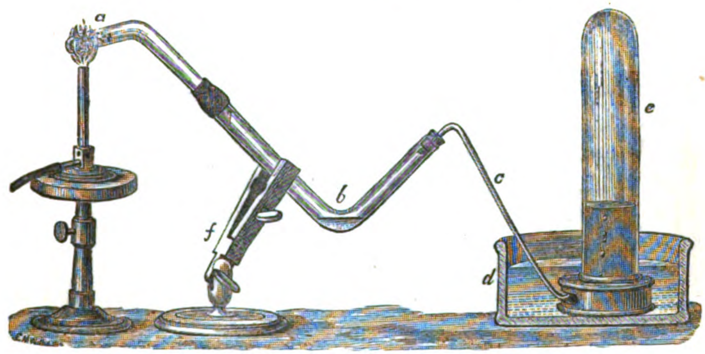
2186.

TUBE CONDENSERS, or substitutes for Woulff's Bottles, for preparing solutions of gases in small quantities, U-form, Fig. 2186. The lengths given are those of one limb only.

2186. Length of tube 6 inches, bore ½ inch, 7d.
2187. Length of tube 8 inches, bore ¾ inch, 1s.
2188. Length of tube 12 inches, bore 1 inch, 1s. 6d.
2189. Connecting Tube, bent at a proper angle, to connect the U-tube with a gas bottle, *h*, Fig. 1941, 4d.

The use of the above apparatus is illustrated in "Chemical Recreations," p. 330. When the Condenser contains a small quantity of water, and is immersed in iced water contained in a beaker, a saturated solution is easily procured of any gas that is absorbable by water, such as Ammonia.

This apparatus also serves for washing or drying gases, or for trying their action on different solutions.



2192.

Tube Condensers, V-form, Fig. 2190.

The lengths given are those of one limb only.

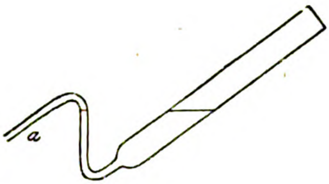

2190.

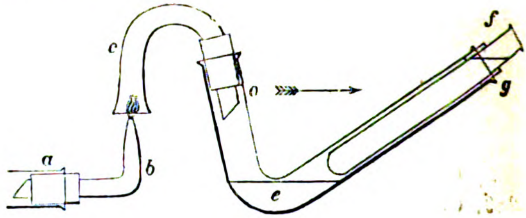
2190. Length of tube 4½ inches, bore ⅝ inch, 4d.
2191. Length of tube 6 inches, bore ¾ inch, 8d.
2192. Length of tube 4½ inches, bore ⅝ inch, legs unequal, *b*, Fig. 2192, 6d.
2193. Connecting Tube, form of *i*, Fig. 1941, 4d.
2194. Liebig's Gas Absorber, or tube for saturating a liquid with a gas, Fig. 2194. The large tube, 9 or 10 inches long, ⅝ inch wide, 6d.

The liquid is contained in the bent part; the narrow end, *a*, is connected with the gas bottle. Useful in preparing a small quantity of the solution of any gas. Used by Liebig for the preparation of chloral, by passing chlorine gas into alcohol.

2195. Apparatus for an experiment to prove that when Hydrogen Gas is burnt in the air, water is produced. This consists of five glass tubes connected, as shown in Fig. 2195, 3s., fitted.

a, Chloride of Calcium tube to dry the hydrogen gas; *b*, infusible glass jet at which the gas is burnt; *c*, infusible glass connecting tube; *e*, condensing tube; *f*, tube filled with cold water, to condense the water formed by the gas. The tube *f* is supported at *g* by two slips of cork. The flame at the mouth of *b* should be about half an inch long. This flame causes a current of air to pass through the tubes *c*, *o*, *g*. The oxygen combines with the hydrogen, and forms water, which condenses at *e*. The nitrogen and excess of air escape between *f* and *g*. In half an hour a quantity of water can be collected at the bend *e*.

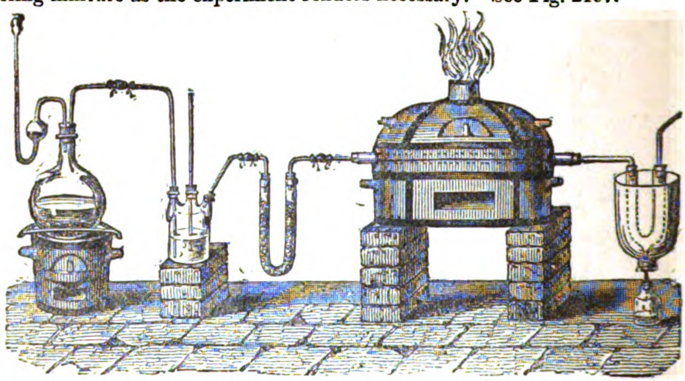




2194. 2195.

2196. Condenser for Vapours, such as hydrocyanic acid, U-form, provided with a glass stopcock for drawing off the condensed liquor; solid Bohemian glass, Fig. 2196, 8s.

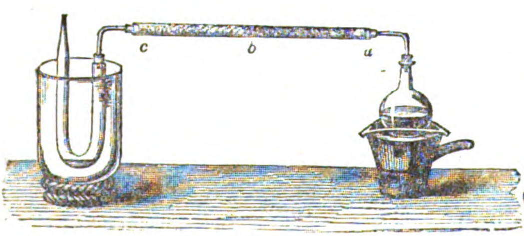
This condenser is mounted for use in an inverted deflagrating jar, the neck of which is closed by a cork, through which the neck of the condenser is passed. The jar is filled with iced water, or such other cooling mixture as the experiment renders necessary. See Fig. 2197.

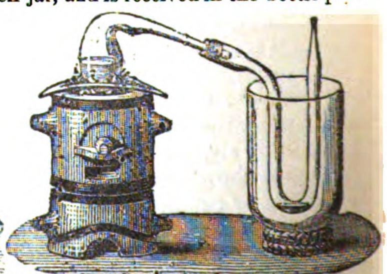


2196. 2197.

2197. Condenser, U-form, with a neck at the bent part for delivering the condensed liquor into another vessel without removing the condenser from the freezing mixture, the latter being placed in an inverted bell receiver, Fig. 2197; length of bent tube 16 inches, bore $\frac{1}{2}$ inch, 1s.

This condenser is represented in Fig. 2197, which is Regnault's apparatus for preparing chloride of silicon. The condenser is at the right-hand end of the series of apparatus. To prepare chloride of silicon, chlorine gas, prepared in the gas bottle at the left-hand end of the figure, is passed through the wash bottle and the drying tube, and then over a mixture of silica and lamp black, heated to redness in a porcelain tube which traverses the furnace. The chloride of silicon is condensed by the freezing mixture contained in the bell jar, and is received in the bottle placed below it.



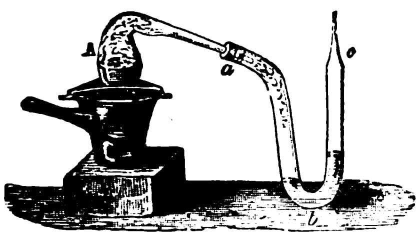


2198. 2199.

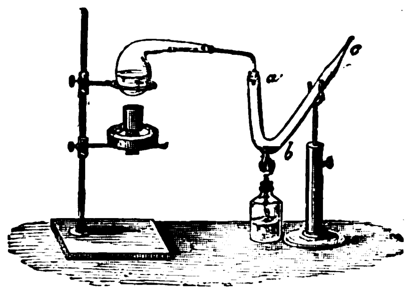
2198. **Condenser for Vapours** that require a freezing mixture, U-form, Fig. 2198, which represents the apparatus for preparing anhydrous hydrocyanic acid. See "Chemical Recreations," page 528. Length of tube 15 inches, bore ½ inch, 10d.

2199. **Bent Tube Receiver** used in the preparation of liquid Peroxide of Nitrogen, and for the distillation of phosphorus. See "Chemical Recreations," pages 292 and 634, Fig. 2199.

a. Small size, length of tube 16 inches, bore ½ inch, 9d.
b. Large size, length of tube 20 inches, bore ⅞ inch, 1s.



2200.



2201.

2200. **Large U-shaped Receiver**, suitable for the condensation of distilled phosphorus, Fig. 2200. See "Chemical Recreations," page 634. Length of tube 22 inches, bore 1 inch, 1s. 3d.

2201. **Bent Tube**, V-form, Fig. 2201, used in the preparation of selenious acid. See "Chemical Recreations," page 631. Length of tube 15 inches, bore ⅞ inch, 10d.

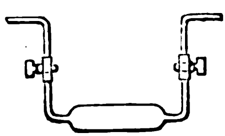
2202. TUBE APPARATUS FOR CONDENSING ANHYDROUS GASES, such as Cyanogen or Sulphurous Acid, into liquids, by means of freezing mixtures :—

2203. Tube 8 inches by ¾ inch, with narrow neck, *a*, Fig. 2202, 5d.

The gas being condensed by the freezing mixture contained in the glass beaker, the leading tube is withdrawn, and the receiver is closed before the blowpipe at the narrow neck, assuming the form of Fig. 2203.

2204. Tube of the form of Fig. 2205, but without stopcocks, the wide part of the tube measuring 4 inches by 1¼ inch, 10d.

2205. Tube of the form of Fig. 2205, with 2 stopcocks, the wide part measuring 2½ inches by ⅞ inch, 5s.

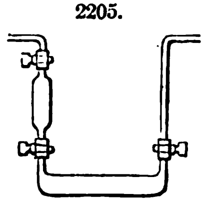


2205.

2203.

2206.

2202.



2207.

2208.

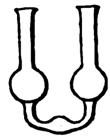
2206. Tube of the form of Fig. 2206, with 2 stopcocks, the wide part measuring 2½ inches by ⅞ inch, 5s.

2207. Tube of the form of Fig. 2207, with 3 stopcocks, intended to permit the liquid to be drawn off in small portions, the wide part measuring 4 inches by 1¼ inch, 8s.

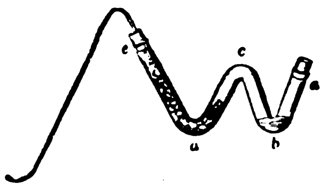
2208. Tube of the form of Fig. 2208, with 3 stopcocks, each wide part measuring 2½ inches by ⅞ inch, 7s.

2209. Wholer's Apparatus for the absorption of substances produced during the analysis of metallic sulphides by the action of chlorine gas, form of Fig. 2209 :—

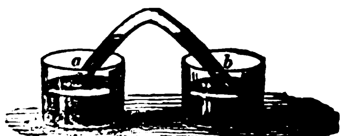
No.	Length of Tube.	Diameter of the Wide Tube.	Diameter of Bulbs.	Price.
1.	10 inches,	½ inch,	¾ inch,	1s. 0d.
2.	15 „	⅞ „	1½ „	1s. 6d.
3.	18 „	1 „	2 „	2s. 0d.



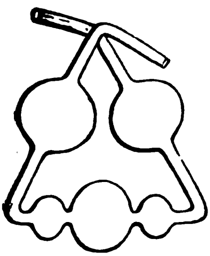
2209.



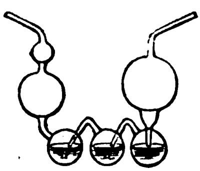
2210.



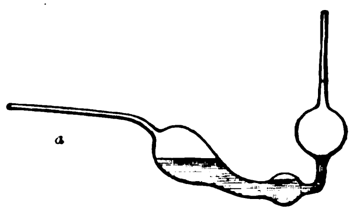
2211.



2213.



2214.



2215.

2210. Bent tube, W-form, Fig. 2210, used in the preparation of Hydrobromic Acid, see "Chemical Recreations," page 690; length of tube, 18 inches, bore ¾ inch, 1s.

2211. Bent Tube, Fig. 2211, used to prove the direct formation of nitrates by electrical action, see "Chemical Recreations," page 298; length of tube, 18 inches, bore 1 inch, 1s.

For the prices of the Glass Pans, such as used in No. 2211, see No. 1780.

2212. Apparatus for the Absorption of Gases by Liquids, *in cases where the apparatus and its contents are to be* Weighed, *both before and after the absorption, in order to determine the exact quantity of gas absorbed:*

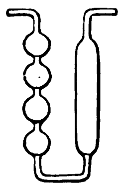
2213. Liebig's Apparatus for the absorption of Carbonic Acid in a solution of caustic potash, Fig. 2213, in a box, 1s. 3d.

2214. Geissler's Apparatus for the same purpose, Fig. 2214, so formed as to stand steadily on 3 bulbs, in a box, 2s. 3d.

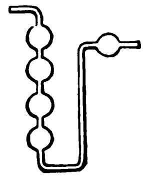
2215. Will and Varrentrapp's Apparatus, as improved by Horsford, for the collection of Ammonia Gas in Hydrochloric Acid, Fig. 2215, 7d.

2216. Mitscherlich's Apparatus for the absorption of Carbonic Acid by solution of caustic potash, Fig. 2216, bulbs, 1 inch, wide tube 6 inch by $\frac{3}{4}$ inch, 1s. 3d.

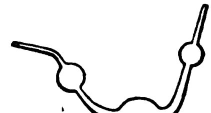
2217. Another form of Mitscherlich's Absorption Apparatus, Fig. 2217, bulbs, 1 inch, 1s.



2216.



2217.



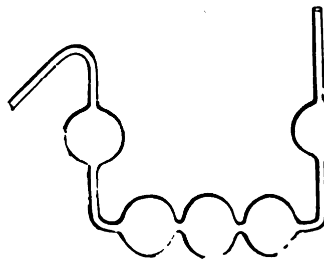
2218.

2218. Modification of Will's Apparatus for the absorption of Ammonia by Hydrochloric Acid, Fig. 2218, 9d.

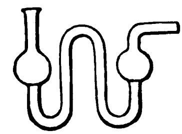
2219. Ure's Apparatus for the Absorption of Gases by Liquids, Fig. 2219, but made with six bulbs, namely four in the lower series, 1s. 6d.

2220. Double U-receiver, form of Fig. 2220, bulbs $1\frac{5}{8}$ inch, tube $\frac{3}{4}$ inch wide, and 27 inches from end to end, 2s.

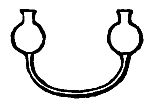
2221. Von Babo's Tube, with two bulbs, Fig. 2221, diameter of bulbs, 3 inches, width of tube, $\frac{3}{8}$ inch, length from end to end, 20 inches, 2s. 6d.



2219.



2220.

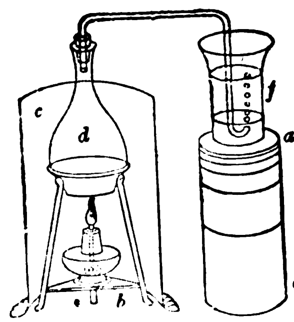


2221.

This apparatus mounted on a stand, for the generation of H_2S gas is figured under No. 4473.

2222. Apparatus for the preparation of Hyrofluosilicic Acid. Hydrofluosilicic Acid is prepared by passing gaseous fluoride of silicon into water. The fluoride of silicon is decomposed. Hydrofluosilicic Acid is produced, and solid silicic acid is deposited in such quantity as to stop up the end of the gas delivery tube, unless prevented by proper precautions. See "Chemical Recreations," page 706. In this apparatus the precaution represented is that of passing the gas into a stratum of mercury, placed under the water in the collecting beaker.

The pieces of this apparatus have been already priced. The blocks *a* are No. 393 ; the tripod *b* is No. 295 ; the screen *c* is No. 296 ; the flask *d*, *e*, is similar to No. 2033 ; and the beaker *f* is one of those described at No. 1440.



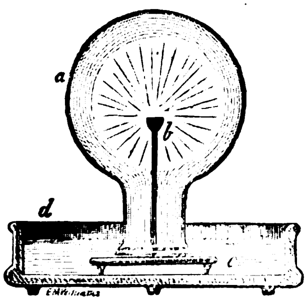
2222.

APPARATUS FOR CLASS EXPERIMENTS WITH GASES.

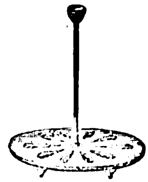
2223. A considerable quantity of the apparatus described between No. 1935 and No. 2222, might very properly be placed under this head; but I only put here some articles that have escaped the analytical method of the preceding sections, or some apparatus which it is necessary to put together in a complex form, to show the method of combining the more simple instruments with one another, to suit particular chemical demonstrations. This section, therefore, is not to be considered as complete in itself, but only as supplementary to the preceding sections relating to gas apparatus. A detailed account of the use of this apparatus is given in my work entitled "Chemical Recreations."

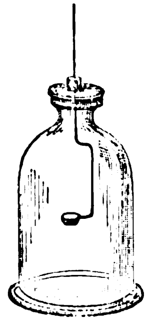
2224. Large Glass Globe, 8 to 9 inches in diameter, for burning phosphorus in oxygen gas, *a*, Fig. 2224, 3s.

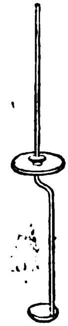
2225. Ditto, larger, the globe about 12 inches in diameter, 4s. 6d.

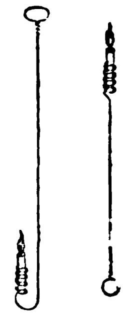


2224.


2226.


2230.


2231.

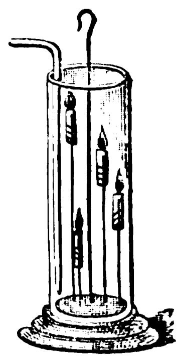

a. b.

2232.

2226. Metal Cup, on iron foot, to contain the phosphorus to be burnt in the oxygen globe, 1s. 3d.
2227. Flat Circular Stoneware Pan, 12 inches in diameter, for use in the same experiment, *d*, Fig. 2224, 1s. 9d.
2228. Deflagrating Jars, to contain oxygen gas for combustion. See No. 2101.

DEFLAGRATING SPOONS, to contain phosphorus, sulphur, &c., to be burnt in oxygen gas in the deflagrating jars :—

2229. Iron Bowl, iron wire, tinplate flange, and cork above it, to fix the wire at any required height, 6d.
2230. Brass Bowl, iron wire, brass flange, with cork to regulate the length of the rod, Fig. 2230, 1s.
2231. Brass Bowl, brass ground flange, and iron wire in stuffing box, 2s. 6d.
2232. Pair of Wax Tapers, mounted on copper wires, for trying the combustibility of gases, Fig. 2232; *a*, to plunge downwards into oxygen and heavy gases; *b*, to plunge upwards into hydrogen, &c., *per pair*, 6d.
2232A. Set of 4 Tapers, mounted on a wooden stand, Fig. 2232*a*, for insertion in a jar of oxygen or carbonic acid, as described at Fig. 22, in Valentin's "Inorganic Chemistry," 1s. 6d.
2233. Hank of fine Iron Wire, to form spirals for combustion in oxygen gas, 6d.
2234. Hank of fine Steel Wire, for the same purpose, 1s.
2235. Charcoal Bark, for burning with brilliant sparks in oxygen gas, *per ounce*, 2d.
2236. Cup with metal stand, similar to Fig. 2226, but smaller, for holding phosphorus to burn under an inverted gas jar in common air, 4d.


2232*a*.

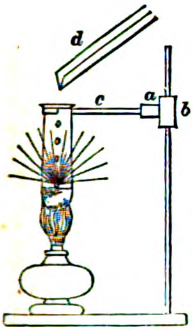
2237. Wide Hard Glass Test Tube, tin crook, and wooden support for deflagrating carbon, sulphur, or phosphorus in the oxygen gas given off by fused nitre, Fig. 2237, "Chemical Recreations," page 183, 2s.
2238. Apparatus for collecting a gas and transferring it into a bladder.

This apparatus is represented by Fig. 2238. The air receiver and its brass fittings have been described between Nos. 2110 and 2115. There remains the bladder to price. This is connected with a collar of the form of Fig. 2239, the screw of which has the same thread as the Stopcock No. 697.

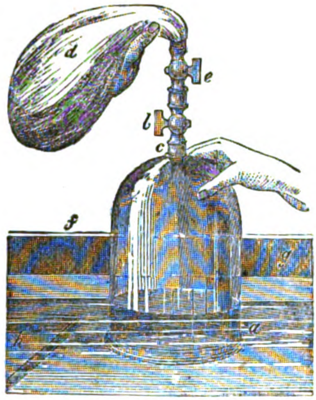
2240. Bladder, prepared, and mounted with brass bladder piece, *d*, Fig. 2238, 2s.

For other sizes of Bladders and Gas Bags, consult Nos. 2136 to 2150.

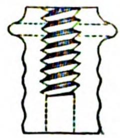
2241. Brass Blowpipe Jets, to be attached by a stopcock to a bag or bladder filled with oxygen gas, to direct a stream of oxygen upon metals burning on charcoal, Figs. 2241, *a b c, each* 2s.



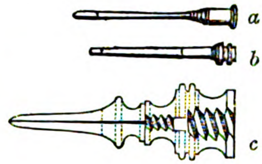
2237.



2238.



2239.



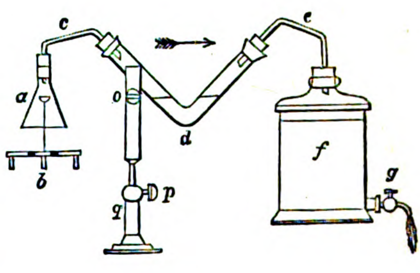
2241.

2242. Apparatus to show the presence of Carbonic Acid Gas in air expired from the lungs, pint size, fitted with tubes, Fig. 2242. See "Chemical Recreations," page 272, 2s. 6d.

The bottle is supplied with lime water If the mouth is applied at *b*, and air is sucked through the bottle, the lime water is scarcely altered; but if the mouth is applied at *a*, and air from the lungs is blown into the bottle, the lime water speedily becomes turbid.

2242.

2243.



2245.

2243. Apparatus for explaining Ventilation, consisting of a wide-mouthed bottle, half gallon size, with cork and two tubes, by the positions of which the ventilation is regulated, see "Chemical Recreations," page 553, 4s.

2244. Small candle holder, as represented in Fig. 2243, to fix a lighted taper within a glass cylinder or bottle in experiments on combustion or ventilation, 3d.

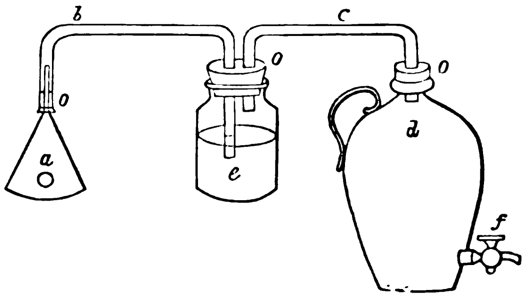
2245. Apparatus to collect the carbonic acid gas that is produced by the flame of a spirit lamp or candle, consisting of a glass funnel and three bent tubes, *a, c, d, e*, Fig. 2245, 2s.

2246. See "Chemical Recreations," page 346. The candle is placed within the funnel, instead of the support *b*. In *d*, clear lime water is placed. When water is made to run from the aspirator *f*, air is drawn through the apparatus in the direction of the arrow, and carries with it the carbonic acid produced by the flame. This acts upon the lime water in *d*, and renders it turbid. In the apparatus as represented by Fig. 2245, sulphur or phosphorus can be burnt in the cup *b*, and the acids produced be made to act upon liquids placed in the receiver *d*. Thus sulphurous acid gas acting upon a yellow solution of chromate of potash changes its colour to green, in consequence of reducing the chromic acid.

2247. Fig. 2247 represents an apparatus, similar in principle, but suitable for operating on larger quantities than that represented by Fig. 2245. In this case, the substance to be burnt or oxidised is placed on a hot plate or tile below the funnel, and air is permitted to pass over it through the hole *a*.

2247. Price of the Apparatus, Fig. 2247, without the Aspirator, 4s.

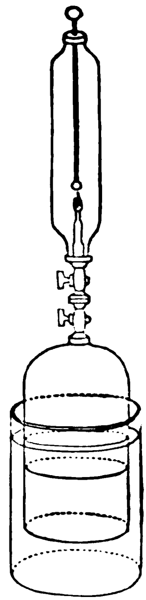
The Aspirators are priced at page 21.



2247.

2248. Davy's Apparatus for showing that a jet of oxygen gas can be burnt in an atmosphere of hydrogen gas, Fig. 2248, see "Chemical Recreations," page 214. Price of the upper glass receiver, with brass fittings, one stopcock, and a platinum jet, 18s.

The Brass Stopcocks and lower receiver are priced at Nos. 2110 to 2112.



2248.

BALLOONS.

These Balloons are made of gold-beaters' skin. When not in use, they should be kept in a close tin case, with a little camphor to preserve them from insects. They ought never to be wetted. When they are expanded with air from the mouth, the lips ought not to touch the mouth of the balloon. They will all ascend with dry coal gas. In filling a balloon the gas should be passed through a glass tube containing pieces of chloride of calcium, to free the gas from water. The large sizes of balloons, when in good condition, may be kept suspended two or three days, fastened by a string to the table. But the hydrogen gas is gradually exchanged for atmospheric air by osmotic action, and the balloon then descends. The hydrogen gas with which a balloon is to be filled must all be prepared before the filling is attempted, and should be contained in a gas holder, or in large jars provided with stopcocks.

2249. *Prices of Spherical Balloons.*

No. 1.	9 inches diameter,	1s. 3d.	No. 4.	15 inches diameter,	3s.
2.	10½ „	1s. 9d.	5.	18 „	5s.
3.	12 „	2s. 6d.			

The Balloons are usually coloured in gores, but the three smallest sizes of round balloons are also coloured plum-pudding pattern.

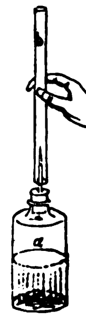
No. 6. Oval Balloon, 3 feet high, two feet in diameter, ... 15s.
7. Balloon in the shape of Mr. Punch, 6 feet high, and 9 feet in circumference, ... 63s.
8. Balloon in the shape of an Elephant, 3 feet long and 2½ feet high, well formed and coloured, and adjusted to ascend in proper position, ... 35s.
9. Spherical Balloon, 6 inches diameter, will rise with hydrogen gas, but not with coal gas, ... 1s.

2250. Balloons of Collodion, extremely thin and light, for ascension with hydrogen gas. Sizes about 4 inch, 1s.; 9-inch, 1s. 6d.; 12-inch, 2s.; 15-inch, 3s.

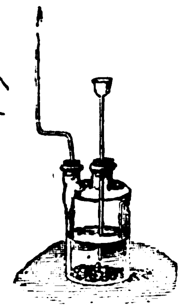
2251. Apparatus for exhibiting the Philosophical Candle, consisting of a 16 ounce gas bottle with a long jet of infusible Bohemian glass, at which to burn the hydrogen gas, Fig. 2251, 1s. 6d.

2252. Ditto, in the form of a Woulff's bottle, with a safety funnel to prevent an explosion in the event of the fusion of the jet, Fig. 2252, 2s. 6d.

2253. Long Gas Tubes, open at both ends, for producing musical sounds when held over the hydrogen gas flame, 20 inches long, 1 inch wide, 1s.



2251.



2252.

Other sizes of tube may be used. The musical note changes with the size of the tube.

2254. Jet Tube of hard Bohemian glass, with fine point for the above experiment, 10 or 12 inches by $\frac{1}{3}$ inch wide, 3d.

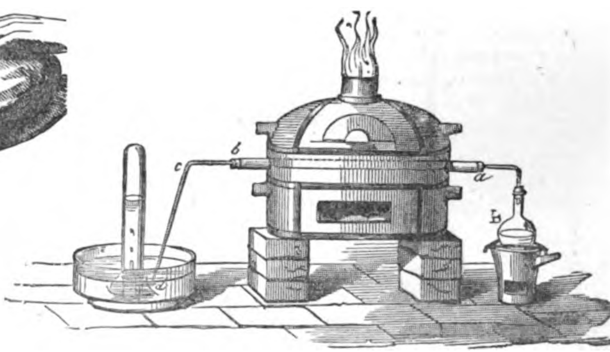
2255. Brass Tobacco Pipe, to use with the gas bladder, No. 2238, to blow soap bubbles with hydrogen gas, or oxyhydrogen gas, Fig. 2255, 2s.

2256. Bladder, Stopcock, and Tobacco Pipe, complete, Fig. 2256, 7s.

2257. Revolving Jet, T shape, for attaching to a receiver, No. 2238, to exhibit the combustion of coal gas, 3s.

2256.

2255.



2258.

2258. Apparatus for exposing substances to the action of gases at high temperatures, such as the production of hydrogen gas by the action of red-hot iron on steam; consisting of a French oblong fireclay furnace, 13 inches long inside, a Berlin porcelain tube, 26 inches long by $1\frac{1}{8}$ inch diameter, a 30 ounce flask for boiling water, with 3 gas delivery tubes and connectors, Fig. 2258 ("Chemical Recreations," page 197), £2, 15s.

Operations of this description can, however, be more conveniently performed by means of the Gas Furnaces for tube operations described at No. 1064.

Reduction Tubes, for heating solids in gas, as in the decomposition of oxide of copper by hydrogen gas, of peroxide of barium by hydrogen gas, or of metallic sulphides by chlorine gas; strong tubes, $\frac{1}{3}$ inch bore, with bulbs in the middle, 1 inch in diameter, hard white Bohemian glass, *per dozen:*

2259. 12 inch tube, one bulb, straight, *e*, Fig. 2264, 5s.

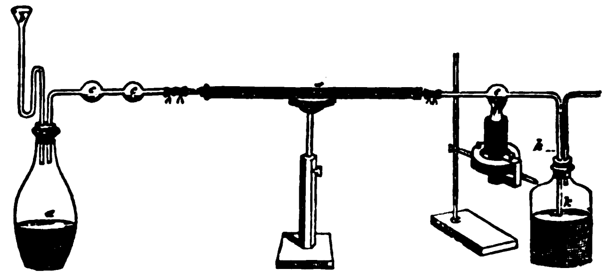
2260. 12 inch tube, two bulbs, straight, 6s.

2261. 12 inch tube, one inch bulb, bent at one end, *e*, Fig. 2263, 6s.

2262. 12 inch tube, two bulbs, bent at one end, *c*, *c*, Fig. 2263, 7s.

Figs. 2263 and 2264 show the manner of fitting up such tubes for use.

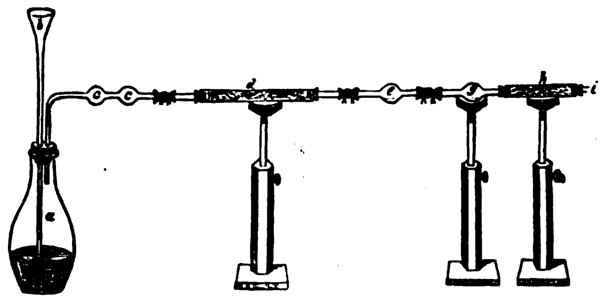
2263. Apparatus for the Conversion of Metallic Oxides into Chlorides, Fig. 2263.



2263.

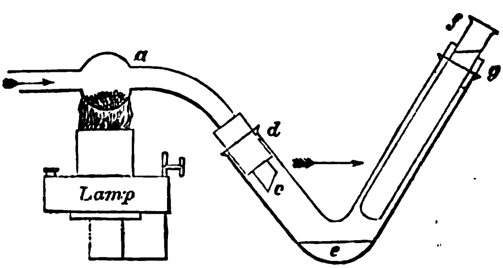
2264. Apparatus for the Reduction of Metallic Oxides by Hydrogen Gas, Fig. 2264.

The parts of these sets of apparatus have been priced in preceding section. Gas bottles at No. 1962; Chloride of Calcium Tubes, No. 2047; Supports, No. 329-341; Spirit Lamps, No. 870.



2264.

2265. Griffin's Apparatus for showing the Production of Water by passing dry hydrogen gas over ignited oxide of copper, and the reduction of the oxide to the metallic state, consisting of three tubes, a reduction tube, and two condensing tubes, Fig. 2265, *a* to *g*, 2s. 6d.



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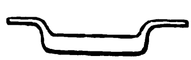
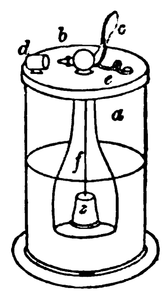


2266.



2267.

2266. **Reduction Tubes**, of the form shown by Fig. 2266, hard Bohemian glass, 8 to 10 inches long, 10d.

Hydrogen Lamps, according to Döbereiner, for the instantaneous and constant production of fire, by the action of spongy platinum upon hydrogen gas, neatly fitted up:—

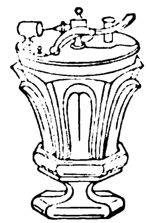
2267. Plain Glass Jars, with brass cover, zinc, and platinum, complete, Fig. 2267, 7s. 6d.

2268. Coloured and Ornamental Jars, Fig. 2268, many patterns, from 10s. 6d., 18s., 30s., 42s. *each*.

2269. Spongy Platinum, fixed in rings, for ditto, Fig. 2269, to fit the socket *d*, Fig. 2267, 1s.

2270. Brass Jets for ditto, Fig. 2267*b*, 1s. *each*.

2271. Cast Zinc Cylinders for ditto, Fig. 2267*z*, 4d.



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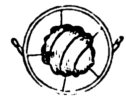


2269.

2273.

2272.

Directions for Use.—Put the apparatus together as shown in the figure. Fill the outer jar two-thirds full of a mixture of one part of sulphuric acid with four parts of water. Cover up the platinum, *d*, with paper, and open the stopcock, *c*, to let out the common air from the inner bell glass, *f*. Then let the stopcock close, and allow the bell to fill with hydrogen gas. This must two or three times be allowed to escape while the platinum is covered: the hydrogen gas may after that be collected for use. The paper being taken from the platinum, the hydrogen on escaping from the stopcock first makes the platinum red hot, and then takes fire. But at first the gas requires to be lighted with paper to dry the platinum. Paper or wooden matches should be used to take a light from this lamp, as sulphur matches spoil the platinum.

2272. Davy's Lamp without Flame, for perfuming rooms, or exhibiting the formation of Lampic acid; consisting of a prepared ball of spongy platinum, connected to a cotton wick by a small glass wick holder, ready for insertion into a Spirit Lamp, Fig. 2272, 2s., *in a box.*

When the Lamp is to be used, it is lighted in the ordinary manner, and when the platinum bulb is heated, the flame is blown out. Thereupon the bulb becomes red hot, and continues so as long as the lamp contains any spirit. The light is extinguished by putting on the glass cap of the lamp, or by blowing upon it strongly. This apparatus can be used with any bottle that contains spirit.

2273. Davy's Lamp without Flame, consisting of a spirit lamp with a coil of platinum wire, form of Fig. 2273, 3s. 6d.

Davy's Safety Lamp for Coal Miner's Brass Lamps, iron gauze:—

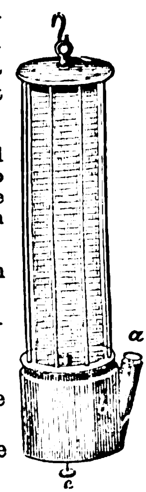
2274. Single Gauze, Fig. 2274, 6s.

2275. Double Gauze, 8s.

2276. Double Gauze, with glass cylinder round the flame for increase of light, 12s.

2277. Iron Wire Gauze, 50 meshes to the inch, for explaining the theory of the safety lamp, piece 8 inches square, 1s.

2278. Ditto, in larger quantities, 2s. 6d. per square foot.



2274.

OXYHYDROGEN BLOWPIPES.

2279. Tate's Apparatus for burning oxyhydrogen gas, consisting of a water cistern, with a gas pipe leading from the gas holder that contains the mixde gases, with a jet plugged with discs of wire gauze of 100 meshes to the inch, and a cork safety valve, to render any possible explosion harmless, Fig. 2279, 8s.

2280. Hemming's Safety Jet, for the Oxyhydrogen Blowpipe, Fig. 2280, with a female screw at *b*, adapted to the stopcock, Fig. 697; the head *d* is movable, so that the jet *c* can be placed immediately in the socket *a*, when a straight jet is required, 8s. 6d.

2281. Oxyhydrogen Blowpipe, form of Fig. 2281, with two stopcocks and union connectors for tubes to bring the two gases, a jet for the lime light, a massive jet, marked *a*, to be used for the fusion of metals, &c., on charcoal, and a support for holding and turning the lime cylinder for the lime light, the whole mounted on an iron tripod foot, as represented in Fig. 287, 30s.

2282. Oxyhydrogen Blowpipe for the Lime Light, similar in principle to the last, but differently arranged, on a larger scale, and mounted on a tall and massive brass stand, with a sliding pillar to adjust the height of the light, as represented by Fig. 2282, but mounted on an iron tripod foot. Price without the caoutchouc tubes, £2, 2s.

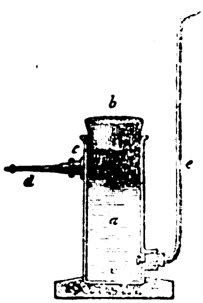
2283. Oxyhydrogen Blowpipe for the Lime Light, similar to the last described, but mounted on a three-legged wooden stool, the stopcocks and pipes passing below the top of the stool, 35s.

2284. Daniel's Oxyhydrogen Blowpipe for the Lime Light, with Maugham's Jet with lime-holder; somewhat like Fig. 2284, but without the stopcock, 22s.

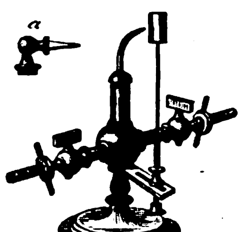
2284A. Bottle containing 12 lime cylinders, 2s.

2284B. " " " in stoppered, sealed Bottle, for transport to a hot climate, 3s. 6d.

2284C. Bottles containing 12 lime balls instead of cylinders, at same prices.



2279.



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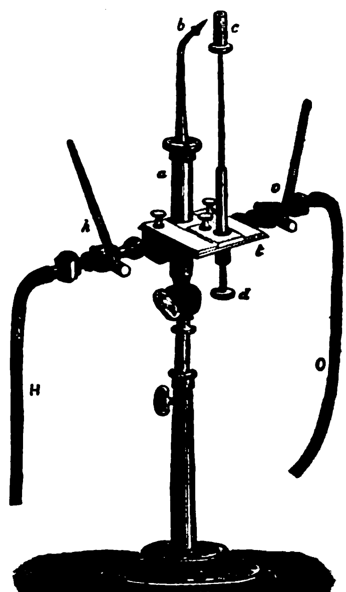
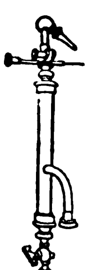
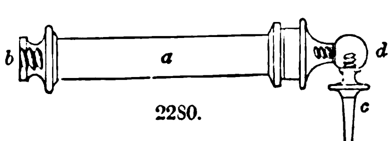


2282.



2284.

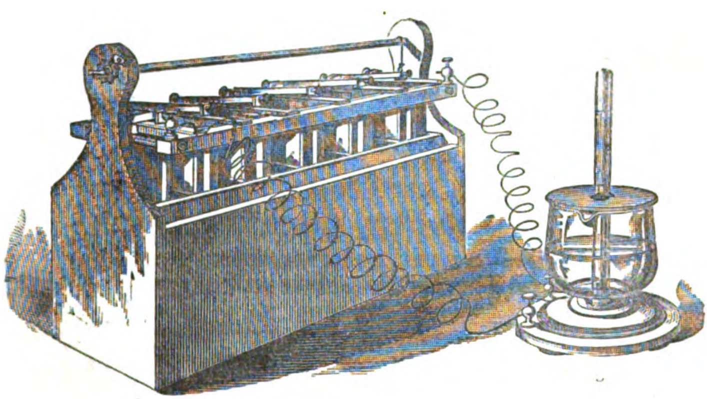


2280.

APPARATUS FOR EXHIBITING VOLTAIC DECOMPOSITIONS.

2285. SMEE'S GALVANIC BATTERY, consisting of six cells, each silver plate presenting 20 square inches of surface to the exciting fluid, arranged in a mahogany frame, suspended by means of an iron rod and ratchet wheel over an incorrodible stoneware trough, which contains the exciting fluid; with binding screws and two sets of connecting bands, the shorter bands being used to connect the zinc binding screw of one cell with the platinised-silver binding screw of the next, when *intensity* is required; but if *quantity* is needed, the short connectors are removed and the two long ones used—one to connect all the zinc binding screws together, and the other to connect the screws in connection with the platinised silver. The conveniences of this form are manifold: from the ease with which any desired power may be obtained by merely raising or depressing the battery frame; from the means at command of instantly setting it in action, and as readily stopping the current; from the facility of using *any one* or *all* the batteries, and the little trouble required to re-amalgamate or add new zinc plates.

The voltaic energy of this arrangement is sufficient to yield 1 cubic inch of the mixed gases in 50 seconds; it will heat to redness 4 inches of platinum wire, fuse iron wire with facility, and empower a sufficiently strong electro-magnet to sustain many hundredweights. Price £3, 10s.



2285.

2286. Zinc Plates for this Battery, per pair, 1s.

The fluid adapted for exciting all the forms and sizes of Smee's Battery is recommended by the inventor to be made by mixing together one part *by measure* of sulphuric acid (oil of vitriol), and seven parts of water; but for general purposes it has been found that one part of acid to ten of water is sufficiently powerful. Whatever strength is used, it is important that the acid be added slowly to the water, and that the mixture be made in a well-glazed vessel, *free from lead*, and in all cases allowed to cool before being used. Care must be taken in using this battery that no salt of lead, copper, or any other metal be dropped into the exciting liquid, nor any nitric acid added to increase the intensity.

2287. **Grove's Platinum Battery, Porcelain or Glass Cells, with porous pots, amalgamated zincs, platinum plates, and spring clips to each pair, in a frame, forming one of the most powerful of all voltaic arrangements, well adapted for illustrating the brilliant experiments of Galvanism and Electro-magnetism, and to illustrate the applications of electricity to produce motive force, Fig. 2287.**

***Solutions to excite this Battery.*—The outer glass cell is filled with sulphuric acid, diluted with seven times its bulk of water, and the inner cell with concentrated nitric acid.**

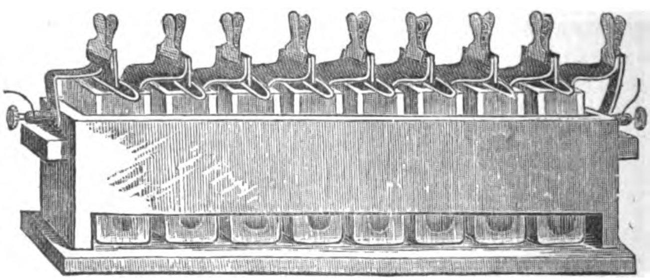
In Porcelain Cells :

Grove's Battery, Pint size, containing :—

4,	6,	8,	10,	12	cells.
38s.,	55s.,	75s.,	90s.,	110s.	in deal trays.
40s.,	60s.,	80s.,	100s.,	120s.	in teak trays.

Grove's Battery, Quart size, containing :—

4,	6,	8,	10,	12	cells.
56s.,	80s.,	105s.,	130s.,	160s.	in deal trays.
60s.,	88s.,	110s.,	140s.,	170s.	in teak trays.



2287.

Bunsen's Charcoal Battery, in single cells, of the form of Fig. 2289 and 2393*b*; each consisting of a stout glass cell *a*, a zinc cylinder *b*, a porous pot *c*, a rectangular block of gas coke *d*, a binding screw *e*, and a slip of copper to form a connector *f*. The dimensions given are only approximate :—

No.	Size of Glass Cell.	Size of Charcoal.	Price.
2288.	$6\frac{1}{2} \times 4\frac{1}{2}$	$8\frac{1}{4} \times 1\frac{3}{4}$	7s. 0d.
2289.	$5\frac{1}{2} \times 4$	$6\frac{1}{4} \times 1\frac{1}{2}$	5s. 0d.
2290.	$4 \times 3\frac{1}{2}$	$4\frac{3}{4} \times 1\frac{1}{2}$	3s. 6d.
2291.	$3\frac{1}{2} \times 2\frac{1}{2}$	$4 \times \frac{7}{8}$	2s. 6d.

This battery is to be excited by concentrated nitric acid, put into the porous pot that contains the charcoal, and diluted sulphuric acid in the glass cylinder. For ordinary use, the diluted sulphuric acid may be made with one part of oil of vitriol with ten parts of water. When extra power is required, the water may be diminished to seven or eight parts. The mixture must be cold when put into the cells. The liquids on both sides of the porous pot must be kept at the same height. When the experiments are finished, the nitric acid must be thoroughly washed from the coke.

From six to ten cells of the Charcoal Battery are required for the decomposition of water. The greater the number of cells, the more rapidly is the gas produced. The electric light demands for its production thirty to fifty cells. With six to ten cells a small bright continuous point of light can be produced.

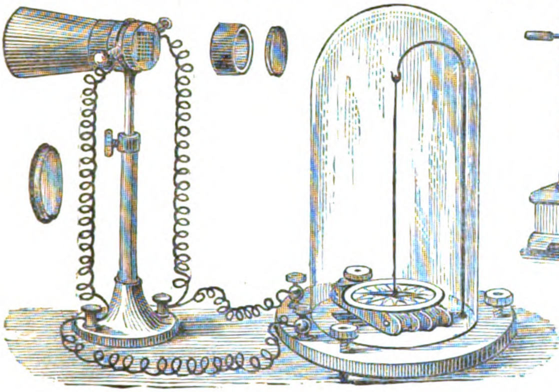
2292. Induction Coils, Fig. 2292, for producing an electric spark for the decomposition or combination of gases, in Hofmann's Gas Tubes, No. 2391, and for other purposes; best London make.

Giving a ½ inch spark, £2, 2s. | Giving a ¾ inch spark, £3 6s.

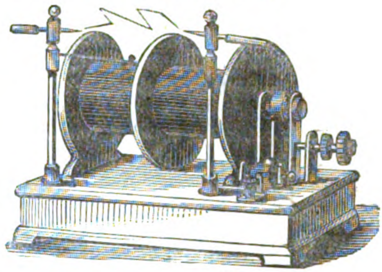
2292A. Cotton-covered Copper Wire, for making connections, No. 14, per lb. 3s.

2292B. Thermo-Electric Pile and delicate Galvanometer, Fig. 2292*b*.

The Pile of 54 Pairs, £3. The Galvanometer, £1, 10s.



2292*b*.



2292.

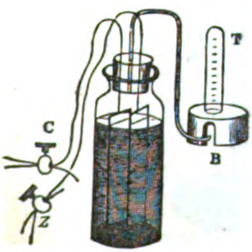
APPARATUS FOR WATER ELECTROLYSIS.

The battery power must be at least six cells of Smee's, Grove's, or Bunsen's form of Galvanic Battery. The greater the number of cells used, the more rapidly is the decomposition of the water effected.

2293. Apparatus for the Decomposition of Water by Galvanism, and the delivery of the mixed gases into a gas holder; consisting of a large glass jar, 14 inches long, 2 inches wide, with large iron electrodes [to be used with a weak solution of caustic potash], two binding screws, a caoutchouc cap, and gas delivery tube, Fig. 2293, 7s.

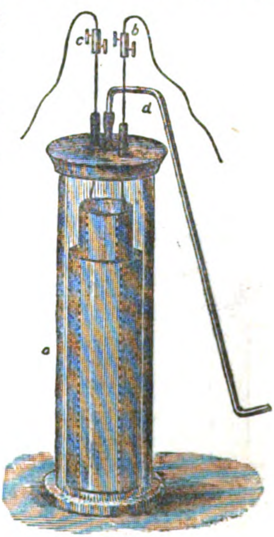
2293A. Another, of smaller size, 20 ounces' capacity, form of Fig. 2293*a*, with iron electrodes, to be used with a weak solution of caustic potash, price, *without the parts marked* B, T, 4s.

2293B. The same, with platinum electrodes, Fig. 2293*b*, 5s.



2293*a*.

2294.



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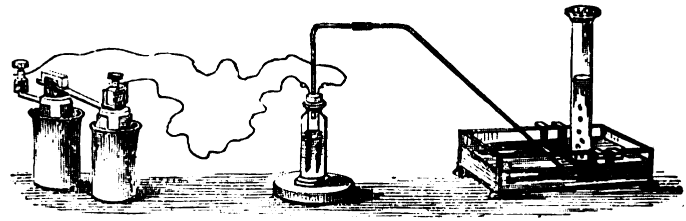
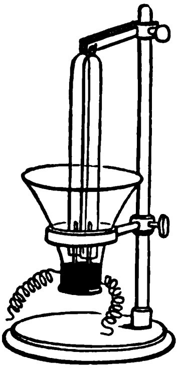


2293*b*.



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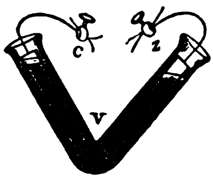

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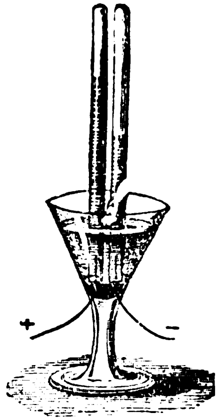
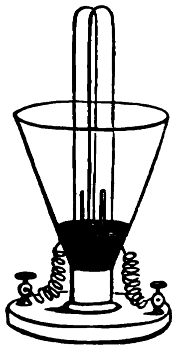


2297*a*.



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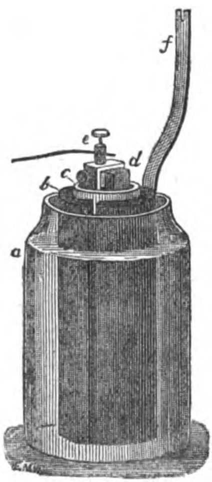

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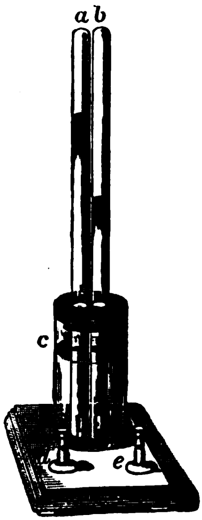

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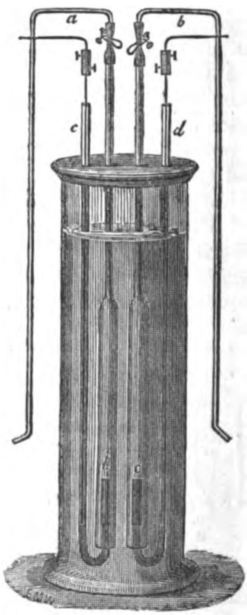
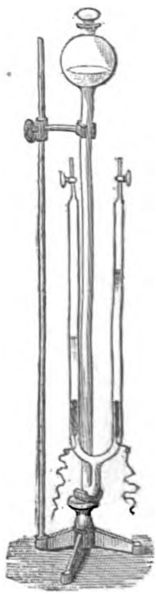


2298.



2299*a*.

2294. Apparatus for decomposing water and collecting the two gases in separate tubes, form of Fig. 2294, the gas tubes graduated, 4s.
2295. Another Apparatus, suitable for collecting larger quantities of the gases, Fig. 2295, 6s.
2296. Another form of the same Apparatus, B, Fig. 2285, 10s. 6d.
2297. Another, Fig. 2297, 10s. 6d.
2297A. Another, Fig. 2297*a*, 7s.
2298. Another, Fig. 2298, Buff's, 14s.
2299. Another, Fig. 2299, 18s.
2299A. Hofmann's Apparatus, which acts on the same principle as Buff's, Fig. 2298, 12s.

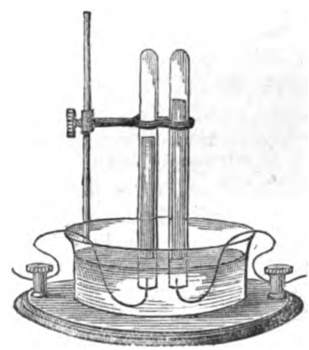
Stand for do., Metal or Wood, 6s.

2300. FARADAY'S V TUBE, for the decomposition of neutral salts, &c., fitted with Corks, Platinum Electrodes, conducting wires, binding screws, &c., Fig. 2300, 3s.

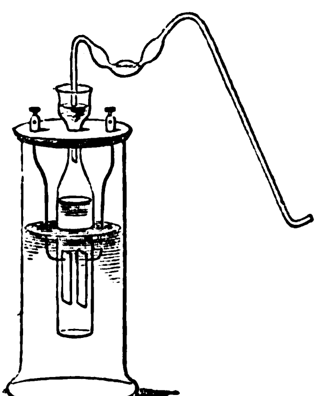
The Tube and Electrodes only, 2s.

Fill the tube with a solution of the salt in water coloured with infusion of blue cabbage. Place the platinum plates and wires, as shown in the figure, and connect the screws c and z to the wires of a battery containing at least six pairs of plates. The current passes through the fluid, and the dissolved salt is decomposed, the acid constituent passing to one pole, and the alkali to the other. The changes are rendered visible by the infusion turning red at the positive electrode and green at the negative.

2300A. Faraday's Voltameter, described also by Hofmann and Valentin, Fig. 2300*a*, 17s. 6d.
2301. Platinum Wire, adapted for Galvanic purposes, where the heating power of a battery is to be tested, $\frac{1}{200}$ of an inch in diameter, 6d. per yard.
2302. Bunsen's Apparatus for decomposing water by galvanism, and preparing pure oxyhydrogen gas for analytical purposes, consisting of glass tube with platinum plates, and a bent gas delivery tube; mounted in a glass cylinder, with a wooden cover and binding screws, Fig. 2302, 12s.



2300*a*.



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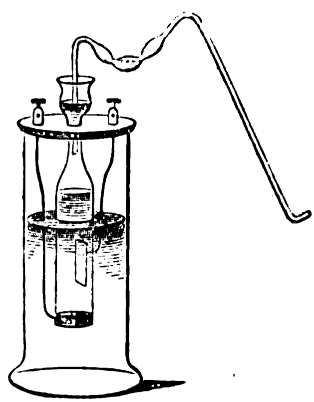


2303.

2302A. The Glass Tube Apparatus, without the glass cylinder, wood cover, and screws, 8s.

2303. Bunsen's Apparatus for preparing pure Hydrogen Gas by Galvanic Decomposition of Water, Fig. 2303, with glass cylinder, wooden cover, and binding screws, 12s.

2303A. The Glass Tube Apparatus, without the cylinder, wooden cover, and binding screws, 8s.

The instruments, No. 2302 and 2303, are described in Bunsen and Roscoe's "Gasometry," pages 63-68; but Figs. 2302 and 2303 show some improvements in the style of mounting. The detonating gas is produced by passing the voltaic current through diluted sulphuric acid, strength 1 to 10, the power being that of four Bunsen's carbon batteries, Fig. 2289. The bulbs in the leading tube contain strong oil of vitriol. The outer cylinder is partly filled with alcohol to prevent the heating of the wires by the volatic current.

In Fig. 2303, the positive wire passes through the glass into an amalgam of zinc and mercury. The battery power is that of two or three carbon batteries. Free hydrogen is given off, and the liquor in the tube soon becomes saturated with sulphate of zinc, which must be removed after each operation.

2304.

2304. Another Apparatus for Preparing Pure Hydrogen Gas for eudiometrical use, Fig. 2304, 6s.

The use of this apparatus is described in *Chemical Recreations*, page 228. It is a modification of 2303.

2305. Sir H. Davy's Apparatus for explaining the composition of water, consisting of a glass tube, with a pair of platinum plates, for the galvanic decomposition of water, and a pair of wires for recomposing the water by an electric spark, without removing the gases into another vessel, 10s. 6d.

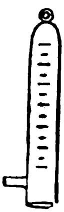
2306. Glass Tubes for Collecting the Oxygen and Hydrogen Gases, separated by the decomposition of water, graduated into cubic centimetres, small size, *per pair*, 1s. 6d.

2307. Ditto, 20 or 25 centimetres in length, graduated into cubic centimetres, *per pair*, 4s.

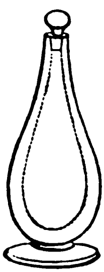
2308. Graduated Tubes, in which to collect and measure the gases produced by the decomposition of water, Fig. 2308, the graduation in decimals of cubic inches :

a. Tube 8 inches long, $\frac{3}{4}$ inch diameter, 2s. 6d.
b. „ 10 „ $\frac{7}{8}$ „ 3s. 0d.

2309. Mounted Bell Jar for collecting the gas produced by the decomposition of water, Fig. 2309, 3s. 6d.


2308.


2309.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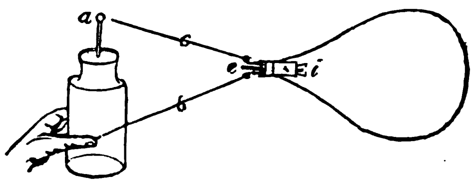


2311.

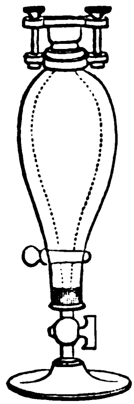
APPARATUS for EXPLODING MIXTURES of OXYHYDROGEN GAS, namely, two volumes of hydrogen with one volume of oxygen :—

Under this heading may be included Hofmann's Gas Analysis Tubes, fully described and figured under No. 2391.

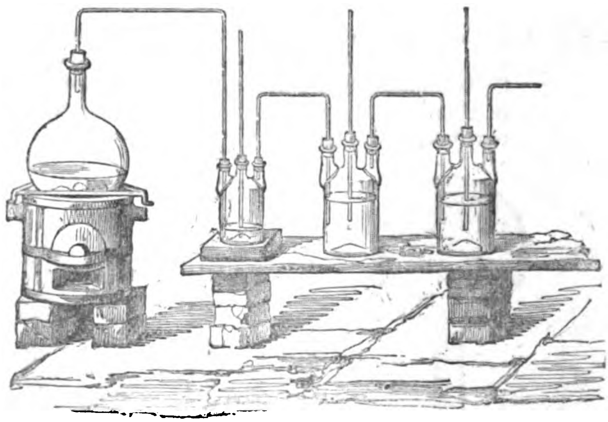
2310. Stout German Glass Detonating Bottle, with foot and ground stopper, Fig. 2310, 1s. 6d.

The gas is fired by drawing the stopper, and applying a light at the neck of the bottle.

2311. Large Bladder, fitted with glass tube, for use in filling the bladder with gas, and two Wires for conveying an electric spark for firing the gas, Fig. 2311, 2s.



2314.



2318.

This apparatus, when ready for exploding, should be attached to two wires, *b* and *c*, which should be at least 20 feet long, to keep the bladder a safe distance from the operator, who is to use the electrical apparatus. When the bladder is large it is advisable to expose it in the open air for explosion, because the concussion is unpleasantly violent in a room.

2312. Cavendish's Eudiometer, for showing the production of water by the combination of oxygen and hydrogen gases, when the mixture is exploded by the electric spark, Fig. 2314, 35s.

See *Chemical Recreations*, page 217.

The wires by which the spark is conveyed, pass through the glass stopper, but are not shown in this figure.

2313. Siemen's Ozone Tube, Fig. 2313, for the production of ozone on the lecture-table, by the use of the Induction Coil, No. 2292.

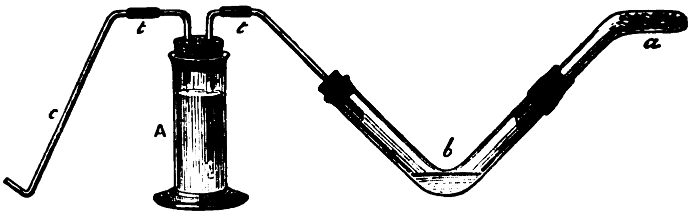
Unmounted 6s.; mounted, 18s.

2315. Apparatus for exhibiting the sudden and total absorption and condensation of certain gases (ammonia and hydrochloric acid) by water. Fig. 2315, *a* and *b*.

The glass cylinder, Fig. 2315*a*, is priced at No. 2122. The flask, Fig. 2315*b*, at No. 1405. The glass pans at Nos. 1542 and 1780.

2313.

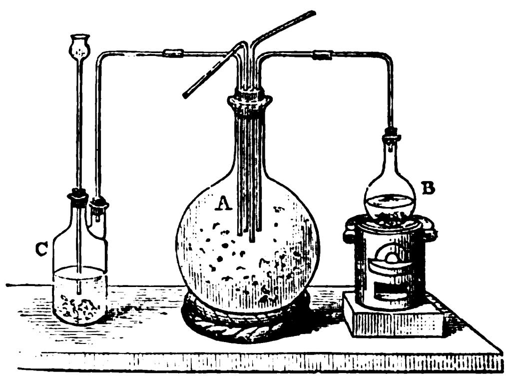
2315*a*.



2317.

2316. Apparatus for the Distillation of Ammonia from Bones, of gas from coal, and of acetic acid from oak wood, as class experiments, processes described in "Chemical Recreations," pages 326, 556, and 433, apparatus represented in this book by Fig. 330, page 32, consisting of a tube retort, a bent tube receiver, and a gas delivery tube, 2s.

2315*b*.



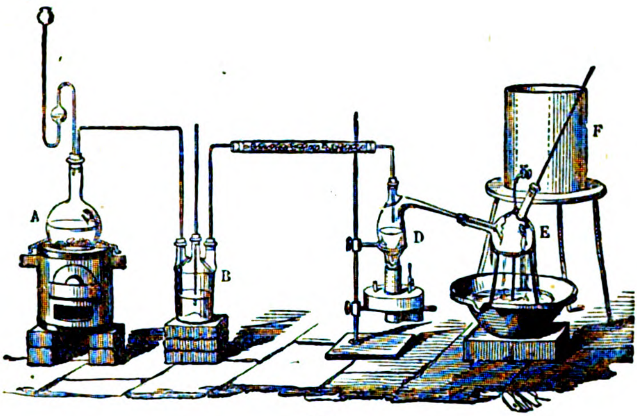
2319.

2317. Glass Tube Apparatus for the Preparation and Purification of Coal Gas, as a class experiment. See "Chemical Recreations," page 557, represented by Fig. 2317, including a pint jar, 4s.

2318. Regnault's Apparatus for the Preparation of Hydrochloric Acid ("Chemical Recreations," page 673), consisting of a French fireclay furnace, $6\frac{1}{2}$ inches diameter, with one door, a flask (ballon), 40 ounce capacity, two Woulff's bottles with three necks, of 50 ounce capacity, one Woulff's bottle with three necks, of 20 ounce capacity, ten glass bent tubes, with corks, and caoutchouc connectors, Fig. 2318, 18s.

2319. Apparatus for Explaining the Production of Sulphuric Acid by the action of nitric oxide gas, and sulphurous acid gas on steam, "Chemical Recreations," page 600, consisting of a glass globe, 12 inches diameter, a 30 ounce flask, fitted for sulphurous acid, and a 20 ounce Woulff's bottle, with two necks, fitted with acid funnel, for nitric oxide, with four connecting tubes, a clay support for the globe, and a fireclay furnace, with one iron ring, Fig. 2319, 20s.

2319A. A simpler form of this apparatus consists of a glass jar, into which the tubes pass, but without the Gas Bottles, 3s. 6d.



2320.

2320. Regnault's Apparatus for the Preparation of Terchloride of Phosphorus, Fig. 2320.

This figure is given as an example of a very complex set of apparatus for the distillation of a gas. The operation is described in "Chemical Recreations," page 687.

All the parts of this apparatus have been described in preceding sections. The furnace at No. 803; the gas bottle at No. 2034; the Woulff's washing bottle at No. 2038; the chloride of calcium tube at No. 2053; the spirit lamp at No. 870; the tubulated retort at No. 1809; the two necked receiver at No. 1849; the conical pan at No. 1540; the water bottle at No. 246; the stools at No. 406; and the blocks at No. 393.

GAS APPARATUS FOR ANALYTICAL PROCESSES.

2321. The observations that were made at No. 2223, the commencement of the last subdivision, might be repeated in this place; since the articles about to be described are not presented as a *set*, or a *collection* of apparatus for the Analysis of Gases, but are merely a few articles of that character which did not properly fall into any of the preceding sections. A complete collection of analytical apparatus for gases would include a great number of articles that have been already described, in addition to what are grouped here.

2322. M'Leod's modification of Professor Frankland's Gas Analysis Apparatus; finest finish, on polished mahogany Table Stand, Cathetometer on Arc, and Eudiometrical and Laboratory Tubes, accurately graduated. £33.

2323A. Eudiometrical Tubes, each extra, 21s.

2323B. Laboratory Tubes, each extra, 8s. 6d.

2324. Frankland's Gas Analysis Apparatus, of a much simpler construction, on Oak Stand, Iron Standard, and without a Cathetometer. £6, 10s. 0d.

The Cathetometer for use with this Instrument is described at No. 2383. Price £3, 10s.

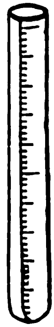
GRADUATED GAS TUBES AND JARS.

2325. GLASS GAS RECEIVERS, so graduated as to show the WEIGHT of a GAS from the MEASURE, as explained in Griffin's "Chemical Recreations," page 141.

a. Gas Tube, 11 inches long, 3 inches diameter, contains 1 grain of pure hydrogen gas at 60° Fahr. Bar, 30 inches, and divided into 100 parts, each equal to $\frac{1}{100}$ grain, 4s.

b. Gas Tube, 10 inches long, $\frac{7}{8}$ inch diameter, contains $\frac{1}{10}$ grain of hydrogen, graduated into 100 parts, each $= \frac{1}{1000}$ grain, 3s.

c. Gas Tube, 8 inches long, $\frac{3}{8}$ inch diameter, contains $\frac{1}{100}$ grain of hydrogen, graduated into 100 parts, each $= \frac{1}{10000}$ grain of hydrogen, 3s.



2326.

The weight of any gas measured in these vessels is found by multiplying the measure of the gas by its specific gravity, taking the latter from a table in which hydrogen is fixed at unity. See "Chemical Recreations," page 141, or "The Radical Theory in Chemistry," page 50, for a table of all known gases and vapours.

2326. Glass Tubes graduated into decimals of the English cubic inch :—

1. Containing	1 cu. in.	in	100ths,	2s. 6d.
2. ,,	1½ ,,		50ths,	3s. 0d.
3. ,,	2 ,,		50ths,	3s. 6d.
4. ,,	2½ ,,		10ths,	2s. 6d.
5. ,,	2½ ,,		50ths,	3s. 0d.
6. ,,	4 ,,		20ths,	4s. 0d.
7. Containing	8 or 9 cu. in.	in	10ths,	4s. 6d.
8. ,,	10 ,,		10ths,	5s. 0d.
9. ,,	16 ,,		10ths,	7s. 0d.
10. ,,	36 to 39 ,,		5ths,	8s. 0d.
11. ,,	50 to 55 ,,		5ths,	9s. 0d.

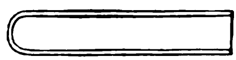
2327. Cylindrical Jars, with foot and flange, graduated into English cubic inches, German glass.

3 cubic inches,	1s. 0d.	10 cubic inches,	1s. 9d.	24 cubic inches,	4s.
4 ,,	1s. 0d.	12 ,,	2s. 6d.	30 ,,	5s.
6 ,,	1s. 3d.	15 ,,	3s. 0d.	40 ,,	6s.
8 ,,	1s. 6d.	20 ,,	3s. 6d.	50 ,,	7s.

2328. BELL GAS RECEIVERS, with necks, German glass, graduated into cubic inches.

50 cubic inches,	250 cubic inches,
100 ,,	300 ,,
150 ,,	400 ,,
200 ,,	500 ,,

2329. Glass Cylinder, form of Fig. 2329, about 12 inches long, 2 inches wide, contents 30 cubic inches, graduated into cubic inches, 2s.



2329.

2330. Glass Cylinder, with funnel-shaped mouth, 8 inches long, 2 inches diameter across the middle, 3 inches across the funnel mouth, contents about 50 cubic inches, graduated into ½ cubic inches, 5s.

2331. Glass Tubes, graduated into cubic centimetres.

25 c. c. in $\frac{1}{5}$ c. c. 1s. 6d.	150 c. in $\frac{1}{1}$ c. c. 3s.
50 c. c. in $\frac{1}{5}$ c. c. 2s. 0d.	200 c. in $\frac{1}{1}$ c. c. 4s.
100 c. c. in $\frac{1}{2}$ c. c. 2s. 6d.	

2332. Cylindrical Jars, with foot and flange, graduated into centimetre cubes, German glass.

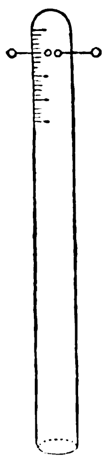
5 cent. cubes,	6d.	150 cent. cubes,	2s. 0d.	500 cent. cubes,	3s. 6d.
10 ,,	9d.	200 ,,	2s. 6d.	600 ,,	4s. 0d.
25 ,,	1s. 0d.	250 ,,	2s. 9d.	700 ,,	5s. 0d.
50 ,,	1s. 3d.	300 ,,	3s. 0d.	800 ,,	6s. 0d.
75 ,,	1s. 6d.	400 ,,	3s. 3d.	1000 ,,	7s. 0d.
100 ,,	1s. 9d.				

2333. **Cylindrical Jars, with foot and flange, graduated into centimetre cubes, with figures reading upwards as well as downwards, German glass :—**

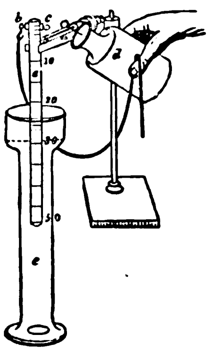
5 c. cubes,	9d.	150 c. cubes,	2s. 6d.	500 c. cubes,	4s.
10 „	1s. 0d.	200 „	3s. 0d.	600 „	5s.
25 „	1s. 6d.	250 „	3s. 3d.	700 „	6s.
50 „	1s. 9d.	300 „	3s. 6d.	800 „	7s.
100 „	2s. 3d.	400 „	3s. 9d.	1000 „	8s.

2334. **Bell Glass Receivers**, with necks, German glass, graduated into cubic centimetres.

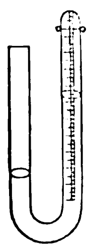
1000 centimetre cubes.	6000 centimetre cubes.
2000 „ „	8000 „ „
3000 „ „	10000 „ „
5000 „ „	



2338.

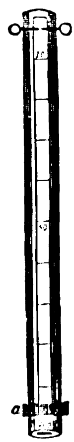


2338*a*.

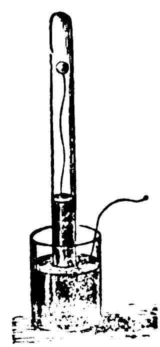


2340.

2343.



2342.



2354.

EUDIOMETERS.

For the analysis of atmospheric air, and of mixtures that contain oxygen or hydrogen, or other gases that are decomposed by combustion with either of these, and for explaining the composition of water.

2338. Volta's Eudiometer, about 16 to 18 inches long, and $\frac{5}{8}$-inch wide, Fig. 2338 or Fig. 2338*a*, graduated the entire length, the upper part closely.

a. 3 cubic inches, graduated to show 100ths of a cubic inch, 4s. 6d.
b. 60 centimetre cubes, graduated to show $\frac{1}{5}$ or $\frac{1}{10}$ c. c., 4s. 6d.

2339. Japanned Tinplate Case for Volta's Eudiometer, 1s.

2340. Ure's Syphon Eudiometer, form of Fig. 2340.

a. 2 cubic inches, graduated to show $\frac{1}{100}$ cubic inch, 6s.
b. 50 centimetre cubes, graduated to show $\frac{1}{5}$ or $\frac{1}{10}$ c. c., 6s.

2341. Japanned Tinplate Box to hold Ure's Eudiometer, 1s. 6d.

2342. Mitscherlich's Eudiometer, very stout glass tube with stopper, form of Fig. 2342; length about 13 inches, external diameter, $1\frac{3}{4}$-inch; contents 2 cubic inches, graduated to show $\frac{1}{100}$ c. c., 15s.

The stopper is used to prevent loss of gas while the expansion occasioned by the explosion takes place. The glass is made extremely thick, to enable it to withstand the explosion; but the difficulty of preparing and annealing the instrument is such that it is rare to find one that remains sound for any length of time. It sometimes happens that after an instrument has been made for months, it suddenly breaks without being touched.

2343. Eudiometer Balls, Fig. 2343, per dozen, 4s.

These are made of a mixture of clay and spongy platinum. When passed up by means of an iron wire into a mixture of oxygen and hydrogen gases confined over mercury, as represented by Fig. 2354, the ball causes the gases to combine gradually without explosion. See "Chemical Recreations," page 215.

2344. Cavendish's Eudiometer, see No. 2312.

2345. Bunsen's Eudiometer, form of Fig. 2345, graduated from end to end, and having the platinum wires bent up inside close to the roof of the tube, in the manner represented by Fig. 2345*a*. Various lengths, 12 to 36 inches long, and of various diameters from $\frac{5}{8}$ inch to 1 inch, as follows:—

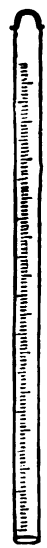
2346. Bunsen's Eudiometers, with wires, but not graduated.

a.	13 inches long,	for scale of	300	millimetres,	2s.
b.	20 ,,	,,	500	,,	3s.
c.	33 ,,	,,	800	,,	4s.

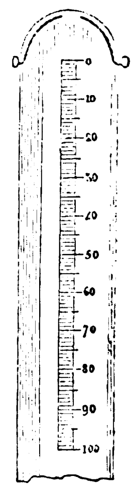
2347. Bunsen's Eudiometer, with wires, graduated lineally to millimetres.

300	millimetres,	3s. 6d.	600	millimetres,	5s. 6d.
400	,,	4s. 0d.	700	,,	6s. 0d.
500	,,	5s. 0d.	800	,,	6s. 6d.

2348. Bunsen's Eudiometer, with wires, graduated lineally into spaces, each one twenty-fifth of an English inch, with numbers written in series like a millimetre scale:—



2345.



2345*a*.

400 spaces,	16 inches,	4s. 0d.	700 spaces,	28 inches,	6s. 0d.
500 ,,	20 ,,	5s. 0d.	800 ,,	32 ,,	6s. 6d.
600 ,,	24 ,,	5s. 6d.	900 ,,	36 ,,	7s. 6d.

2349. Bunsen's Eudiometer, gauged internally, and graduated into centimetre cubes.

18 inch, 50 centimetre cubes, showing $\frac{1}{5}$ c. c. 4s.
18 ,, 32 ,, ,, $\frac{1}{10}$ c. c. 4s.

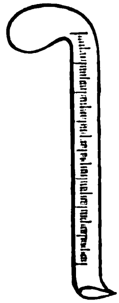
2350. Bunsen's Eudiometer, gauged internally, and graduated into cubic inches, showing $\frac{1}{10}$ c. i., length 32 to 36 inches, *each* 5s.

2351. Bunsen's Absorption Tube, Fig. 2351, about 250 millimetres long, 20 wide, and about 60 c. c. in capacity, graduated into millimetres. (See Bunsen's "Gasometry," page 23, Fig. 18), 2s.

2352. Bunsen's Absorption Tube, with retort bulb to receive absorbing substances, Fig. 2352. (See Bunsen's "Gasometry," page 23, Fig. 19), 2s.

2353. Absorption Tubes with graduations to show internal capacity, expressed in centimetre cubes or cubic inches, *at the same prices.*

2351.



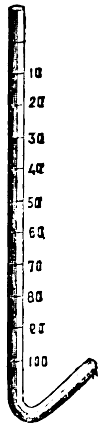
2352.

2353A. Absorption Tube or Eudiometer as used by Hofmann, Frankland, Valentin, &c., Fig. 2353*a.* It is about 26 inches long, and half an inch in bore, and is divided on the long limb into 100 parts, 4s.

2354. Mould for making balls of solid reagents for the absorption of special gases from gaseous mixtures; size of the balls, $\frac{1}{4}$-inch diameter, 2s.

The reagent in a fused or pasty condition is put into the two halves of the mould, a platinum wire twisted in corkscrew is placed in the middle, and the two halves are pressed together. After a time the ball is carefully removed from the mould, and the outer end of the platinum wire is fastened to a long iron wire for use. The gases to be operated upon are put into absorption tubes, Nos. 2351 or 2352, and the balls pushed up through the mercury, as represented by Fig. 2354. But this figure represents the external wire as passing out of the mercury. That is erroneous. It ought not to pass out of the mercury, otherwise an exchange of atmospheric air is liable to take place with the gas confined in the tube.

Among the reagents that are employed for the absorption of gases in this manner are the following:—



2353*a.*

Absorbing Reagents.	*Gases to be Absorbed.*
Peroxide of Manganese.	Sulphurous Acid.
Caustic Potash.	Carbonic Acid.
Phosphorus.	Oxygen.
Coke saturated with a mixture of anhydrous and fuming sulphuric acid.	Olefiant Gas. Vaporised solid and liquid Hydrocarbons.
Chloride of Calcium.	Water.
Phosphate of Soda Crystallised.	Chlorine.
Borax Crystallised.	Chlorine.

See Bunsen and Roscoe's "Gasometry," page 52; "Handwörterbuch der Chemie," Bd. II. S. 1062, section Eudiometer, where a special article is given on the analysis of coal gas; Rose's "Analytischen Chemie," Bd. II. S. 916; Miller's "Elements of Chemistry," vol. II., page 661; Regnault, "Cours élémentaire de Chimie," tome IV., page 74.

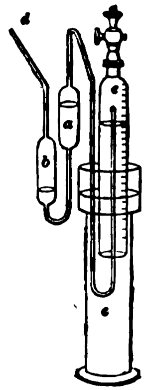
GAS PIPETTES.

2357. Gas Pipette, Ettling's, for transferring a portion of Gas from a long narrow gas receiver into another receiver, without inverting the long receiver, Fig. 2357, *small size pipette,* each bulb 3 by $\frac{3}{4}$ inch, the outer syphon tube 9 inches long, 1s. 3d.

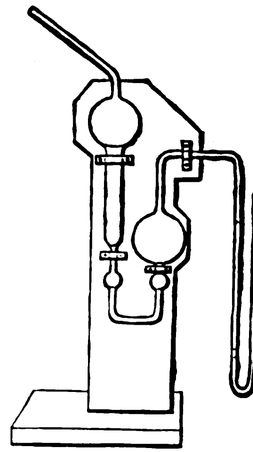
2358. Ditto, *large size pipette*, each bulb 3½ by 1 inch, the outer syphon tube 18 inches long, 1s. 6d.

2359. Ditto, a packing case, containing one pipette of each size, 3s. 6d.

2360. This instrument is made according to the pattern exhibited by Fig. 2357. It will, perhaps, be acceptable to all chemists who work much with pneumatic apparatus. It renders large pneumatic troughs unnecessary, and presents the advantage that any given quantity of gas can, by means of it, be taken from a bell-glass or graduated tube, standing within a cylinder, and transferred to another vessel, without its being necessary to remove the bell-glass from the cylinder for the purpose of decanting the gas. And this transference can be effected with the help of very little liquid.



2357.



2361.

In using the pipette, the cylinder *a* is first to be filled with water (or mercury) by dipping the branch *c* into the liquid, and sucking at the end *d*. The point *e* is then to be introduced into the tube from which the gas is to be taken; and by sucking again at the point *d*, the liquid is removed from the cylinder *a* into the cylinder *b*, while its place is filled by gas from the tube. The apparatus is then pressed downwards until the point *e* dips into the liquid contained in the cylinder (water or mercury), upon which some of the liquid enters into the branch *c*, and prevents the escape of the gas.

The gas is removable from the pipette by blowing into the end *d*; and if the orifice at the end *e* is very small, and the gas is blown out gently, any determinate quantity of it can be thus transferred into an eudiometer or other vessel.

When the liquid that confines the gas is mercury, it is then somewhat difficult to blow out the gas, in consequence of the weight of the column of mercury. This difficulty can be overcome by good management.

2361. Doyere's Gas Pipette, described by Gerhardt, *Traité de Chimie Organique*, I. 104, Fig. 2361, without stand, 2s. 6d.

2362. Ditto, mounted on a wooden stand with brass bands, Fig. 2361, 9s.

2363. Miller's Gas Pipette (see Miller's *Elements of Chemistry*, II., 477), with two iron stopcocks, mounted on a board, 20s.

INSTRUMENTS FOR GAS ANALYSIS USED BY BUNSEN.

2365. Large Porcelain Tubes, glazed inside and outside, by the rubbing of which, with silk and amalgam, electricity is produced sufficient to charge a small Leyden jar for giving the spark in eudiometrical experiments. (See Bunsen's "Gasometry," page 46.) Thuringian porcelain, 24 inches long, 2 inches wide, 4s. 6d.

2366. Ditto, Berlin porcelain, 35 by 1½ inches, 16s.

2367. Small Leyden Jar, 2½ inches high, 1½ inch wide, fitted for this operation, 2s.

2368. Ditto, coated outside with platinum, 6s.

Bunsen's Apparatus for preparing pure hydrogen and oxyhydrogen gas for use in eudiometrical operations, see Nos. 2302 and 2303.

Bunsen's Gas Holder for Eudiometrical Operations, see No. 2177.

2369. Bunsen's Steam Apparatus, for converting the water produced by an explosion in the Eudiometer into vapour, and measuring it in that state. (See Bunsen's "Gasometry," page 47.) *Price, without support and gas burner*, 33s.

2370. Bunsen's Apparatus for Graduating Glass Tubes, with scale of millimetres, &c., complete. (See Bunsen's "Gasometry," page 26, Fig. 21.) Price £2, 12s. 6d.

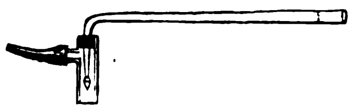
2371. Bunsen's Absorptiometer, for determining the laws of the absorption of gases in liquids. (See Bunsen's "Gasometry," page 138, Fig. 43.) £7.

2372. Bunsen's Apparatus for determining the specific gravity of gases by effusion, Fig. 2372. (See Bunsen and Roscoe's "Gasometry," Fig. 40, page 122.) 12s. 6d.

2373. Bunsen's Apparatus for measuring the volume of a gas, with a view to the determination of its specific gravity, consisting of a graduated flask, contents 200 to 300 c. cubes, and a chloride of calcium desiccating tube, Fig. 2374. (See Bunsen and Roscoe's "Gasometry," Figs. 38 and 39.) 6s.

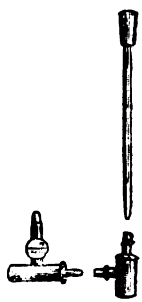
2374. Ditto, a Pneumatic Trough for use with the preceding apparatus; mahogany, with plate glass sides, Fig. 2374, 20s.

2375. Copper Cone and three Copper Collars, for grinding the necks of flasks under ¼ inch bore, and fitting glass stoppers to them by grinding with emery and turpentine; to form such apparatus as No. 2373. (See instructions in Bunsen's "Gasometry," page 118.) *The set*, 2s. 6d.

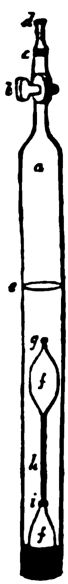


2377.

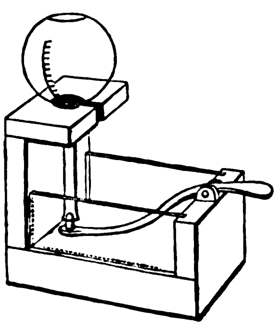
2383*a*.



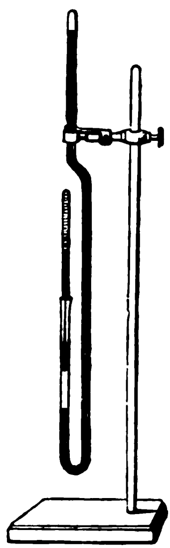
2377*b*.



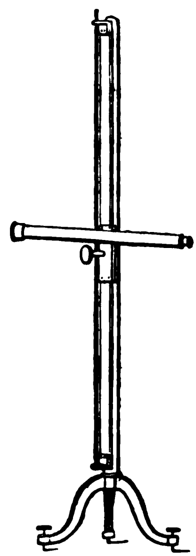
2372.



2374.



2378.



2383.

2376. Blowpipe Lamp, to attach to a blowpipe, for use in sealing up the ends of glass tubes and the narrow necks of flasks that contain gases, mineral waters, &c., 2s. 6d.

The use is explained in Bunsen and Roscoe's "Gasometry," page 3. In order to have both hands free during the fusion of the neck of a vessel, a mouth blowpipe is employed, and a lamp, containing about $\frac{1}{16}$ ounce of oil, is connected with the blowpipe by means of a wire and a small ring. By bending the wire, it is easy to give the flame the requisite form and length. A cork is fixed in the upper end of the blowpipe, and is to be placed between the teeth, by which means the blowpipe can be held in such positions as to throw the flame in any desired direction, horizontal, vertical, or transverse.

2377A. Mouth Blowpipe, attached to a Gas Burner, for the same use, Fig. 2377, 3s.

2377B. Ditto, with regulating stopcock and moisture chamber, form of Fig. 2377*b*, 8s.

2378. Bunsen's Syphon Barometer, form of Fig. 2378, tube graduated on both branches into millimetres, diameter of the tube such as to take about 12 ounces of mercury, filled and boiled, 15s. of London made 25s

2379. The Graduated Barometer Tube, without mercury, 8s.

2380. Support for the Barometer, consisting of an iron clamp, rod, and foot, as represented in Fig. 2378, 6s. 6d.

2381. Thermometer for insertion in the lower limb of the Barometer, 4s.

2382. Plummet to attach to a thread, and suspend near the Barometer, &c., to secure their being placed in a vertical position. (See Bunsen's "Gasometry," page 22.) 1s.

2383. Cathetometer, form of Fig. 2383, the telescope with micrometer, for use in observing the height of the mercury in Barometers, Gas Tubes, Eudiometers, &c., without approaching near them, £3, 10s.

2383A. Petroleum Flashing Test set of apparatus, made in accordance with the Act of Parliament for the use of the Inspectors when testing the volatility of petroleum oils, with a thermometer, Fig. 2383*a*, 21s.

APPARATUS USED IN THE TECHNICAL ANALYSIS OF COAL-GAS.

2384. Graduated Bottle, 12 inches by 3½, with a stopper at top and a neck at the side near the bottom, graduated into 100 parts, 8s.

2385. Graduated Tube, 30 inches by ¾ inch, form of Cooper's Gas Receiver, with a bulb at top and the mouth stoppered, graduated into 100 parts, 7s.

2386. Pair of Cooper's Gas Receivers, 10 or 12 inches by ¾ inch, graduated into cubic inches, with a porcelain tray, 6 by 5 inches, and a mahogany stand, 10 by 12 inches, with two jointed brass clamps and 16 inch rods to support the tubes, 25s.

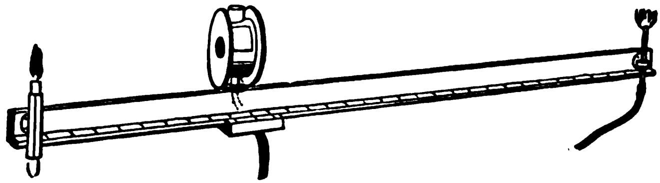
2387. Cooper's Tube, 30 inches long, and about ⅝ inch diameter, the contents graduated into 100 parts, and each part into 5ths; in all 500 divisions, 7s.

2388. *a.* Sheet Iron Water Trough, for use with ditto, 3 feet high, 4½ inches wide, with glass top.

b. Ditto, in the form of a tube, with glass top, 7s.

2389. BUNSEN'S PHOTOMETER, for comparing and measuring the power of gas-lights, 50s.

Bunsen's Photometer is represented by Fig. 2389; the slide, provided with a graduated scale, is about 4 feet long. At the left-hand end is a support (omitted in the figure) and a clamp for the normal candle. At the right-hand end is a clamp for the gas burner that is to be tried. The cylindrical closed chamber, represented on the slide, moves from end to end upon it. It contains a gas burner connected with a flexible pipe, by which it can be fed. On one side of the chamber is a disc of paper, made translucent by stearine, except a circular piece in the middle. The chamber revolves upon its axis, so that the paper disc can be presented either to the normal candle or to the light that is to be tried. The operation of trial is as follows:—The normal candle is allowed to burn ten minutes, until it is in proper condition, and at a height corresponding to the centre of the paper disc. The gas-light in the chamber is then so regulated that, the candle-light playing at the same time on the disc, no difference can be seen between the *greased* and *ungreased* portions of the paper. The chamber is then turned round 180°, so as to place the paper disc opposite the gas-light that is to be tried, and the chamber is to be pushed along the slide towards the gas-light, until the different parts of the paper again become indistinguishable. If, then, the distance from the paper of the gas-light and of the normal candle is the same, which is to be observed on the engraved scale attached to the slide, the gas-light has the illuminating power of one standard candle. If the distance of the gas-light is twice that of the normal candle, the illuminating power of the gas-light is four times that of the candle, and so on.



2389.

2390. Calorimeter, or Fuel Tester, invented by Lewis Thomson, M.R.C.S., &c., for analysing the heating power of coal, and indicating the number of parts of water a given quantity of coal is capable of boiling.

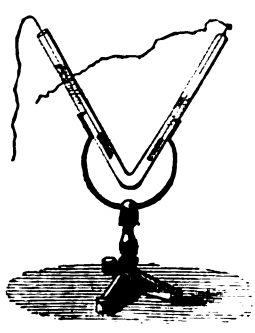
Complete Apparatus, consisting of Combustion Cylinder, with separate spring clutch-base, 6 cylindrical upper furnaces, 2 wide do., glass cylinder graduated to 29,000 grains, Thermometer in copper case, Scales and Weight, Iron Pestle and Mortar, Hair Sieve and Canister filled with oxygen mixture, in French polished, cloth lined mahogany case, with Drawer, Lock, and Key. £6, 16s.

SPECIAL APPARATUS SUITABLE FOR ILLUSTRATING THE EXPERIMENTS DESCRIBED IN PROF. HOFMANN'S "INTRODUCTION TO MODERN CHEMISTRY."

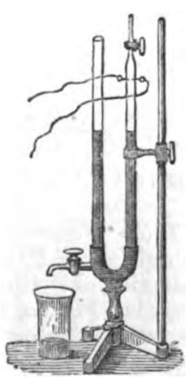
2391, 0. Apparatus for the decomposition of HCl, H_2O, or NH_3—A V Tube, with two Platinum Electrodes, Fig. 0, 5s.

2391, 1. Apparatus for decomposing HCl by Sodium—A U Tube like Fig. 10, but without the Electrodes, and having a Pinchcock instead of a Glass Tap, 4s.

2391, 2. Apparatus to determine the Volume of H in HCl—A U Tube, without Electrodes, with two Cocks, like Fig. 3, 6s. 6d.

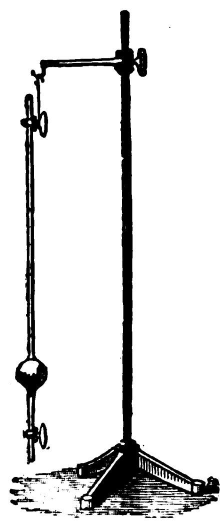


2391, 0.



2391, 3.

2391, 4a.



2391, 4.

2391, 3. Apparatus to demonstrate that three Volumes H combine with one Volume N to form two Volumes of NH_3—A U tube, with Electrodes and two Cocks, Fig. 3, 7s. 6d.

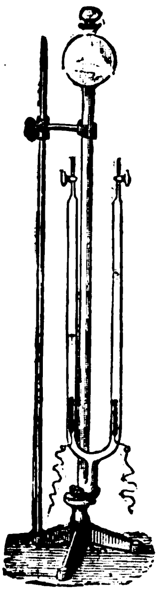
2391, 4. Apparatus to demonstrate that Cl and H combine to form HCl, without alteration of Volume—Glass Tube, with Bulb and two Glass Cocks, Fig. 4, 5s. 9d.

2391, 4A. Do, another form, Fig. 4*a*, 5s. 9d.

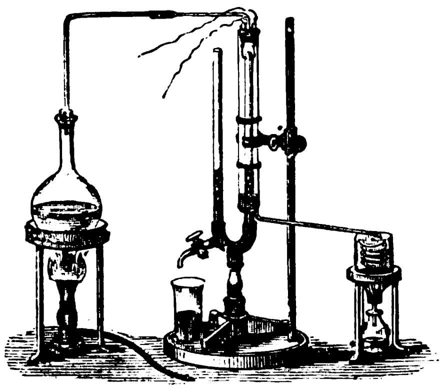
2391, 5. Apparatus to show that two Volumes H combine with one Volume O to form H_2O water—A U Tube, with Taps, two Electrodes, and raised Bulb Reservoir, Fig. 5, 12s.

2391, 6. Apparatus to illustrate that in the production of water the gases diminish one-third in Volume the volumetric composition of steam—A U Tube, with outside Condenser-Tube, a Glass Cock, and Condensing Worm, Fig. 6, 8s. 6d.

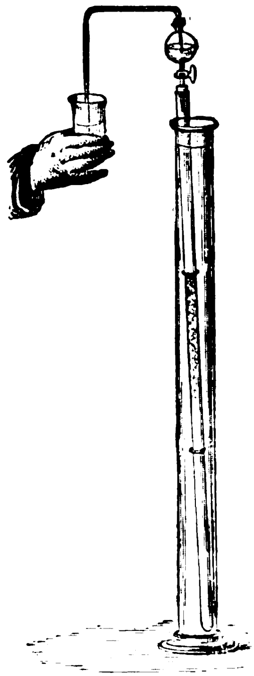
2391, 7. Apparatus to prove that three Volumes H unite with one Volume N to form Ammonia NH_3—A long Tube, with Stopcock and Delivery Tube, in a tall Glass Cylinder, without the Cylinder, Fig. 7, 10s.



2391, 5.



2391, 6.



2391, 7.

2391, 7A. The Cylinder only, Fig. 7, 5s.

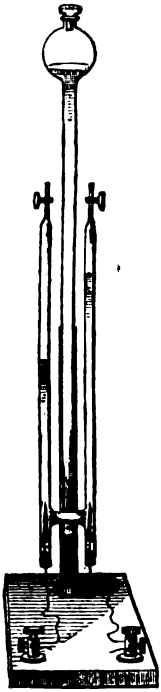
2391, 8. Apparatus for the decomposition of HCl—A U Tube, with open lower ends to permit the introduction of Platinum Electrodes, Fig. 8*a*, 10s.

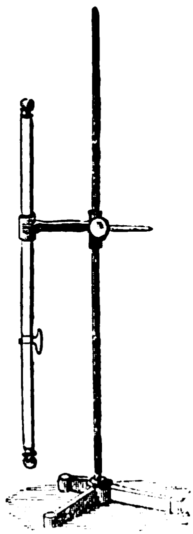
2391, 8A. Ditto, with Carbon Electrodes, Fig. 8*a*, 10s.

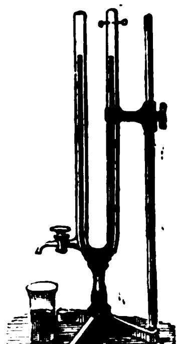
2391, 9. Apparatus to prove that the combining Volumes of H and Cl in the formation of HCl are always constant—A straight Tube, with two end Stoppers, and a Stopcock at one-third its length, Fig. 9, 7s. 6d.

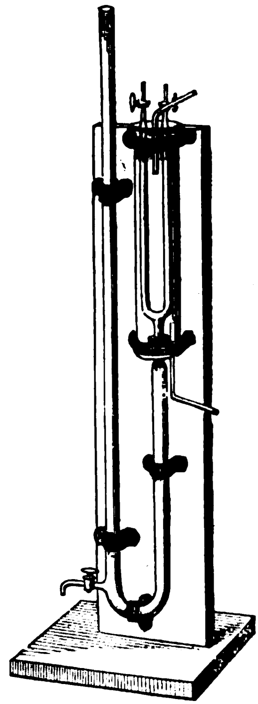
2391, 10. Apparatus to show that H and O always combine in the same proportions—A U Tube, with Tap at bottom and Electrodes, Fig. 10, 5s.

2391, 11. Apparatus to show the effects of temperature and pressure on compound or simple gases—A U Tube, with three Cocks and Steam Jacket, Fig. 11, 12s.


2391, 8*a*.


2391, 9.


2391, 10.


2391, 11.

2391, 12. Lecture Table Eudiometer, graduated—A U Tube, with two Taps and Electrodes, Fig. 3, 12s.

2391, 13. Apparatus for the decomposition of Steam by the Electric Spark—Glass Globe, with Platinum Electrodes and large Boiling Flask, Fig. 13, 3s. 9d.

2391, 14. Gas Diffusion Tube, with Plaster Disc, Fig. 14, 1s. 6d.

2391, 15. Apparatus for the preparation of Acetyline—Globe with four necks and Carbon Electrodes, Fig 15, 5s.

2391, 16. Mercuric Oxide Tube Retort, to show Metallic Mercury, Fig. 16, 1s.

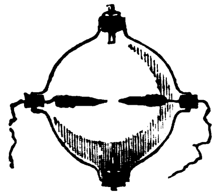
2391, 17. Apparatus for the decomposition of Ammonia by Spark, and for the subsequent combustion of the liberated Hydrogen by Copper Oxide, Fig. 17, 13s.

The Tubes should only just pass through the corks, and that on the right should be closed by means of a *glass* Tap.

2391, 18. Combustion of O and N by Spark, Fig. 18,13s.

2391, 19. Apparatus to show the combustion of Oxygen and Nitrogen by electric spark, Fig. 19, 3s. See Errata [illegible]

Stands for Hofmann's Tubes, of Wood or Metal, according to form and quality, from 6s. to 20s. each.

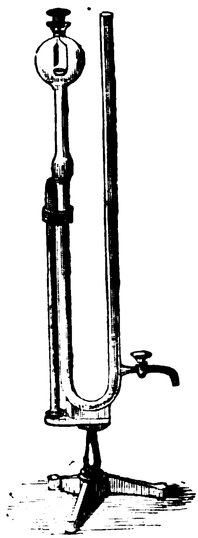


2391, 15.

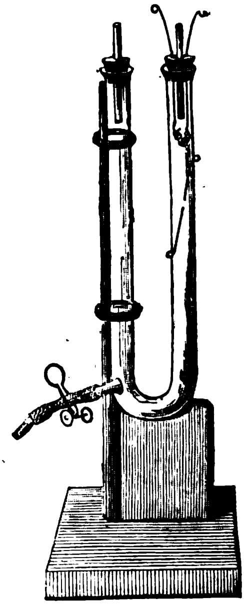
2391, 13.

2391, 14.

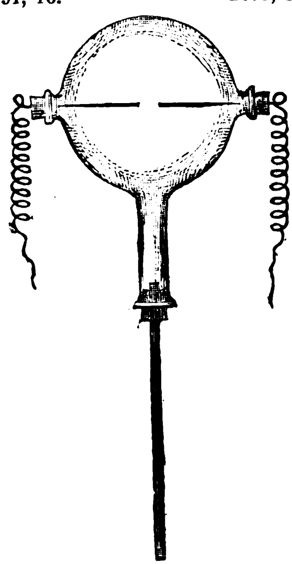
2391, 16.



2391, 18.



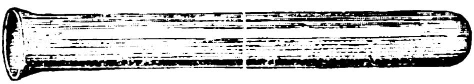
2391, 17.



2391, 19.

Application of Chemical Tests.

2400. **TEST TUBES,** OF THE BEST THIN HARD WHITE GERMAN GLASS, closed and properly rounded at one end, and bordered at the mouth; neatly finished and well annealed, Fig. 2400.



2400.

PRICE PER DOZEN.

LENGTH of TUBES in INCHES.	DIAMETER of the TUBES across the middle in inches.								
	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{4}$	$1\frac{1}{2}$
2 inch,	3d.	3d.	4d.	4d.	5d.	—	—	—	—
3 ,,	3d.	3d.	4d.	5d.	6d.	7d.	8d.	—	—
4 ,,	4d.	5d.	6d.	7d.	9d.	1s. 0d.	1s. 1d.	—	—
5 ,,	6d.	6d.	7d.	8d.	9d.	1s. 1d.	1s. 3d.	1s. 6d.	—
6 ,,	—	—	8d.	9d.	10d.	1s. 3d.	1s. 6d.	1s. 8d.	1s. 10d.
7 ,,	—	—	9d.	10d.	1s. 0d.	1s. 3d.	1s. 6d.	1s. 9d.	2s. 0d.
8 ,,	—	—	—	—	1s. 3d.	1s. 6d.	1s. 9d.	2s. 0d.	2s. 6d.

Test Tubes of smaller sizes than the above are described under the head of Blowpipe Apparatus.

2401. Brush for cleaning Test Tubes, handle of galvanised iron wire, Fig. 2401, 3d., or 2s. 6d. per dozen.

2401.

2402. Ditto, for very narrow tubes, 2d., or 1s. 6d. per dozen.

COLLECTIONS OR ASSORTMENTS OF TEST TUBES.

2403. Collection of 42 Testing and Boiling Tubes, 3s. 3d.

12 each of 5 by $\frac{1}{2}$ and 6 by $\frac{3}{4}$ inch.

6 each of 3 by $\frac{3}{4}$, 6 by 1, and 6 by $1\frac{1}{4}$ inch.

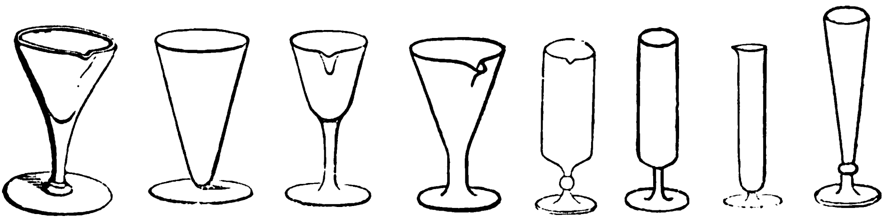
2404. Collection of 60 Testing and Boiling Tubes, 5s. 8d.
12 each of 5 by $\frac{1}{2}$, 5 by $\frac{5}{8}$, 5 by $\frac{3}{4}$, and 6 by 1 inch.
6 each of 6 by $\frac{3}{4}$, and 7 by $1\frac{1}{4}$ inch.

2405. Collection of 120 Testing and Boiling Tubes, 8s. 4d.
12 each of 2 by $\frac{1}{4}$, 3 by $\frac{3}{8}$, 3 by 1, and 4 by $\frac{1}{2}$ inch.
12 each of 5 by $\frac{1}{2}$, 5 by $\frac{5}{8}$, 5 by $\frac{3}{4}$, and 6 by 1 inch.
6 each of 6 by $\frac{3}{4}$, 6 by $1\frac{1}{2}$, 7 by $\frac{3}{4}$, and 7 by $1\frac{1}{4}$ inch.

TEST TUBES, IN NESTS, in round pasteboard cases, suitable for travelling sets of apparatus.

2406. Nest of 3 tubes, from 3 inch by $\frac{3}{8}$ inch, to 5 inch by $\frac{3}{4}$ inch, 4d.
2407. Nest of 6 tubes, from 2 by $\frac{1}{2}$ inch to 6 by 1 inch, 6d.
2408. Nest of 9 tubes, from $2\frac{1}{2}$ by $\frac{3}{8}$ inch to 7 by 1 inch, 1s.
2409. Nest of 12 tubes, from $2\frac{1}{2}$ by $\frac{1}{4}$ inch to 9 by $1\frac{1}{2}$ inch, 1s. 9d.

TEST GLASSES ON FEET.



2410. 2412. 2413. 2414. 2415. 2420. 2421. 2422.

These Test Glasses are made either of Bohemian or of hard German white glass, which are not so readily rendered opaque by the scratching of the stirrers as are the Test Glasses that are made of soft English flint glass.

2410. Clark's Conical Test Glass, Fig. 2410, 1 ounce size, $3\frac{1}{2}$ inches high, 2 inches diameter, with spout, made very broad, to show slight changes of colour when a mass of liquor is looked through horizontally. *Per Dozen*, 2s. 9d.

2411. Very Small Light Conical Test Glass, form of Fig. 2410, 1 inch high, 1 inch diameter, with spout; for trying the action of small quantities of fluid on litmus paper, &c., as in the testing of water and dilute fluids. *Per Dozen*, 1s. 3d.

2412. Conical Test Glass, small and stout in the glass, for portable laboratories, form of Fig. 2412, 1 inch diameter, 2 inches high, contents $\frac{1}{2}$ ounce, without stalk or spout. *Per Dozen*, 1s. 9d.

2413. Bohemian Test Glasses, form of Fig. 2413, conical, with rounded bottom and spout, fine white glass, elegant form. *Price per Dozen:*—

1 ounce, 3s.	3 ounces, 5s.	6 ounces, 8s.
2 ounces, 4s.	4 „ 6s.	8 „ 10s.

2414. French Test Glasses, conical, with spout, form of Fig. 2414. *Per Dozen:*—

1 ounce,	3s. 0d.	5 ounces,	5s. 0d.	12 ounces,	8s. 0d.
2 „	3s. 6d.	6 „	5s. 6d.	16 „	10s. 0d.
3 „	4s. 0d.	7 „	6s. 0d.	24 „	14s. 0d.
4 „	4s. 6d.	8 „	7s. 0d.	32 „	18s. 0d.

CYLINDRICAL TEST GLASSES, with spout, form of Fig. 2415. *Per Dozen:—*

2415.	Contents	2	ounces,	5½	inches high,	1	inch wide,	3½	inches	deep within,	4s.
2416.	,,	4	,,	6½	,,	1½	,,	4½	,,	,,	5s.
2417.	,,	6	,,	7	,,	2	,,	4½	,,	,,	6s.
2418.	,,	8	,,	7	,,	2¼	,,	5	,,	,,	7s.
2419.	,,	12	,,	8	,,	2½	,,	6	,,	,,	8s.

2420. CYLINDRICAL TEST GLASS, form of Fig. 2420, without spout, contents 18 to 20 ounces, 8 inches high, 3⅓ inches wide, 4½ inches deep within. *Per Dozen*, 10s.

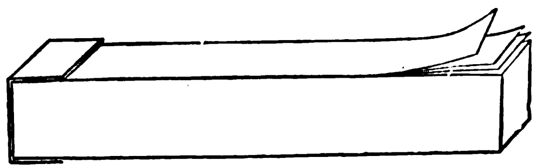
GLASS STIRRERS, suited to the different sizes of Test Glasses, see No. 115, page 10.

2421. GERMAN TEST TUBES ON FEET, with expanded mouth and spout, form of Fig. 2421. *Per Dozen:—*

1.	1½ inch high,	¼-inch wide,		10d.
2.	2 ,,	⅜ ,,	1s.	0d.
3.	3 ,,	½ ,,	1s.	2d.
4.	4 inches high,	⅝-inch wide,	1s.	4d.
5.	5 ,,	¾ ,,	1s.	6d.
6.	6 ,,	1 ,,	1s.	9d.

2422. TALL CONICAL TEST GLASS, champagne form, Fig. 2422, without spout, contents 10 ounces, 9 inches high, 3 inches wide, 8d.

2423. TEST PAPERS, DELICATE, bound in cheque books of 50 leaves each, size 3 inches long by ¾ inch wide, Fig. 2423.

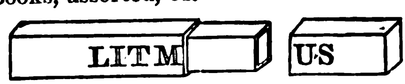

2423.

The following kinds:—

1. Blue Litmus, for Acids.
2. Red Litmus, for Alkalies.
3. Neutral Litmus, either for Acids or Alkalies.
4. Turmeric, for Alkalies.
5. Brazil Wood, for Hydrofluoric Acid.
6. Lead, for Sulphuretted Hydrogen.
7. Starch, for Iodine.

The Blue Litmus will detect half a grain of sulphuric acid in a gallon of water—namely, 1 in 140,000. The Red Litmus will detect 1 grain of caustic soda in a gallon of water, or 1 in 70,000. The test papers are hard-sized, so that the lines can be drawn across them with the wet point of a glass rod, and thus many trials may be made with one leaf of paper.

2424. Price of a Single Book of Test Paper, 2d.
2425. Test Paper Books, assorted, *per dozen*, 1s. 6d.
2426. Wooden Box, with 6 Test Books, assorted, 1s.
2427. Large Wooden Box, with 12 Books of Litmus, 2s.
2428. Neat Case, containing 6 dozen Test Books, assorted, 9s.
2429. Leather Case, for the pocket, to hold one Test Book, 4d.
2430. Leather Case, with one book of blue or neutral litmus, 6d.



2429.

Japanned Tinplate Cases, with hinged tops, *at the same price as leather cases.*

2431. Stoppered Glass Bottle, with 12 Books Neutral Litmus, 3s.
2432. TEST PAPERS FOR LECTURERS.—Test Papers, strongly coloured, and of large size, 5 inches long, ¾ inch wide, for experiments at lectures; in a pasteboard box, containing 6 books, namely, blue and red litmus, yellow and brown turmeric, lead paper, and starch paper, each book containing 32 leaves, per box, 1s. 6d.

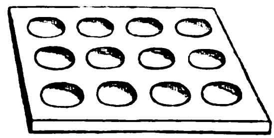
2433. Any of the Books separately, 3d. each.
2434. Ozone Paper, per packet, 1s.
2435. Lowe's Ozone Box, for exposing Ozone Papers to the free action of the air in the shade, 15s.
2436. Test Metals.—An assortment of small metallic bars and wires for percipitating metals in qualitative testing, in a turned wooden box, 1s.
2437. The metals separately, each 1d.

Iron Bar.	Zinc thin Wire.	Copper thin Wire.	Lead Wire.
Zinc Bar.	Copper Plate.	Tin Wire.	

2438. Test Spoon,—a small spoon of polished German silver, with a bowl $\frac{1}{4}$ inch diameter, for lifting small quantities of powder, fluxes, &c., the handle fashioned into a spatula, $3\frac{1}{2}$ inches long, Fig. 2438, 3d.

2438.

2439. Porcelain Testing Slabs, square Plates of White Glazed Porcelain, with 12 flat cavities for Testing Liquors that give Coloured Precipitates, as fully explained at No. 2816. Fig. 2439, two sizes :—



2439.

2439. Berlin Porcelain, $4\frac{1}{2}$ by $3\frac{1}{2}$ inches with 12 cavities, $\frac{3}{4}$ inch diameter, 1s. 9d.
2440. Thuringian Porcelain, $3\frac{3}{4}$ by 3 inches, with 12 cavities, $\frac{5}{8}$ inch diameter, 1s. 2d.
2441. Round flat Plates of Berlin Porcelain, white and glazed, with depression in the middle like that of dinner plates, for use instead of Watch Glasses, in examining Coloured Precipitates.

$1\frac{1}{2}$ inch diameter, 2d. ; $1\frac{3}{4}$ inch diameter, 2d.

2442. Pipettes for applying Tests in Drops, &c. See No. 1690.
2443. Pipette Bottles for Tests. See No. 1556.

CHEMICAL TESTS IN SOLUTION.

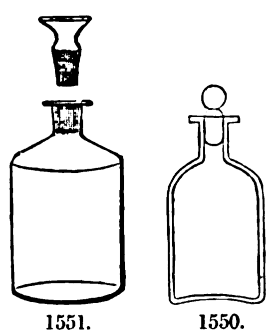
2445. The Reagents enumerated in the following table are carefully prepared, in accordance with the Strength and Purity recommended by Rose, Fresenius, and other analytical chemists. But with this difference,—that, whereas it is usual to prepare solutions of tests according to certain variable and not very precise standards, such as 1 to 5 of water, 1 to 12, 1 to 15, 1 to 24, &c., an attempt is now made to give to each solution an Atomic Strength. The standard of measure fixed upon is the *Decigallon* and one Atom of any chemical substance, weighed in *grains*, and made into a solution of the bulk of a Decigallon, at 62° F., is called a solution of One Degree of strength (marked 1°). If 2 atoms are dissolved in a solution of that bulk, it is a solution of 2°. If 5 atoms are dissolved, it is a solution of 5°, and so on.

As the measure which in this work is called a Septem, is the *thousandth part* of a Decigallon, it follows, that, with a pipette graduated into Septems, the $\frac{1}{1000}$ part of an atom of any chemical substance contained in a solution of 1°, or any number of $\frac{1}{1000}$ parts, can be readily measured off. In like manner, Equivalent Quantities of any two liquors susceptible of double decomposition, can be measured off for effecting such a decomposition. Thus, 10 Septems of Chloride of Barium of 5°, will decompose 5 Septems of Sulphate of Sodium of 10°. Consequently, test liquors prepared on this plan, can not only be used for all the processes of quantitative analysis, but serve also, to a certain extent, for quantitative experiments. They are also adapted to ensure the Lecturer against the pain of occasionally failing in the performance of Class Experiments, in consequence of his not knowing the strength of the solutions he has occasion to mix together to produce a desired effect. Indeed, the conveniences that must result from the use of test solutions of *systematic degrees of strength* are so obvious, that chemists would, no doubt, have long ago been accustomed to use them, but for the circumstance, that the arrangement cannot be successfully extended to the entire series of chemical reagents. With some reagents it is difficult and troublesome to *ascertain* the degree of strength of the solutions; with others it is yet more difficult to *preserve* the solutions in an *unaltered* condition. The *reagents* which decompose in water, either cold, or during changes of temperature, and those which rapidly absorb oxygen or carbonic acid from the atmosphere, cannot possibly be the subjects of successful commercial dispensation in the form of accurate test solutions. Every chemist who wishes to use such changeable tests in a state of absolute purity must himself prepare the solutions when he wants them for instant use. But the circumstance, that these changeable compounds cannot be kept in a pure state, nor of fixed strength, need not prevent the systematic use of other reagents to which objections of the same kind do not apply. I therefore venture to recommend this subject to the consideration of chemists, although it is thus encumbered with difficulties. This much will be gained at any rate; the unchangeable test liquors will be more useful than hitherto, while those that are changeable will be no worse than they always were.

I must add a caution on another point. Although these test solutions are VOLUMETRIC, they must not be confounded with the solutions that are expressly prepared for volumetric analysis, and which are described in the next section of this work. In both cases, indeed, the strength expressed in degrees is quoted in the description of each particular test solution; but the solutions of chemicals now under consideration are *strong* solutions, some of them nearly or quite *saturated*, while the solutions for volumetric analysis are all made *very dilute*. I may add further, that the chemical strength of these strong test solutions is not adjusted with the same exactness as that of the dilute solutions for Volumetric analysis. In the latter case, great accuracy is indispensable, and only such liquors are used as can be graduated with precision. In the former case, such exactness is in some instances unnecessary; in many cases it is not attainable; and in other cases, it is not so desirable as to warrant the great expense that would be incurred in effecting it.

For the sake of convenience in Analysis, bottles to contain Acids and Alkalies are put into the following series; but as such liquids cannot be sent by Railway, or by Ship, without being " DECLARED,*" they require to be packed in a separate Case for travelling.* See Article ACIDS in the General List of Chemicals.

2446. The Test Solutions are supplied at the prices quoted in the columns marked B in the following table, in narrow-mouthed white hard German glass stoppered bottles, of the form and superior quality described at No. 1551 in this work. The bottles have printed labels, stating the particulars that are given in this table.



1551. 1550.

If the Test Solutions are supplied in bottles of the form and quality described at No. 1550 in this work, the prices are reduced to the terms stated in the columns marked A. These bottles are not so elegant as those of class B, nor are they so carefully stoppered. If the Tests are required for travelling cabinets, those of class B are much to be preferred to those of class A. But the latter are quite sufficient for ordinary laboratory use.

No.	Name of the Reagent.	Symbol.	Atomic Weight.	Atoms in 1000 Septems.	Grains in 1 Septem.
2447	Acetic Acid	$H,C^2H^3O^2$	60	40	2·4
2448	Alcohol, Sp. gr. 805	H,C^2H^5O	46		
2449	Ammonium, Carbonate	NH^4,NH^4,CO^3	96	15	1·44
2450	Ammonia	NH^3	17	40	·68
2451	Ammonium, Chloride	NH^4,Cl	53·5	20	1·07
2452	Ammonium, Molybdate	NH^4,MoO^2	98	2	·196
2453	Ammonium, Oxalate	NH^4,CO^2	62	4	·248
2454	Ammonium, Sulphide	NH^4,S	34	10	·34
2461	Barium, Acetate	$Ba,C^2H^3O^2$	127·5	4	·51
2462	Barium, Chloride	BaCl	104	5	·52
2463	Barium, Hydrate	BaHO	85·5	2	·171
2464	Barium, Nitrate	$BaNO^3$	130·5	3	·3915
2470	Calcium, Chloride	CaCl	55·5	20	1·11
2471	Calcium, Hydrate	CaHO	37	·4	·0148
2472	Calcium, Nitrate	$CaNO^3$	82	10	·82
2473	Calcium, Sulphate	$CaSO^2$	68	·25	·017
2475	Chlorine Water, *saturated*	Cl			
2476	Cobalt, Nitrate	$CoNO^3$	91·5	5	·4575
2477	Copper, Sulphate	$CucSO^2$	79·75	5	·399
2483	Ether, Sulphuric	C^2H^5,C^2H^5O	74		
2491	Gold, Terchloride	AucCl	101	3	·303
2496	Hydrochloric Acid	HCl	36·5	50	1·825
2497	Hydrofluosilicic Acid	HSi^2F^3	72	3	·216
2498	Hydrosulphuric Acid	HS	17	2	·034
2499	Ferric Chloride	FecCl	54·16	10	·5416
2500	Ferric Sulphate	$FecSO^2$	66·66	10	·6666
2501	Ferrous Sulphate	$FeSO^2$	76	10	·76
2505	Indigo, Sulphate				
2510	Lead, Acetate	$Pb,C^2H^3O^2$	162·5	4	·65
2511	Lead, Nitrate	$PbNO^3$	165·5	4	·662
2514	Magnesium, Sulphate	$MgSO^2$	60	5	·3

Contents of the Bottles in Fluid Ounces.

No.	2 oz.				3 oz.				4 oz.				6 oz.				10 oz.				20 oz.			
	A		B		A		B		A		B		A		B		A		B		A		B	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
2447	1	0	1	3	1	1	1	7	1	4	2	0	1	9	2	4	2	9	3	5	5	0	5	8
2448	1	1	1	6	1	5	1	11	1	10	2	4	2	6	3	1	4	0	4	8	7	6	8	2
2449		7	1	0		8	1	2		10	1	4	1	0	1	7	1	6	2	1	2	6	3	2
2450		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
2451		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
2452		7	1	0		8	1	2		10	1	4	1	0	1	7	1	6	2	1	2	6	3	2
2453		8	1	1		10	1	4	1	0	1	6	1	3	1	10	1	10	2	6	3	4	4	0
2454		10	1	3	1	1	1	7	1	4	2	0	1	9	2	4	2	9	3	5	5	0	5	8
2461		9	1	2		11	1	5	1	2	1	8	1	6	2	1	2	4	3	0	4	2	4	10
2462		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
2463		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
2464		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
2470		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
2471		6		11		6	1	0		7	1	2		8	1	3	1	0	1	7	1	3	1	11
2472		8	1	1		10	1	4	1	0	1	6	1	3	1	10	1	11	2	6	3	4	4	0
2473		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
2475		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
2476	1	9	2	2	2	5	2	11	3	2	3	9	4	6	5	1	7	0	7	8	12	6	13	2
2477		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
2483	1	3	1	8	1	8	2	2	2	2	2	9	3	0	3	7	4	9	5	5	9	4	10	0
2491	8	5	8	10	12	5	13	0	16	6	17	0	24	0	24	6	40	0	40	8	80	0	80	8
2496		7	1	0		8	1	2		10	1	4	1	0	1	7	1	6	2	2	2	6	3	2
2497		10	1	3	1	1	1	7	1	4	2	0	1	9	2	4	2	9	3	5	5	0	5	8
2498		7	1	0		8	1	2		10	1	4	1	0	1	7	1	6	2	2	2	6	3	2
2499		8	1	1		9	1	3		11	1	5	1	2	1	9	1	8	2	4	2	11	3	7
2500		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
2501		7	1	0		8	1	1		9	1	3		11	1	6	1	3	1	11	2	1	2	9
2505		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
2510		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
2511		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
2514		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
	A		B		A		B		A		B		A		B		A		B		A		B	

No.	Name of the Reagent.	Symbol.	Atomic Weight.	Atoms in 1000 Septems.	Grains in 1 Septem.
2516	Mercuric Chloride	HgcCl	135·5	3	·4065
2517	Mercurous Nitrate	$HgNO^3$	262	1	·262
2518	Mercuric Potassio-Iodide	KI,HgcI	393	1	·393
2522	Nitric Acid	HNO^3	63	30	1·89
2523	Oxalic Acid	HCO^2	45	10	·45
2527	Platinic Chloride	PtcCl	85	5	·425
2529	Potassium, Bicarbonate	$KHCO^3$	100	10	1·1
2530	Potassium, Carbonate	K^2CO^3	138	10	1·38
2531	Potassium, Bichromate	$2KCrO^3 + Cr^2O^3$	295	2	·59
2532	Potassium, Chromate	$KCrO^2$	97·25	5	·49
2533	Potassium, Cyanide	KCN	65	10	·65
2534	Potassium, Ferridcyanide	KCy,FecCy	109·66	6	·658
2535	Potassium, Ferrocyanide	K^2FeCy^3	184	3	·552
2536	Potassium, Hydrate	KHO	56	20	1·12
2537	Potassium, Iodide	KI	166	5	·83
2539	Potassium Sulphate	KSO^2	87	5	·435
2540	Potassium, Sulphocyanide	K,CN,S^2	97	5	·485
2550	Silver, Nitrate	$AgNO^3$	170	2	·34
2555	Sodium, Acetate	$Na,C^2H^3O^2$	82	5	·41
2557	Sodium, Bitartrate	$NaC^2H^2O^3 + H,C^2H^2O^3$	172	4	·688
2558	Sodium, Carbonate	Na^2CO^3	106	10	1·06
2559	Sodium, Chloride	NaCl	58·5	10	·585
2560	Sodium, Hydrate	NaHO	40	20	·8
2561	Sodium, Phosphate	Na^2H,PO^4	142	2	·284
2562	Sodium, Sulphate	$NaSO^2$	71	10	·71
2563	Sodium, Sulphide	NaS	39	5	·195
2571	Sulphuric Acid	HSO^2	49	50	2·45
2572	Sulphuric Acid, *concentrated*	HSO^2	49	263	12·8
2576	Stannous Chloride	SnCl	94·5	5	·4725
2577	Starch (*permanent solution*)	InCaCl + NaCl	...	...	...

Contents of the Bottles in Fluid Ounces.

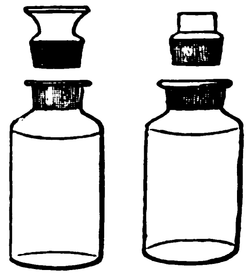
No.	2 oz.				3 oz.				4 oz.				6 oz.				10 oz.				20 oz.			
	A		B		A		B		A		B		A		B		A		B		A		B	
	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
2516		8	1	1		10	1	4	1	0	1	6	1	3	1	10	1	11	2	6	3	4	4	0
2517		7	1	0		8	1	2		10	1	4	1	0	1	7	1	6	2	1	2	6	3	2
2518		11	1	4	1	2	1	8	1	6	2	0	2	0	2	7	3	2	3	9	5	10	6	6
2522		8	1	1		10	1	4	1	0	1	6	1	3	1	10	1	11	2	6	3	4	4	0
2523		7	1	0		8	1	2		10	1	4	1	0	1	7	1	6	2	1	2	6	3	2
2527	6	5	6	10	9	5	9	11	12	6	13	0	18	6	19	1	30	8	31	4	61	0	61	8
2529		7	1	0		8	1	2		10	1	4	1	0	1	7	1	6	2	1	2	6	3	2
2530		9	1	2		11	1	5	1	2	1	8	1	6	2	1	2	4	2	11	4	2	4	10
2531		7	1	0		8	1	2		10	1	4	1	0	1	7	1	6	2	1	2	6	3	2
2532		7	1	0		8	1	2		10	1	4	1	0	1	7	1	6	2	1	2	6	3	2
2533		11	1	4	1	2	1	8	1	6	2	0	2	0	2	7	3	2	3	9	5	10	6	6
2534		8	1	1		10	1	4	1	0	1	6	1	3	1	10	1	11	2	6	3	4	4	0
2535		7	1	0		8	1	2		10	1	4	1	0	1	7	1	6	2	1	2	6	3	2
2536		9	1	2		11	1	5	1	2	1	8	1	6	2	1	2	4	2	11	4	2	4	10
2537		11	1	4	1	2	1	8	1	6	2	0	2	0	2	7	3	2	3	9	5	10	6	6
2539		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
2540		8	1	1		9	1	3		11	1	6	1	2	1	9	1	8	2	4	2	11	3	7
2550	1	2	1	7	1	6	2	0	2	0	2	6	2	9	3	4	4	6	5	2	8	0	8	8
2555		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
2557		8	1	1		10	1	4	1	0	1	6	1	3	1	10	1	11	2	6	3	4	4	0
2558		6		11		8	1	2		10	1	5	1	0	1	7	1	6	2	2	2	4	3	0
2559		7		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
2560		8	1	1		10	1	4	1	0	1	6	1	3	1	10	1	11	2	6	3	4	4	0
2561		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
2562		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
2563		7	1	0		8	1	2		10	1	5	1	0	1	7	1	6	2	2	2	6	3	2
2571		7	1	0		8	1	2		10	1	4	1	0	1	7	1	6	2	2	2	6	3	2
2572		9	1	2		11	1	5	1	2	1	9	1	6	2	1	2	4	3	0	4	0	4	8
2576		8	1	1		9	1	3		11	1	6	1	2	1	9	1	8	2	4	2	11	3	7
2577		6		11		7	1	1		8	1	2		9	1	4	1	1	1	8	1	8	2	4
	A		B		A		B		A		B		A		B		A		B		A		B	

TESTS TO BE KEPT IN THE DRY STATE.

2600. These Tests consist of substances which require to be used in the solid form, or of those the solutions of which undergo spontaneous decomposition, or which attack the bottles or fix the stoppers. They also include materials for the production of the Gases that are used in Analysis.

The Reagents are packed in wide-mouthed German white glass stoppered bottles of the capacity of 2, 6, 10, and 20 fluid ounces. The bottles are filled. There are two kinds of bottles. Those marked B are of the fine quality and good form described at No. 1577. Those marked A are of the form and quality described at No. 1576. Both correspond with the narrow-mouthed Solution bottles described at No. 2446.

The PRICES *include the Cost of the* BOTTLES.



1577. 1576.

No.	TESTS	2 ounce.				6 ounce.				10 ounce.			
		A		B		A		B		A		B	
		s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
2602	Ammonium, Sesquicarbonate		10	1	2	1	7	2	0	2	1	2	8
2603	Ammonium, Nitrate, cryst.	1	0	1	4	2	0	2	5	3	3	3	10
2604	Barium, Acetate, cryst.	2	0	2	4	4	2	4	7	6	6	7	1
2606	Barium, Carbonate, pasty	1	11	2	3	3	11	4	4	6	0	6	7
2607	Barium, Hydrate, cryst.	2	0	2	4	4	2	4	7	6	6	7	1
2610	Calcium, Fluoride		10	1	2	1	2	1	7	1	5	2	0
2611	Copper, precipitated												
2612	Gall Nuts in powder		9	1	1	1	4	1	9	1	10	2	5
2613	Ferrous Sulphate, cryst., granul.	1	1	1	5	2	1	2	6	3	0	3	7
2615	Lime, Chloride		8	1	0	1	0	1	5	1	3	1	10
2616	Litmus	1	1	1	5	2	0	2	5	2	8	3	3
2617	Oxalic Acid, cryst.	1	4	1	8	2	8	3	1	2	9	3	4
2619	Potassium, Hydrate, partially purified	1	2	1	6	2	5	2	10	3	6	4	1
2620	——— by Alcohol, nearly pure	2	0	2	4	4	6	4	11	7	1	7	8
2621	Potassium, Red Chromate	1	8	2	0	3	4	3	9	5	1	5	8
2625	Sodium, Hydrate, partially purified	1	2	1	6	2	5	2	10	3	6	4	1
2626	——— by Alcohol, nearly pure	2	0	2	4	4	6	4	11	7	1	7	8
2627	Sodium, Chloride		11	1	3	1	9	2	2	2	5	3	0
2628	Sodium, Nitrate		9	1	1	1	4	1	9	1	9	2	4
2629	Sodium, Sulphide	1	8	2	0	3	6	3	11	5	6	6	1
2631	Tartaric Acid, cryst.	1	7	1	11	3	3	3	8	5	0	5	7
2632	Tin, Protochloride, cryst.	1	6	1	10	3	1	3	6	4	10	5	5
2633	Zinc, pure in rods	2	6	2	10	4	6	4	11	7	1	7	8
2636	Flux for Silicates, $KNaCO^3$	1	7	1	11	3	3	3	8	5	0	5	7

Substances for Preparing Gases.

No.		6 ounce.				10 ounce.				20 ounce.			
		A		B		A		B		A		B	
		s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
2640	Iron, Sulphide. For HS	1	2	1	7	1	7	2	2	2	8	3	3
2641	Manganese, Peroxide. For Cl		11	1	4	1	1	1	8	1	8	2	3
2642	Potassium, Chlorate. For O	1	9	2	2	2	1	2	8	3	8	4	3
2643	Zinc, granulated. For H	1	0	1	5	1	4	1	11	2	0	2	7
2644	Carrara Marble. For CO^2	1	3	1	8	2	0	2	7	3	3	3	10
2645	Fluor Spar. For HF	1	2	1	7	1	5	2	0	2	0	2	7

Test Papers. See No. 2423.
Test Metals. See No. 2436.

Blowpipe Reagents.

No.		2 ounce.				6 ounce.				10 ounce.			
		A		B		A		B		A		B	
		s.	d.	s.	d.	s.	d.	s.	d.	s.	d.	s.	d.
2650	Borax		11	1	3	1	8	2	1	2	3	2	10
2651	Microcosmic Salt	1	6	1	10	3	1	3	6	4	7	5	2
2652	Sodium, Carbonate		10	1	2	1	6	1	11	2	1	2	8
2653	Potassium, Cyanide	1	10	2	2	3	9	4	2	5	10	6	5
2476	Cobalt, Nitrate, *solution*	1	9	2	2	4	6	5	1	7	0	7	8
2655	Potassium, Bisulphate	1	1	1	5	2	0	2	5	2	11	3	6
2656	Potassium, Nitrate	1	0	1	4	1	9	2	2	2	7	3	2
2658	Boracic Acid, fused	1	9	2	1	3	7	4	0	5	7	6	2
2659	Gypsum, crystallised	1	9	2	1	3	7	4	0	5	7	6	2

Collections *of* Chemical Tests *contained in* Portable Cabinets. *For Particulars refer to the Section on* Chemical Cabinets.

In ordering Reagents from the preceding Lists, it is only necessary to specify the No. and the size of the bottle desired.

Volumetric Analysis.

Those who wish to study the general principles of Volumetric Analysis, or to become acquainted with the special rules for the practice of that art, will necessarily refer to works that treat expressly on those subjects. Among such works, I may mention MOHR'S *Lehrbuch der Titrirmethode*, 1862; SUTTON'S *Handbook of Volumetric Analysis*, 1863; FRESENIUS *on Quantitative Chemical Analysis*, 1860, or the later German edition of that work; and, finally, the Tenth edition of GRIFFIN'S *Chemical Recreations*.

I propose in this work merely to refer to a number of practical points; such as the varieties and relative merits of the necessary apparatus, the way to handle it so as to ensure the best results, the composition of the principal Test solutions, with short notices of the purposes to which they are to be applied; and an account of the weights, measures, and methods of reckoning employed in Volumetric Analysis. Where it can be done with brevity, I shall give instructions for performing the analytical operations; but I cannot enter fully into the long details which the explanation of certain processes demand, and I by no means propose to supersede the use of books written expressly to teach the art of Volumetric Analysis.

WEIGHTS AND MEASURES USED IN VOLUMETRIC ANALYSIS.

2675. Instruments for use in Volumetric Analysis are so graduated, that the unit of measurement is the thousandth part of the capacity of the vessel in which the Normal or Standard Test liquors are prepared. Each unit of measurement therefore contains the $\frac{1}{1000}$ part of the pure chemical substance that is dissolved in the standard measure to prepare any given test liquor.

At the present time, three different units of measurement are in use among English chemists :—

The first is the CENTIMETRE CUBE. When this unit is used, the test liquors are prepared in the LITRE, which contains 1000 Centimetre Cubes.

The second is the DECEM, or the measure of 10 English grains of water at 62° Fahr. For use with this measure, the test liquors are prepared in a vessel that contains 1000 DECEMS, or 10,000 grains of water.

The third unit is the SEPTEM, which contains 7 English grains of water at 62° Fahr. The test liquors to be used with this measure are prepared in a DECIGALLON, which contains 1000 Septems, and is the tenth part of an Imperial gallon, or has the capacity of 16 fluid ounces, or an avoirdupois pound of water. A Burette containing 100 Septems measures the hundredth part of the Imperial gallon.

In MOHR'S *Lehrbuch*, the unit adopted is the Centimetre Cube. In SUTTON'S *Handbook*, it is the Centimetre Cube, and subordinately the Decem. In GRIFFIN'S *Chemical Recreations*, and in many parts of the present work, it is the Septem.

RELATION OF THE KILOGRAMME TO THE BRITISH POUND, AND OF THE LITRE TO THE PINT.

2676. According to the Act of Parliament, passed in the year 1864, "*To render permissive the Use of the Metric System of Weights and Measures*," the Kilogram is said to be equivalent to 15432·3487 British Grains, and the Litre to be equivalent to 1·76077 British Pints.

As the number of grains in a pound is 7000, and the number of grains of water in a pint is 8750, we deduce thence the following equivalents:—

15432·3487 ÷ 7000 = 2·20462125 Imperial Pounds in a Kilogram.
1·76077 × 8750 = 15406·7375 Grains of water in a Litre.
15406·7375 ÷ 7000 = 2·2009625 Pounds of water in a Litre.

A Gramme (or Gram, as it is spelt in the Act of Parliament) is the 1000th part of a Kilogramme, and a Centimetre Cube is the 1000th part of a Litre. Consequently,—

A Gram weighs against brass	15·4323487 English Grains.
A Centimetre Cube contains of water	15·4067375 English Grains.
Difference =	0·0256112 English Grain.

The Schedule of comparative Weights and Measures which is attached to "*The Metric Weights and Measures Act*, 1864," contains no reference to temperature, or other conditional circumstances affecting the ascertainment of standards; but, as the English Standard Weights, to which the Kilogram is compared, are adjusted at 62° Fahr., and weighed in the open air against weights made of brass, while the French Standards are weighed in a vacuum, at the temperature of the maximum density of water, about 39·1° Fahr., these differences in the mode of establishing standards must be taken into consideration in all comparisons of French and English Weights and Measures. In France, a centimetre cube of water is said to weigh a gramme, but the centimetre cube of water, as now legalised in Britain, does not weigh a gramme: there is a difference of 0·0256112 English grain. Our Parliamentary Metrical system is built therefore on a false basis.

EASY CONVERSION OF FRENCH DECIMAL MEASURES INTO ENGLISH DECIMAL MEASURES.

2677. The English Gallon contains 10 pounds of water. The measure of one pound of water is a Decigallon. The grains of water in a Decigallon are 7000. If we take as a unit of measurement the bulk of 7 grains of water, and call it a *Septem*, we have in the Decigallon 1000 Septems; and, consequently, the relation of the Septem to the Decigallon is the same as that of the Centimetre Cube to the Litre.

2678. In order to avoid the trouble of making calculations with Decimals having many figures, I propose to consider the Kilogram as being equal to 2·2 lbs., and the Litre as equal to 2·2 Decigallons. The errors involved in this proposal are as follow:—The Kilogram is undervalued by 46 in 22046, equal to 1 in 480, or 32 grains by weight in the Kilogram. The Litre is undervalued by 1 in 2200, or 6¾ grains by measure in the Litre. The last error is one that, with ordinary measures, is scarcely capable of experimental detection; and even the former is of little practical importance; so that for technical and commercial purposes these equivalents may be safely adopted, in calculating the relations of the Metric and British weights and measures.

2679. SUGGESTED EQUIVALENTS OF METRIC AND BRITISH WEIGHTS AND MEASURES.

1 Gramme = 15·4 Grains.
1 Centimetre Cube = 2·2 Septems = 15·4 Grains of Water.
1 Kilogramme = 15400· Grains = 2·2 avoirdupois lbs.
1 Litre = 2200· Septems = 2·2 Decigallons.
1 Septem = ·454546 Centimetre Cube.
1 Decigallon = 454·546 Centimetre Cubes = 1 lb. of Water.
1 Gallon = 4545·46 Centimetre Cubes = 4·54546 Litres = 10 lbs. of Water.
1 Decem = ·649351 Centimetre Cube.
1 Fluid Drachm = 54·6875 Grains = 7·8125 Septems = 3·5511 Cent. Cubes.
1 Minim = ·91146 Grain of Water.

The Fluid Drachm and Minim, quantities which have these very awkward relations both to English and French standards, have been adopted by the compilers of the British Pharmacopœia of 1864

Relation of Normal Test Liquors to the Three Units of Measurement.

2680. I take oil of vitriol, or hydrated sulphuric acid, HSO^2, as an example. Its atomic weight is 49 :—

a. For a Litre, 49 grammes by weight of the acid are diluted with water to a Litre by measure.

b. For 1000 Decems, 49 × 10 = 490 grains of the acid by weight are diluted to 1000 Decems by measure.

c. For a Decigallon, or 1000 Septems, 49 × 7 = 343 grains of the acid by weight are diluted to a Decigallon by measure.

2681. These three liquors, so differently prepared, are identical in strength, provided the Gramme is made equivalent to 15·4 Grains, and the Centimetre Cube to 2·2 Septems. 1 Centimetre Cube of any one of the liquors then contains the $\frac{1}{1000}$ part of 49 Grammes of HSO^2; 1 Decem of each contains the $\frac{1}{1000}$ part of 490 Grains, and 1 Septem contains the $\frac{1}{1000}$ part of 343 Grains of the acid. The reason of this is, that

	1 Gramme per Litre	=	7 Grains per Decigallon	=	10 Grains per Decem.
Because,—	15·4 Grains in 15·400	=	7 Grains in 7000	=	10 Grains in 10000.

The same liquor could therefore be used in analysis, with Burettes graduated according to any of the three systems.

But, necessarily, if the Centimetre Cube is taken as equivalent to 15·4 grains of water by volume, while the brass gramme that is made use of is equivalent to 15·4323487 grains by weight, the test liquors made with materials weighed with such a gramme will be, as above noted, about one-fifth of a per cent., or 1 in 500, stronger than if made with grain weights. If a correction on this account is considered to be necessary, it is very easy to make it. Thus, to reduce gramme solutions to grain solutions, 500 volumes are to be diluted with water to 501 volumes. To strengthen grain solutions to gramme solutions, $\frac{1}{500}$ part by weight of the solid contents must be added to 501 volumes by measure.

Conversion of French Prescriptions into English.

2682. It is here assumed that the prescriptions refer to solid bodies weighed in grammes, and to liquids measured in Centimetre Cubes, and that the English weights are grains, and the measures Decems or Septems.

a. With Septem Measures.—For the liquids, use Septems instead of Centimetre Cubes. For the solids, multiply the grammes by 7, and weigh the products in grains.

b. This conversion gives the *ratios* of the substances correctly, but, to determine the *absolute quantities*, each product must be multiplied by 2·2. For approximate quantities, the figures expressing the ratios have merely to be doubled.

c. With Decem Measures.—For the liquids, use Decems instead of Centimetre Cubes. For the solids, multiply the grammes by 10, and weigh the products in grains. To find the absolute quantities, multiply each product by 1·54. For approximate quantities, take each product 1½ times.

Of course, these two calculations come to the same thing as the process of multiplying both the Grammes and the Centimetre Cubes of the original prescriptions directly with 15·4, signifying grains; but it often happens that only the ratios are required, the persons who use the Septem or Decem measures intending to use other absolute quantities.

By adopting the English Decimal system afforded by the Septem, the labour of rendering French prescriptions into English is much lessened. The following example will illustrate this point :—

Prescription from a French work on Photography.		Equivalent Quantities after 2682 *a*.	Absolute quantities after 2682 *b*.
Azotate d'argent	30 grammes.	210 grains.	462 grains.
Acide acétique	36 grammes.	252 grains.	554·4 grains.
Eau distillée	500 C C.	500 septems.	1100 septems.

Calculations.—$30 \times 7 = 210$, and $210 \times 2{\cdot}2 = 462$.
$36 \times 7 = 252$, and $252 \times 2{\cdot}2 = 554{\cdot}4$.
$500 \times 1 = 500$, and $500 \times 2{\cdot}2 = 1100$.

When exactness is demanded, $\frac{1}{500}$ part in volume is to be added to the liquid, making the above quantities 501 instead of 500 Septems, and 1102·2 instead of 1100 Septems.

In the British Pharmacopœia, the following equivalents are given to assist Apothecaries in translating prescriptions:—

1 pound = 453·5925 grammes.		1 pint = 0·567936 litres.
1 ounce = 28·3495 grammes.		1 fluid ounce = 0·028396 litres.
1 grain = 0·0648 grammes.		1 fluid drachm = 0·003549 litres.
		1 minim = 0·000059 litres.

If an attempt be made to translate the above simple prescription by means of these equivalents, the reckoning will be found to be much more complicated.

Choice of a Unit of Measurement for Graduated Test Solutions.

2683. Dr. Mohr recommends Normal *Volumetric Solutions* to be prepared by weighing an atomic weight of any chemical substance in grammes, and making with that quantity a solution that measures a Litre. This strength is, as I have shown, the same as that obtained by weighing 10 atoms in English grains, and making with that quantity a solution of 1000 Decems, or by making with 7 atoms in grains a solution measuring a Decigallon.

But solutions of that strength have been found to be, in the majority of cases, too strong for convenient use, and accordingly another series of solutions have been made, which have only one-tenth part of the strength of the Normal solutions, and these are called Deci-normal.

In English manufactories, where liquids are measured by the gallon, and solids weighed by the pound, neither the Centimetre Cube nor the Decem present the advantages that are offered by the Septem, by which the English weights and measures are readily thrown into a decimal system as perfect in theory and as convenient in practice as the French system. 1000 Septems make a Decigallon. The Decigallon of water weighs one Imperial pound, and is the tenth part of the Imperial gallon. Hence the results of analyses of small quantities of chemical products, measured in Septems, can be transferred to pounds and gallons with the greatest facility.

Normal volumetric solutions of the strength shown above would, on the septem standard, require 7 atoms of the chemical, weighed in grains, to be dissolved in a Decigallon of solution, and Deci-normal solutions would have to be made with $\frac{7}{10}$ atom in a Decigallon. These are not convenient numbers, and I prefer the following:—

In the great majority of cases, the strength obtained by one atom, weighed in grains and made into a Decigallon of solution at 62° F., is very convenient. The strength is equal to $\frac{10}{7}$ or about $1\frac{1}{2}$ time that of Mohr's Deci-normal solutions. It serves, therefore, for all the purposes for which those solutions are used, and also for most of the experiments for which the Normal solutions are commonly taken. And having one chemical atom in 1000 septems, or the $\frac{1}{1000}$ part of an atom in every septem, the strength of the solution is such as to render all calculations extremely easy.

When it is desirable to have still weaker solutions, half an atom per Decigallon can be taken; while for the cases where strong solutions are necessary, those made with 5 atoms per Decigallon will be found amply sufficient, and they afford easy calculations. I have given in the last edition of "Chemical Recreations" an account of some important volumetric solutions prepared on this scale; and many others will be noticed in the present work.

A little consideration of the foregoing particulars will show that the Septem standard, taken in relation to volumetric analysis, is quite as convenient as the Centimetre Cube; while in its character as an integral part of a decimal system of English weights and measures, it is greatly superior.

2683*a*. Empirical Test Solutions.—Independently of the test solutions that may be prepared on a systematic plan resting upon the atomic weights of the substance, or upon this or that unit of measurement, it is frequently, nay, commonly, demanded by manufacturers whose operations of Chemical Testing fall to be made by workmen, that the Test Solutions to be used shall be so prepared that the measures of the burette shall directly indicate percentages, not referring to atomic weights, but to 100 or other round number of grains of some given substance contained in the crude mixture that is subjected to analysis. A test solution prepared with this view is said to be *empirical*; that is to say, it is not in accordance with the scientific system observed by the philosophical chemist in his investigations. Every test liquor prepared for a technical purpose of this nature must be made to suit the special wants of the manufacturer, and accord with the graduation of the instruments that he is accustomed to make use of.

2683*b*. Choice of the Quantity of a Crude Substance that is to be taken for a Volumetric Analysis.—The quantity of any substance to be taken for analysis depends upon the kind of graduation employed, and the strength of the test solution. When Normal solutions and centimetre graduation are used, the quantity of substance to be taken is the $\frac{1}{10}$ part of an atom weighed in grammes, and for Deci-normal solution, the quantity to be taken is the $\frac{1}{100}$ part of an atom weighed in grammes; because, in these cases, the number of Centimetre Cubes of the test liquors that are required to complete the analyses indicate that so many *per cents.* of the pure chemicals are present in the crude substances that are submitted to analysis. In like manner, when Normal solutions and the Decem graduations are employed, the quantity of

substance to be taken is 1 atom weighed in grains, and for Deci-normal solutions it is the $\frac{1}{10}$ part of an atom weighed in grains. The reason of this is, that 100 Decems of normal solutions are equal to 1 atom of the pure chemical, so that 1 Decem indicates 1 per cent.

2683*c*. **When the Septem graduation is employed, the quantity of substance to be weighed out depends upon the strength of the test solutions that are to be used. When these are of 1°,—that is to say, when a Decigallon contains only 1 atom of the pure chemical weighed in grains,—then 100 Septems contain only the $\frac{1}{10}$ part of an atom of the pure chemical, and the $\frac{1}{10}$ part of an atom of crude substance weighed in grains is to be taken for analysis. But when the test liquors are of 5°, then 5 times as much crude substance must be taken, if it is desired that the Septems of test liquor used shall indicate *percentages* of the substance that is to be estimated.**

2683*d*. The choice of the quantity of crude substance to be taken for analysis depends, however, in all these cases, partly upon another consideration,—namely, that it is frequently necessary to repeat the volumetric testing of the same substance, or to subject the substance to a variety of tests. Thus, in the testing of crude soda, it is often necessary to determine,—1st, the total alkaline strength; 2ndly, the proportion due to caustic alkali, as distinguished from carbonated alkali; 3rdly, the percentage of sulphates; 4thly, that of chlorides; 5thly, that of sulphides or hyposulphites, &c. As separate weighings of the substance for all these operations would be troublesome, it is better to weigh out at once 10 times the proper quantity of substance, to dissolve this in a Normal measure (namely, a Litre, a flask of 1000 Decems, or a Decigallon), and by means of a pipette to take successive doses of $\frac{1}{10}$ part, or 100 measures, for the separate trials.

2683*e*. When empirical test solutions are employed, the quantity of crude substance to be taken depends entirely upon the arbitrary standard of the test solution. You prepare, for example, a test acid of such strength, that 100 Septems of it indicate 100 grains of pure carbonate of soda. In that case, you weigh out 100 grains of crude soda, and the test solution then indicates *percentages* of pure carbonate in the crude article. Or, on the principle explained above, and in order to have a better average, you dissolve ten hundred grains of the crude soda in a Decigallon of solution, and you take the $\frac{1}{10}$ part, or 100 Septems of the solution, for each Volumetric Analysis. In that manner, ten testings require only one weighing. This subject is further discussed at No. 2912.

2683*f*. Decimal Weights and Measures founded on the existing Imperial Standards.—We might have in Britain the advantages of a decimal system of weights and measures, without introducing the French system, and with comparatively little alteration of the Weights and Measures now in common use. The plan is, to abolish the Grain, and take as the basis of our decimal system a weight equal to 7 Imperial grains. Names would be required for this new unit, for the measure of water corresponding to that weight, and for the measure of water corresponding to a pound weight, which latter might be called a Pint. The following table shows the relations of such Decimal Weights and Measures:—

DECIMAL WEIGHTS AND MEASURES,

FOUNDED ON THE IMPERIAL GALLON AND THE AVOIRDUPOIS POUND.

Weights.					
Stone?	Pound.	Ounce.	Dram?	Grain?	Value in Imperial Grains.
Measures.					
Gallon.	Pint?	Gill?		Minim?	
1·	10·	100·	1000·	10000·	70000·
·1	1·	10·	100·	1000·	7000·
·01	·1	1·	10·	100·	700·
·001	·01	·1	1·	10·	70·
·0001	·001	·01	·1	1·	7·

1 Hundredweight = 10 Stones. 1 Ton = 10 Hundredweights.

The names used in the above table are subjects for consideration. One thing is clear, that it is expedient to have different names for weights and measures. But whether it is expedient to apply *old* names to *new* quantities, such as *pint* to a measure of $\frac{1}{10}$ gallon instead of $\frac{1}{8}$ gallon, and *grain* to a weight seven times as much as it now means, is doubtful. On the other hand, comes the fact, that it is difficult for the public to learn new names, especially long Greek-looking names; in preference to doing which, they would probably prefer to attach new meanings to old names. I exhibited a copy of this Table, with a set of illustrative brass weights, at the Great Exhibition of 1851. On that occasion, I proposed for the measure of the pound of water the term Decigallon; and for the proposed unit, equal in value to 7 grains, I proposed the terms Baro for the Weight, and Barim for the Measure. It has, I believe, been suggested by Sir John Herschell, that a suitable term for the unit of a system of weights would be Mil. In the event of the adoption of that term, the word Milim might be used to indicate the correspondent unit of liquid measurement.

Apart from the difficulties presented by nomenclature, which apply with equal force to the French-Greek names, this proposed *decimal* system offers as many conveniences as the French system. It is equally convenient for scientific calculations; and, retaining as its basis the Imperial Gallon and the Avoirdupois Pound, it presents no obstacles to the British Commercial public, either at home or in the Colonies and British Dependencies abroad.

APPARATUS FOR VOLUMETRIC ANALYSIS.

2684. The principal instruments required for Volumetric Analyses are the following:—

Measuring Flasks, used for the preparation of Normal Test Liquors, or for bringing determinate quantities of chemicals into a given volume of solution.

Graduated Test Mixers, for diluting solutions of chemicals from one known strength to another and weaker degree.

Burettes, or finely graduated Test Tubes, for measuring the test liquors used in each analysis.

Pipettes for measuring small quantities of solutions. These are of two kinds; such as deliver one fixed quantity of liquor, or such as, being tubular and graduated from end to end, measure various quantities.

Mixing Jars, in which the liquor to be assayed is mixed with the test liquor.

Miscellaneous Apparatus, comprehending Supports for the instruments, Test Papers, Stirrers, Filters, &c., to which may be added the articles required for special operations, Boiling Tubes, Evaporating Basins, Small Stills and Condensers, &c.

BURETTES AND BURETTE SUPPORTS.

2685. The chief Forms of the burette are those of Mohr, of which several modifications are shown by the figures on page 293; the syphon burette of Mohr, Figs. 2732 and 2733; Binks's burette, Fig. 2736; Gay Lussac's, Fig. 2740; and the old alkalimeter, Fig. 2746, made either with or without a stopper. Of these forms, the most generally useful is that of Mohr, Fig. 2688; but this form cannot be used with certain test solutions, such as that of permanganate of potash, which is decomposed by the vulcanised caoutchouc, by which the burette is closed at the lower end; and this difficulty has given rise to the construction of other forms of the burette, which will be described under the different heads.

2686. In Size, burettes differ greatly. The most common capacities contain 50 centimetre cubes, or nearly 770 grains of water; or 100 septems, equal to 700 grains of water; or 100 decems, equal to 1000 grains of water. But many other sizes are required for special operations; and latterly, burettes of small size have been much used, such as those containing 20 centimetre cubes divided into tenths, 25 to 50 septems divided into fifths, and the like. Whatever the capacity of the instrument, the length of the scale upon it ought not to exceed 15 or 16 inches, otherwise the instrument is inconvenient in use. When the burette is fixed in its stand, as represented by the figures on page 293, you ought to be able to read the line of 0° at the top of the scale, and the lowest number at the bottom, without being forced to climb on a stool, or to go down on your knees.

2687. The Graduation of the burette is usually into centimetre cubes, septems, or decems, or each of these units into halves, fifths, or tenths. It is frequently recommended, that the instrument should contain exactly 100 degrees or marks on the scale. But 100 measures is rarely necessary to be used in any analytical operation; while for technical assays it is often preferable to have a scale with another limit, namely, a less number of degrees than 100, and these divided into fifths or tenths, to permit of the ready determination of fractions. The facility for the exact reading of the scales on burettes that is afforded by the use of Erdmann's float, No. 2728, recommends the use of close graduation, which, with the assistance of delicate pipettes, makes it easy to perform analyses with much smaller quantities of solutions than were formerly used, when graduated instruments were made with little pretension to accuracy or convenience. There is, however, a limit to closeness of graduation; for if the lines are set closer than twenty to the inch, they are not easy to read. The reading of even millimetre scales, which are twenty-five to the inch, almost requires the use of a cathetometer (No. 2383), which is not a convenient adjunct to an alkalimeter.

2688. MOHR'S BURETTE, WITH PINCHCOCK, JET, AND CAOUTCHOUC TUBE. Fig. 2688, *a*, *c*, *d*, page 293.

Mohr's burette is represented by Fig. 2688. *a* is a cylindrical tube, which carries the graduated scale, 0° being at the top and 100° at the bottom. The tube is open at both ends; but the lower end is contracted, and is connected by a short flexible tube of vulcanised caoutchouc with a small glass jet *c*. Across the flexible tube is placed a pinchcock *d*, which closes the tube when left at rest, and opens it when the buttons at *d* are slightly pressed with the finger and thumb. It is easy either to let out a continuous stream of the test liquor, or to limit its passage to single drops. The burette is represented as suspended by a ring of cork or caoutchouc from the upper arm of the support *e b*. The lower arm *f b* serves principally to keep the burette in an upright position. The point *c* is fixed at such a height above the table as to allow free motion to the mixing jar *g*, which is placed below the jet, with the liquid that is to be tested. Various forms of the pinchcock are shown at Nos. 2715–21.

2688. MOHR'S BURETTE, WITH PINCHCOCK, CAOUTCHOUC TUBE, AND JET. Fig. 2688.

Graduated into Centimetre Cubes.

1.	10 CC. in	$\frac{1}{10}$	2s. 0d.
2.	25 ,,	$\frac{1}{2}$	2s. 0d.
3.	25 ,,	$\frac{1}{5}$	2s. 6d.
4.	25 ,,	$\frac{1}{10}$	3s. 0d.
5.	35 ,,	$\frac{1}{5}$	3s. 6d.
6.	35 ,,	$\frac{1}{10}$	4s. 0d.
7.	55 ,,	$\frac{1}{2}$	3s. 6d.
8.	55 ,,	$\frac{1}{5}$	4s. 6d.
9.	55 ,,	$\frac{1}{10}$	5s. 0d.
10.	60 ,,	$\frac{1}{10}$	5s. 0d.
11.	75 ,,	$\frac{1}{2}$	3s. 6d.
12.	75 ,,	$\frac{1}{5}$	5s. 0d.
13.	75 ,,	$\frac{1}{10}$	6s. 0d.
14.	100 ,,	$\frac{1}{1}$	4s. 0d.
15.	100 ,,	$\frac{1}{2}$	5s. 0d.
16.	100 ,,	$\frac{1}{5}$	6s. 0d.
17.	150 ,,	$\frac{1}{5}$	8s. 0d.
18.	200 ,,	$\frac{1}{1}$	5s. 0d.
19.	200 ,,	$\frac{1}{2}$	6s. 0d.

Graduated into Septems.

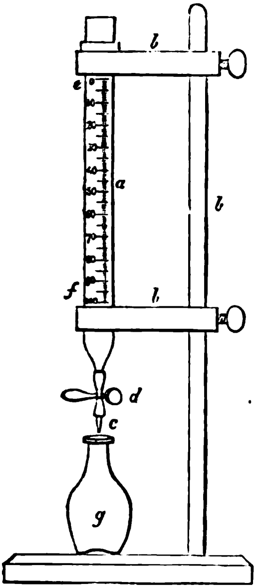
20.	10 Septems in	$\frac{1}{10}$	2s. 0d.
21.	25 ,,	$\frac{1}{5}$	2s. 6d.
22.	35 ,,	$\frac{1}{5}$	2s. 6d.
23.	35 ,,	$\frac{1}{10}$	3s. 0d.
24.	55 Septems in	$\frac{1}{1}$	2s. 6d.
25.	55 ,,	$\frac{1}{5}$	3s. 0d.
26.	55 ,,	$\frac{1}{10}$	4s. 0d.
27.	70 ,,	$\frac{1}{1}$	3s. 0d.
28.	70 ,,	$\frac{1}{2}$	3s. 6d.
29.	70 ,,	$\frac{1}{5}$	4s. 0d.
30.	100 ,,	$\frac{1}{1}$	4s. 0d.
31.	100 ,,	$\frac{1}{2}$	5s. 0d.
32.	100 ,,	$\frac{1}{5}$	6s. 0d.
33.	200 ,,	$\frac{1}{1}$	5s. 0d.

Graduated into Decems.

34.	10 Decems in	$\frac{1}{10}$	2s. 0d.
35.	25 ,,	$\frac{1}{5}$	2s. 3d.
36.	35 ,,	$\frac{1}{5}$	2s. 6d.
37.	35 ,,	$\frac{1}{10}$	3s. 0d.
38.	55 ,,	$\frac{1}{2}$	2s. 9d.
39.	55 ,,	$\frac{1}{5}$	3s. 0d.
40.	55 ,,	$\frac{1}{10}$	4s. 0d.
41.	70 ,,	$\frac{1}{2}$	3s. 6d.
42.	70 ,,	$\frac{1}{5}$	4s. 0d.
43.	100 ,,	$\frac{1}{1}$	4s. 0d.
44.	100 ,,	$\frac{1}{2}$	5s. 0d.
45.	100 ,,	$\frac{1}{5}$	6s. 0d.
46.	200 ,,	$\frac{1}{1}$	5s. 0d.

Special Graduations.—

47.	100 grains in	100°	marked 0 to 100	3s.
48.	1000 ,,	200°	,, 0 to 200	6s.
49.	100 minims in	100°		3s. 6d.
50.	200 ,,	200°		4s. 6d.



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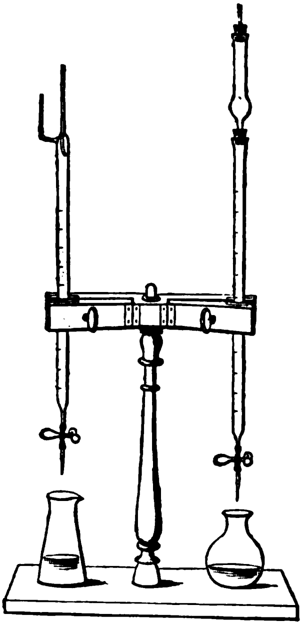

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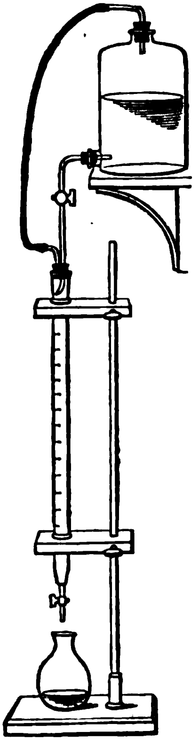

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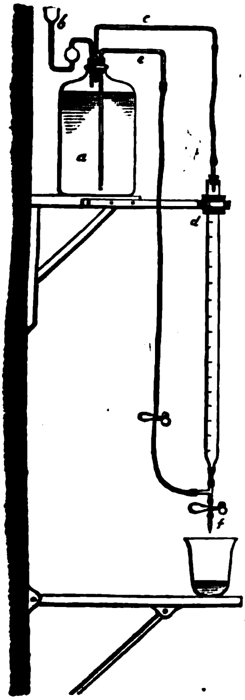

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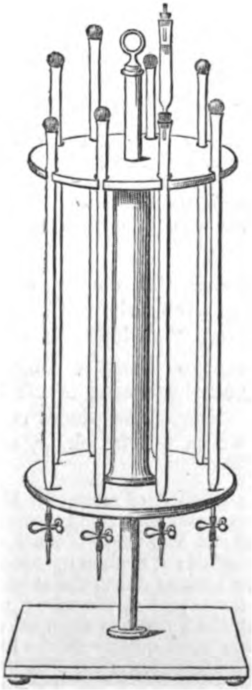
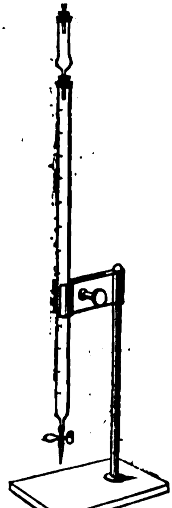


2709.



2708.

2689. **Mohr's Burette, with Glass Stopcock.** Fig. 2690, page 293.

When Mohr's burette requires to be used with a solution of permanganate of potash, or of iodine, or any other test which acts upon sulphur or caoutchouc, the flexible tube cannot be used, because it spoils the test. To meet this difficulty, burettes have been made with a glass stopcock, as represented in Fig. 2690. This apparatus, however, is not so convenient in use as the former kind, the stopcock being more difficult to manage than the pinchcock, and requiring great care to limit the delivery of the liquor to small drops.

Graduated into Centimetre Cubes.

1.	10 CC. in	$\frac{1}{10}$	3s. 0d.
2.	25 „	$\frac{1}{5}$	3s. 6d.
3.	25 „	$\frac{1}{10}$	4s. 0d.
4.	60 „	$\frac{1}{2}$	4s. 6d.
5.	60 „	$\frac{1}{5}$	5s. 0d.
6.	60 „	$\frac{1}{10}$	6s. 0d.
7.	75 „	$\frac{1}{2}$	5s. 0d.
8.	75 „	$\frac{1}{5}$	5s. 6d.
9.	100 „	$\frac{1}{2}$	5s. 6d.
10.	100 „	$\frac{1}{5}$	6s. 6d.
11.	200 „	$\frac{1}{1}$	5s. 6d.

Graduated into Septems.

12.	25 Septems in	$\frac{1}{5}$	3s. 0d.
13.	55 „	$\frac{1}{5}$	4s. 0d.
14.	100 „	$\frac{1}{1}$	5s. 0d.
15.	100 „	$\frac{1}{5}$	6s. 0d.

Graduated into Decems.

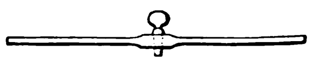
16.	50 Decems in	$\frac{1}{2}$	5s. 0d.
17.	100 „	$\frac{1}{1}$	6s. 0d.

2689a. Mohr's Burette is now sometimes made with the Stopcock projecting laterally near the bottom, and with a stopper and side tube for refilling it at the top. This form is now receiving much general attention. The prices are from 6d. to 3s. each higher than those quoted above.

2690. Mohr's Burette, with Glass Stopcock, and Apparatus for Supporting and Filling the Burette, and for preserving the test liquor. Fig. 2690, page 293, 25s.

This apparatus consists of a burette, with glass stopcock, and apparatus for supporting it, and for supplying the test solution without contact with flexible tubes. The flask which contains the test solution is of 8 pints capacity. It is connected with the burette by a glass tube, having a stopcock in the middle (see No. 2691). This tube is bent, as represented in Fig. 2690, in such a manner as to throw the test liquor against the inner side of the burette, and cause it to descend without producing froth. A flexible tube, that does not come into contact with the liquor, conveys air from the burette to the flask. To fill the burette, the lower stopcock is closed, and the upper one is opened. When it is full, the upper one is closed, and the lower one is used to regulate the outflow of the test liquor. The burette is thus easily filled without waste of the test liquor, and without unnecessary contact with atmospheric air. The flask that contains the test solution is provided with a bent safety funnel, like *b*, Fig. 2693, and mounted in the same way. This is not shown in Fig. 2690.

2691. Glass Tube, with Stopcock, for use in constructing apparatus of the character of 2690. The tube 12 inches long, Fig. 2691, 2s.



2691.

2692. **Arrangement for filling Mohr's Burette with Test Liquor from below**, to prevent the interference of air bubbles, as represented by Fig. 2693, page 293, consisting of the pieces represented in Fig. 2692, namely, the tee-piece *b*, one extra pinchcock, *g*, and two short caoutchouc tubes, *d* and *e*. The set, 1s. 6d.

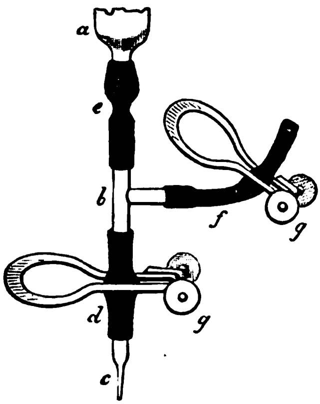
Fig. 2693, page 293, shows the method of mounting Mohr's Burette near a window, where it can be filled with test liquor in an easy and rapid manner. *d* is the burette; *f* the arrangement shown in detail by Fig. 2692; *a*, Fig. 2693, is the bottle of test liquor, placed on a high shelf; *b*, a funnel to permit access of air; *e*, syphon by which the liquor descends to the burette; *c*, tube by which air passes from the burette *d* into the bottle *a*. The burette is filled by opening the pinchcock placed on the caoutchouc part of the tube *e* in Fig. 2693, or *f*, Fig. 2692. When the test liquor is let off by the jet, the burette is supplied with air through the funnel tube *b* and the syphon *c*. The test liquor rises quietly in the burette without producing bubbles or foam, and without free contact with atmospheric air.

The burette can be supplied in this manner from a store bottle placed at a lower level, by means of the apparatus described at No. 2825.

Wooden Supports for Mohr's Burette, form of Fig. 2688, *b*, *b*, *b*, page 293. The burette is supported on the upper arm by a ring of cork or vulcanised caoutchouc. The lower arm serves to keep the burette steady, when the hand is applied to the pinchcock. *The following four varieties* :—

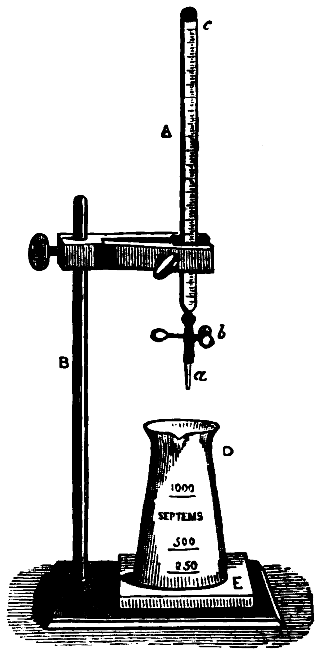
For One Burette.	For Two Burettes.
2694*a*. White Wood, 3s. 6d.	2695*a*. White Wood, 5s. 0d.
2694*b*. Mahogany, 5s. 0d.	2695*b*. Mahogany, 6s. 6d.

2697. **Wooden Clamp Support for Mohr's Burette**, with hinges and screws, which permit of the easy mounting or removal of the burettes, and their ready adjustment, higher or lower, to suit different sizes of



2692.

jars that are to be placed below them. The double support is represented by Fig. 2698, page 293, and the single support by Fig. 2697.



2697.

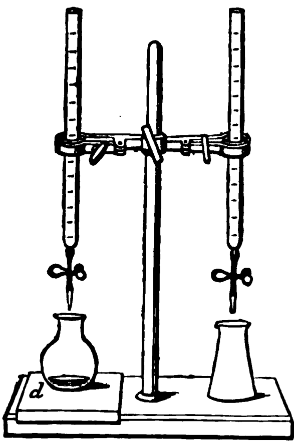
Wooden Screw Clamps for Mohr's Burette, Figs. 2697, 2698.

For One Burette.	For Two Burettes.
2697. Black Wood, 4s. 0d.	2698 Black Wood, 5s. 6d.
2697*a*. Mahogany, 5s. 6d.	2698*a*. Mahogany, 7s. 6d.

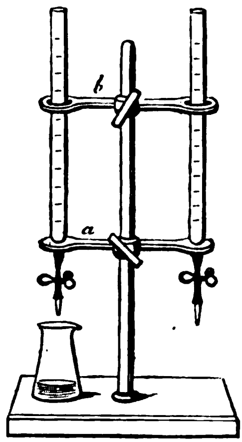
2700. **Iron Clamp Support for one Mohr's Burette**, consisting of an iron clamp lined with cork, and regulated by a screw, attached to a collar with thumbscrew, which slides upon an iron rod, 24 inches by ½ inch, rising from an iron base 7½ inches by 4½ inches. Similar to Fig. 2701, *but for only one burette*, 6s. 6d.

2701. **Iron Clamp Support for a Pair of Mohr's Burettes**, Fig. 2701. Similar to No. 2700, but the iron base 14 inches long, and 5½ inches wide; the rod 24 inches by ½ inch, with branches for two burettes, 10s. 6d.

The advantage of this form of support is, that the burette can be readily set up or taken down without removing the pinchcock, or can have its delivery jet easily fixed at any required distance from the table, to accommodate the size of the mixing jar that is to be used in any given operation. It is very handy when the burette requires to be frequently changed, or frequently washed, for use with a new solution.



2701.

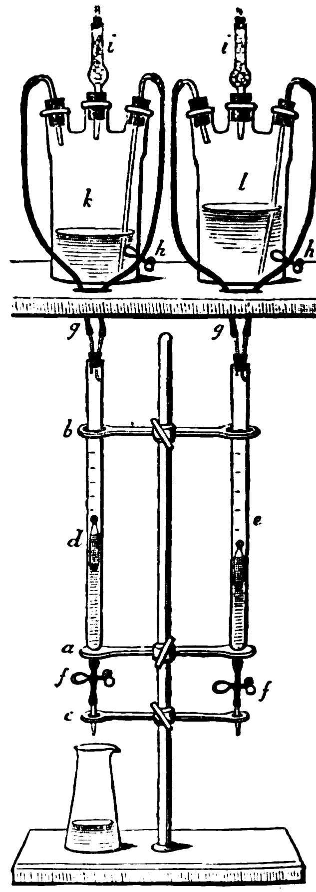


2703.

2702. Support for Mohr's Burette, form of Fig. 2703, *but for a single Burette;* consisting of an iron rod 24 inches by $\frac{3}{8}$ inch, fixed on an iron foot of $7\frac{1}{2}$ inches by $4\frac{1}{2}$ inches, with two brass branches; one of which, *a*, serves to support the burette, and the other, *b*, to keep it upright, 3s. 6d.

2703. Support for a Pair of Mohr's Burettes, constructed on the plan described at No. 2702, but for two burettes, as represented in Fig. 2703, iron foot 14 inches by $5\frac{1}{2}$ inches, iron rod 24 inches by $\frac{3}{8}$ inch, with two brass branches, 5s. 6d.

If the holes in the branches *a* and *b* are too large for a given burette, they can be reduced in aperture by twisting some cord round them. The apparatus, Fig. 2704, is similar to this, but has the additional branch *c*, to steady the jets.



2704.

2704. Support for a Pair of Mohr's Burettes, *with triple branches*, as represented by Fig. 2704. The iron rod measures 24 inches by $\frac{3}{8}$ inch; the iron base 14 inches by $5\frac{1}{2}$ inches; the three branches are of brass: the branch *a* supports the burettes; *b* keeps them upright; and *c* serves to prevent the twisting of the jets when the pinchcocks *f* are pressed. 6s. 6d.

2704a. The Figure 2704 represents a pair of burettes mounted on a support like No. 2704, and placed in connection with two reservoirs of test liquors, mounted on a shelf; the solution in the bottle *k*, for example, consisting of caustic potash, and that in *l* of sulphuric acid, both of the same strength. These bottles are supposed to be placed on a shelf near a window, before which the burette frame is fixed. By opening the stopcocks *h*, the burettes are filled, air passing from the burettes to the store bottles by the tubes *g*. When necessary, air goes into the bottles by the tubes *i i*, depositing its carbonic acid on the substances placed in those tubes (see No. 2823). The branch *c* keeps the delivering jets in proper position over the mixing jars when the pinchcocks *f f* are pressed.

This figure is given as an illustration of the method of mounting apparatus of this description for technical use. In a chemical manufactory many different bottles of tests may be necessary, and the size of the bottles and mode of supporting them must depend upon the requirements of the manufactory and the conveniences of the laboratory. In some places it may be necessary to place the bottles of test solutions *k* and *l* in a lock-up cupboard, tubes of glass and caoutchouc proceeding thence towards the burette stand. Generally speaking, the stock test liquors should be kept in the dark, and always as nearly as possible at the temperature of 62° Fahr. The narrow tubes which lead from the stock bottles to the burettes ought not to be needlessly exposed to sunshine.

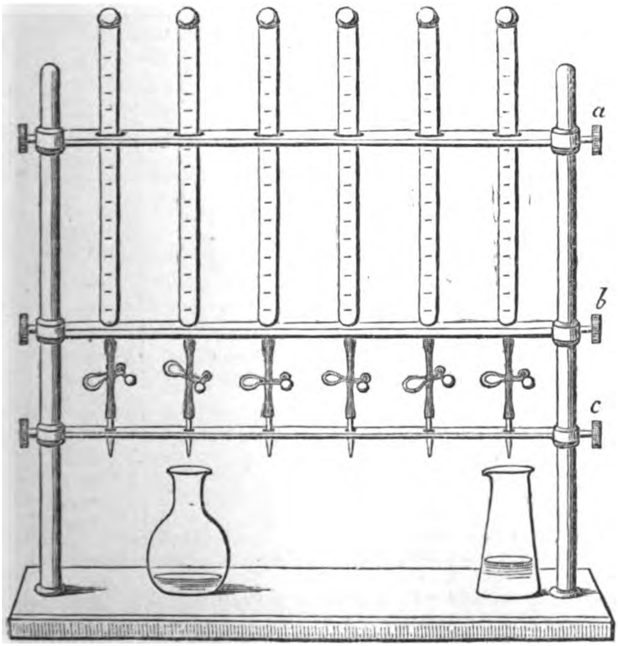
2705. Support for One Mohr's Burette, on the plan represented by Fig. 2704, with three branches. The iron base measures 7½ by 4½ inches; the iron rod 24 inches by ⅜ inch; the three branches of brass, 4s. 6d.

2706. Iron Support for Mohr's Burette, rectangular iron foot, 7½ by 4½ inches, iron rod, 26 inches by ⅜ inch, with two brass clips to hold the burette, 6s. 6d.

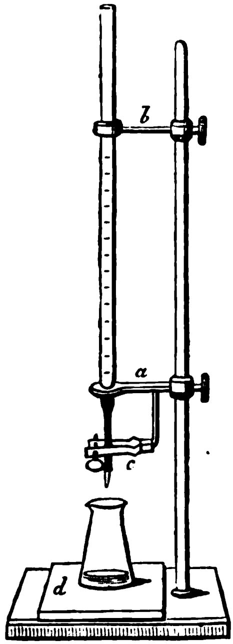
2707. Brass Support for Mohr's Burette, rectangular iron foot, 7½ by 4½ inches, 26-inch polished brass rod, with two strong brass clips to hold the burette, 8s.

2708. Support for Mohr's Burette, consisting of a broad brass clamp, sliding on an iron rod, which is fixed to a square iron base, 7¼ inches by 4 inches. Fig. 2708, page 293, 4s.

2709. Mohr's Revolving Support for Eight Burettes. Represented by Fig. 2709, page 293, excepting that the base is round, and 12 inches in diameter. The burettes are fixed at a suitable height from the base for convenient use, but there is a screw to adjust that height. The scales can be read without removing the burettes from the support. Polished Black Wood, 12s. 6d.



2710.



2711.

2710. Support for Six Burettes, to stand in a row before a window, with triple branches, as represented by Fig. 2710. The branch *b* serves to support the burettes, *a* to keep them upright, and *c* to steady the jets. Length of the base, 32½ inches; width, 6 inches. The upright rods are 24 inches long, and ½ inch in diameter. These and the base are made of iron. The three branches are made of gun-metal. The jets are fixed 3½ inches apart. The burettes being supported by the middle bar *b*, can be fixed at any required height above the base. Price 15s.

The burettes are represented in Fig. 2710 as closed at the upper end by stone marbles, as recommended by Mohr. It seems scarcely necessary to explain that the burettes can, if requisite, be easily connected with store bottles of test solutions by any of the methods shown by Figs. 2690, 2693, or 2704, the bottles being placed on a shelf, or, for safety, in a lock-up press.

2711. Mohr's Burette, mounted on a Support with Brass Arms according to Dr. Percy, for use in the Volumetric Analysis of Ores of Zinc, Copper, &c. Fig. 2711, 18s.

a. The Burette alone, 5s. | *b.* The Support alone, 12s.

The graduation of the burette is 1000 grains in 200° marked 0° to 200°. The support is an iron rod of 24 inches by ⅜ inch; an iron foot 7½ inches by 5¼ inches; two bronzed brass arms for holding the burette; and a special arm for the pinchcock, which is made with a screw, by which the issue of the test solution in single drops can be easily regulated. See Percy's *Metallurgy*.

Pinchcocks for Mohr's Burettes.

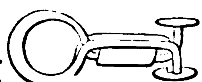
2715. Mohr's Pinchcock, the Original Form, *g*, Fig. 2692, page 295, the usual size for Burettes, namely, about twice the size of the figure, 6d.

2716. Ditto, small size, 6d.

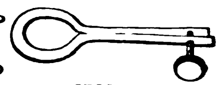
2717. Ditto, large size, 6d.

2718. Ditto, extra strong, for stout tubes, 1s.

2719. Pinchcock, form of Fig. 2719, having a plate to press on the tube, 6d.



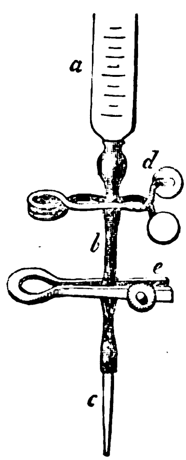
2719.



2720.

2720. Pinchcock with a screw, for producing a regular flow of uniform drops, Fig. 2720, 6d.

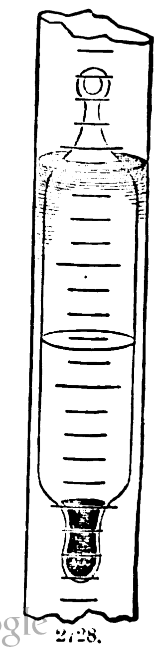
2721. This last pinchcock is fixed for use on a flexible tube *below* one of the other pinchcocks. It is adjusted, by means of the screw, to give drops of a required size. The other pinchcock serves to admit or to cut off the supply of liquor. This limits the supply to drops. The method of applying the two pinchcocks is shown by Fig. 2721. An apparatus of this sort is useful in the assay of silver coin, and in other cases, when drops of test of determined size and value are required to be given with absolute precision. The clamp *e* is screwed up to the requisite size, and then left open. The pinchcock *d* is only opened when the drops are wanted.



2721.

2728. Erdmann's Float, for facilitating the correct reading of the scale engraved on Mohr's Burette. Fig. 2728, 1s.

This float is represented by Fig. 2728, as floating in liquor in a burette. It ought to float upright, and not lean against the side of the burette. It is made about the size of the figure. It must be of such a width as nearly to fill the burette, but yet so loosely as to float freely up and down with the liquor. To set the instrument at zero (0°), the liquor, first filled a little above the mark, is to be run out of the burette until the ring that is cut round the float is brought to coincide with the line of 0° engraved on the burette. The absolute height of the liquor in the burette is to be disregarded. To read the measurable height of the liquor in the burette at any time, is to note that degree on the scale with which the line that is cut round the float coincides. When observing this coincidence, the circle round the float must appear to the eye like a straight line.



2728.

2729. **Rammelsberg's Burette**, a variety of Mohr's Burette; with the addition of a tube to bring the test liquor from its reservoir and deliver it against the inner side of the burette, so as to avoid frothing, and a second tube to carry away atmospheric air from the burette. Fig. 2698, page 293, *the burette on the left hand*, and B, Fig. 2730, with caoutchouc tube, pinchcock, and jet:—

1.	25 Centimetre Cubes	in	$\frac{1}{10}$ CC.	3s.
2.	55 ,,	,,	$\frac{1}{2}$	4s.
3.	55 ,,	,,	$\frac{1}{5}$	4s.
4.	75 ,,	,,	$\frac{1}{2}$	4s.
5.	75 ,,	,,	$\frac{1}{5}$	5s.
6.	100 ,,	,,	$\frac{1}{1}$	4s.
7.	100 Septems	in	$\frac{1}{1}$ S.	4s.
8.	100 Decems	in	$\frac{1}{1}$ D.	4s.

2730. **Mahogany Support** to fix Rammelsberg's Burette against a wall, or a window post, Gay-Lussac's pattern, as used for his silver test. Fig. 2730, *a*, *b*, *c*, 5s.

The method of mounting Rammelsberg's Burette, in connection with a reservoir of test liquor, is shown by Figs. 2690 and 2693, either of which plans may be adopted. In chemical manufactories, where the same volumetric test is to be applied frequently and every day, it is extremely convenient to have the burette always at hand and filled, ready for immediate use.

Rammelsberg's Burette being a close instrument, does not admit the use of Erdmann's float. In that respect, the instruments shown in Figs. 2690 and 2693 are preferable for delicate processes.

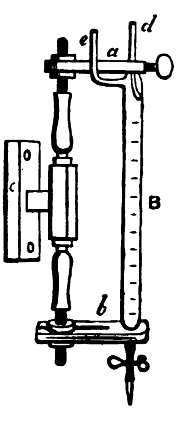
2731. **Mohr's Syphon Burette**, for use with permanganate of potash, two sorts: Fig. 2732, with blowing tube, and Fig. 2733, with caoutchouc ball for blowing.

The prices in the following list are for the Burette with one glass-blowing tube and two syphon jets, but without support and caoutchouc fittings:—

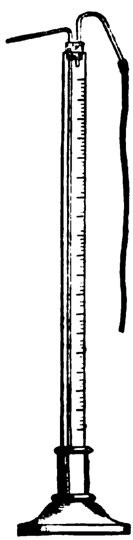
2732. The above with caoutchouc blowing tube, Fig. 2732, 6d. extra.

2733. The above, with caoutchouc blowing ball, Fig. 2733, 1s. extra.

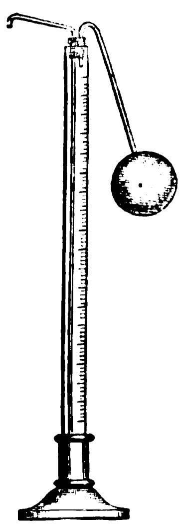
2734. Mahogany Foot for the Syphon Burette, as represented in the figures, loaded with lead, 1s. 6d.



2730.



2732.



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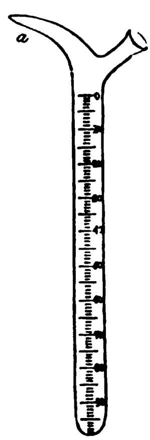


2736.

Graduated into Centimetre Cubes.

1.	25 cc.	in	$\frac{1}{5}$	cc.	2s. 0d.
2.	25	„	$\frac{1}{10}$	„	2s. 6d.
3.	35	„	$\frac{1}{5}$	„	2s. 6d.
4.	35	„	$\frac{1}{10}$	„	3s. 0d.
5.	55	„	$\frac{1}{2}$	„	3s. 0d.
6.	55	„	$\frac{1}{5}$	„	3s. 6d.
7.	55	„	$\frac{1}{10}$	„	4s. 0d.
8.	75	„	$\frac{1}{5}$	„	4s. 0d.
9.	100	„	$\frac{1}{1}$	„	3s. 0d.
10.	100	„	$\frac{1}{2}$	„	4s. 0d.
11.	100	„	$\frac{1}{5}$	„	6s. 0d.

Graduated into Septems.

12.	55 Septems in	$\frac{1}{5}$	3s.
13.	100 „	$\frac{1}{1}$	4s.
14.	100 „	$\frac{1}{5}$	5s.

Graduated into Decems.

15.	60 Decems in	$\frac{1}{2}$	3s.
16.	60 „	$\frac{1}{5}$	4s.
17.	100 „	$\frac{1}{1}$	5s.

2736. BINKS'S BURETTE, form of Fig. 2736.

This is not so convenient an instrument as Mohr's Burette, but it can be used with any kind of test, and is less fragile than the Syphon Burette, or than Gay-Lussac's Burette. The solutions are liable to run down outside the spout *a*, but can, in most cases, be prevented by applying a little stiff tallow to the spout, and boring through it a small hole with a needle. To manage this instrument properly, it must be held near the top, the thumb being placed above the scale. If it is held lower down, the delivery of single drops is difficult.

2736. BINKS'S BURETTE, Fig. 2736.

Graduated into Centimetre Cubes.

1.	10 cc.	in	$\frac{1}{2}$	1s. 9d.
2.	10	„	$\frac{1}{5}$	2s. 0d.
3.	10	„	$\frac{1}{10}$	2s. 6d.
4.	25	„	$\frac{1}{2}$	2s. 0d.
5.	25	„	$\frac{1}{5}$	2s. 6d.
6.	25	„	$\frac{1}{10}$	3s. 0d.
7.	35	„	$\frac{1}{5}$	3s. 0d.
8.	35	„	$\frac{1}{10}$	4s. 0d.
9.	50	„	$\frac{1}{2}$	3s. 0d.
10.	50	„	$\frac{1}{5}$	3s. 6d.
11.	50	„	$\frac{1}{10}$	4s. 0d.
12.	70	„	$\frac{1}{5}$	5s. 0d.
13.	100	„	$\frac{1}{1}$	4s. 0d.
14.	100	„	$\frac{1}{2}$	5s. 0d.
15.	100	„	$\frac{1}{5}$	6s. 0d.
16.	200	„	$\frac{1}{1}$	6s. 0d.

Graduated into Septems.

17.	25 Septems in	$\frac{1}{1}$	1s. 6d.
18.	25 „	$\frac{1}{5}$	1s. 9d.
19.	35 „	$\frac{1}{5}$	2s. 6d.
20.	55 Septems in	$\frac{1}{1}$	2s. 6d.
21.	55 „	$\frac{1}{5}$	3s. 6d.
22.	55 „	$\frac{1}{10}$	4s. 0d.
23.	70 „	$\frac{1}{1}$	2s. 6d.
24.	70 „	$\frac{1}{5}$	4s. 0d.
25.	100 „	$\frac{1}{1}$	3s. 6d.
26.	100 „	$\frac{1}{5}$	5s. 0d.

Graduated into Decems.

27.	50 Decems in	$\frac{1}{2}$	4s. 0d.
28.	50 „	$\frac{1}{5}$	4s. 6d.
29.	100 „	$\frac{1}{1}$	4s. 0d.
30.	100 „	$\frac{1}{2}$	5s. 0d.
31.	100 „	$\frac{1}{5}$	6s. 0d.

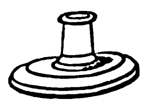
Special Graduations.

32.	16 Clark's Test Measures in $\frac{1}{5}$	3s. 0d.
33.	32 — Test Measures in $\frac{1}{5}$	2s. 6d.
34.	500 Grains in 250°	4s. 0d.
35.	1000 „ in 200°	5s. 0d.
36.	100° after Descroizilles,	4s. 0d.

The block and screen, No. 2743, described as being necessary to the correct reading of the height of liquid in Gay-Lussac's Burette, is equally necessary for use with Binks's Burette.

2737. FOOT FOR BINKS'S BURETTE, Fig. 2738, stained wood, small size, slight, 6d.

2738. FOOT FOR BINKS'S BURETTE, Fig. 2738, large size, mahogany, loaded with lead, 1s. 6d.



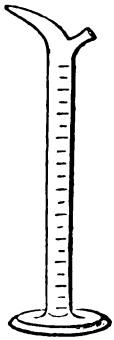
2738.

2739. **Binks's Burette with Foot, in one piece of Glass, stout, for the use of workmen :—**

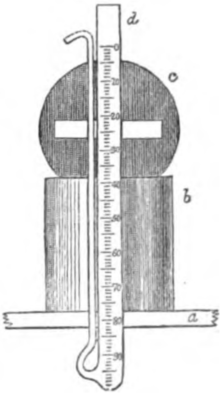
1. 100 Septems in $\frac{1}{1}$ 3s.
2. 100 Decems in $\frac{1}{1}$ 3s.
3. 50 Centimetre Cubes in $\frac{1}{2}$ 3s.
4. Burette for Testing Ammonia in Gas Liquors. 100 Septems in 16° each in $\frac{1}{5}$°. 4s.

Testing of Ammonia in Gas Liquor.—The instrument No. 4 is used at gas works to estimate the value of ammonia liquor, according to the number of ounces of oil of vitriol which saturate one gallon. The acid is formed by diluting with water 2 ounces by weight of oil of vitriol to a pint of test acid. 100 Septems of ammonia liquor being acted upon the number of degrees of test acid used to neutralise it according to the scale, shows the ounces of oil of vitriol per gallon. Blue litmus paper is used as the indicator. See No. 2807.

This method of testing indicates only the free ammonia. What is combined with an acid is not recognised. A more accurate process consists in mixing the gas liquor with milk of lime, distilling it in the apparatus No. 2867, receiving the ammonia in a flask containing water, and testing this distillate, which contains not only the free ammonia of the gas liquor, but that which is liberated by the lime.



2739.

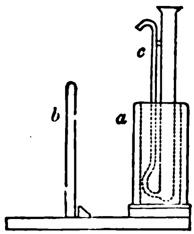


2740.

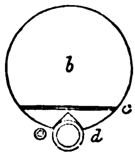
2740. **Gay-Lussac's Burette**, Fig. 2740*d*, consisting of a graduated tube, with an external tube and spout for decanting and dropping the test liquors.

This Burette, like that of Binks, can be used with test liquors of all descriptions, including the permanganate of potash. It is, however, less convenient than Mohr's form of Burette, and is easily broken. It can be used with a blowing-tube, adapted to the wide end by a cork in the same manner as the blowing-tube of Fig. 2732.

1.	20 Centimetre Cubes		in $\frac{1}{2}$	2s. 6d.
2.	20	„ „	in $\frac{1}{10}$	3s. 0d.
3.	50	„ „	in $\frac{1}{2}$	4s. 0d.
4.	50	„ „	in $\frac{1}{5}$	5s. 0d.
5.	50	„ „	in $\frac{1}{10}$	6s. 0d.
6.	100	„ „	in $\frac{1}{2}$	6s. 0d.
7.	200	„ „	in $\frac{1}{1}$	2s. 6d.
8.	50 Septems		in $\frac{1}{1}$	3s. 0d.
9.	100	„	in $\frac{1}{1}$	3s. 6d.
10.	50 Decems		in $\frac{1}{1}$	3s. 0d.
11.	100	„	in $\frac{1}{1}$	5s. 0d.



2741.



2743.

If fitted with a Caoutchouc Blowing Tube, each 6d. extra. If with a Ball, 1s. extra.

2741. **Black wood Support** for Gay-Lussac's Burette, having a space to hold it upright, and a peg on which it can drain, Fig. 2741, 2s.

2742. Round Support, form of Fig. 2738, having a slit cut out for the egress of the narrow tube, mahogany, 1s. 6d.

2743. **Block and Screen** for placing Gay-Lussac's Pouret in a vertical position, and to assist the correct reading of the level of the liquid in the tube *b c*, Figs. 2740 and 2743, 1s. 6d.

The block *b*, represented vertically in Fig. 2740, and horizontally in Fig. 2743, is placed upright on a table against a window. The screen *c*, which consists of tin-plate with a window of tissue paper, is fixed upright in a slit in the block. The Burette is held by the thumb in the triangular vertical slit of the block, at such a level as to bring the surface of the solutions level with the paper screen. The black curve, which shows the height of the liquor, can thus be seen distinctly.

2744. Japanned Tin Case for Gay-Lussac's Burette, 1s.

2746. ALKALIMETER ON FOOT, with a grooved stopper, to control the delivery of the Test Acid, form of Fig. 2746.

This form of instrument does not afford very accurate results, in consequence of the comparative clumsiness of the delivering spout; but the instrument is strong, and is commonly given to workmen for use where only approximate results are required.

Figs. 2746*a* and 2746*b* are forms of Alkalimeter which are now obsolete. They were made like 2746, but without stoppers, and when in use were closed by the *thumb*, from the end of which the test liquor was allowed to trickle. Such instruments are probably now in use only in those establishments where chemical operations of all kinds are performed by the Rule of Thumb, if any such establishments still happen to exist.

Graduation of Instruments of the form of Fig. 2746.

1.	100 Septems	in $\frac{1}{1}$ = 100°	3s.
2.	50 Centimetre Cubes	in $\frac{1}{2}$ = 100°	3s.
3.	100 " "	in 100°	3s.
4.	100 Decems	in $\frac{1}{1}$ = 100°	3s.
5.	2 Ounces of Water	in 100°	3s.

ALKALIMETERS for use with WEIGHED TEST LIQUORS. Two kinds, Schuster's and Mohr's, Figs. 2747 and 2748.

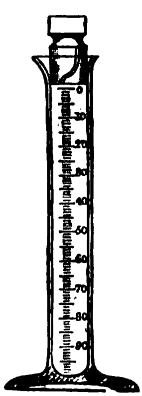
2747. SCHUSTER'S ALKALIMETER, Fig. 2747, 6d.

A very light stoppered glass bottle, of about 2 ounces capacity, in which the Normal Test Acid is weighed, then slowly dropped from a fine orifice until a given weight of Alkali is neutralised. The residual acid is again weighed, and the value of the Alkali is determined from the quantity of Acid used.

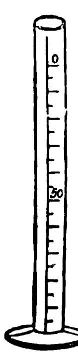
2748. MOHR'S ALKALIMETER, Fig. 2748, 10-ounce capacity, with syphon delivery tube, and Caoutchouc blowing ball, 2s. 6d.

2749. Tallow Holder, useful for greasing the mouths of burettes, 1s.

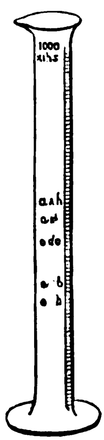
Some test liquors are apt to overflow the spouts of burettes, and the liquor escapes unreckoned, or it forms large and inconvenient drops. To prevent this source of error, the outside of the spouts should be rubbed with a little stiff tallow, and a small hole should be bored through the tallow with a fine needle. The escaping liquor then makes smaller drops, and generally loses the tendency to spread over the outside of the vessels.



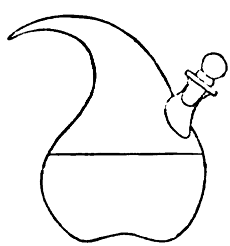
2746.



2746*a*.

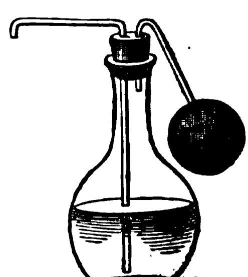


2746*b*.



2747.

2749.



2748

PIPETTES.

2760. Graduated pipettes are instruments for transferring specific quantities of liquors from vessel to vessel. They are of two kinds; first, those which have a bulb, either spherical or cylindrical, and *one mark* on the neck above the bulb, as is represented by Figs. 2768, *a*, *b*, *c*, *d*, *e*. These serve individually for the accurate measurement and delivery of one specific quantity of a liquid, such as 5, 10, or 100 Septems, or Decems, or Centimetre Cubes. The second kind of pipettes is represented by Figs. 2769, *a*, *b*, *c*, *d*. It consists of a narrow cylinder, or tube, *with a scale drawn upon it lengthwise*, like the scale of a burette. We may distinguish these two kinds of pipette by the names of BULB *Pipette* and SCALE *Pipette*. These pipettes serve for measuring various quantities of a liquid, commensurate with the capacity of the bulbs, or the degrees marked on the scales. The chief use of pipettes is to measure with precision that quantity of a solution which is to be subjected to volumetric analysis, or that dose of a graduated test liquo which is required for a specific operation. The proper construction and management of a pipette require a few observations. The lower opening, from which the liquor is to flow, ought not to be more than $\frac{1}{25}$ inch (= 1 millimetre) in diameter. The upper end, which is to be closed by a wet finger when in use, ought to be made narrow by melting and thickening the glass, and then be cut square across, and ground or fused flat, so that the finger can press upon it firmly. This contracted form is shown by the upper ends of Figs. 2768*c* and 2769*a*.

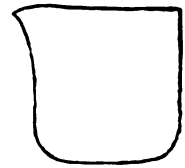
2761. *To Fill the Pipette.*—Wet the ball of the forefinger of the right hand, hold the pipette near the top by the thumb and middle finger of that hand, put the lower end of the pipette into the liquor that is to be used, apply the mouth to the upper end, and gently suck up the liquor into the pipette, carefully watching its rise, until you perceive it to be as high as you wish it; immediately upon which you remove your mouth, and instantly fix your forefinger firmly on the top of the pipette. During this process, you must take care that the point of the pipette remains always below the surface of the liquor, otherwise air enters the pipette, and may force the liquor up into your mouth,—an accident which, as these liquors are always unpleasant and sometimes poisonous, is to be avoided. An effectual preventive is, to begin the operation by dipping the point of the pipette sufficiently deep into the liquor, and holding it firmly there by the left hand, during the inspiration. In cases where poisonous solutions have to be transferred, the apparatus represented by Fig. 2770 may be used. The graduated tube *a* is then held by the left hand, the caoutchouc tube *b* is held by the right hand, and the point is put into your mouth; the eye is then placed opposite the point *a*, to which the liquor is to be made to rise, and when it is sucked up to that point, the flexible tube *b* is pinched to stop the farther rise of the liquor.

2672. *To Regulate the Pipette.*—The pipette being filled and held over the liquor from which it has been supplied, the pressure of the finger on the top is to be relaxed, and the liquor allowed to flow out slowly in drops, until the black curve at the surface of the water in the pipette exactly touches the line of 0°, or other desired degree. The pipette is then to be removed over the mixing jar, previously placed close at hand, and the contents to be delivered into it.

2763. *To Deliver the Contents of a Pipette.*—There are several methods of delivering the contents of a pipette. 1. The contents are allowed to run freely into the mixing jar without permitting the point of the pipette to touch the glass, and without your blowing out the last drop from the pipette. 2. After delivering the bulk of the liquor, the point of the pipette is made to touch the inside of the mixing jar, in order that capillary attraction may carry away the drop that adheres to the point of the pipette. 3. While holding the pipette as last described, you apply your mouth to the top of it and blow out the drop adhering at the point. This last is the safest method; but as instruments of this kind are not adjusted on the same plan by all manufacturers, it is necessary, for those who use the pipette, to try which of these methods answers best with a given pipette. 4. Another point to be noticed is, that different liquors have different degrees of adherence to the pipette, and do not run out of it in the same time. Every operator should, for these reasons, make himself acquainted with the actual *delivering power* of his pipettes. Among other proofs an important one is, to try whether his pipettes deliver quantities which agree with the graduations on his burette. For example, he may adjust the liquor in his burette to 50°, and then, with a pipette marking 10°, he may deliver successive doses of 10° from the pipette into the burette, and observe whether the liquor rises regularly in the burette, as it ought to do, to 60°, 70°, 80°, 90°, 100°.

2764. The first class of pipettes—namely, the pipettes to deliver *one quantity*—are made to deliver the true quantity, independently of what adheres to the inner surface of the pipette; but in general, the pipettes with long scales are so graduated as to show what they *contain*, and therefore they will *deliver* something less than the true quantity. When the pipettes are used for small quantities, and the lower opening is made so small as to cause slow delivery, this difference is not of much consequence. The operator, moreover, has it in his power, by trying his pipette against his burette, to determine what is the amount of loss by adhesion

2765. *Form of Pipettes.*—When pipettes are to be used to take normal test liquors from stock bottles, it is convenient to have them of a form that will enter the neck of the bottle and go nearly to the bottom. Such forms are represented by the Fig. 2768, *d* and *e*. But when the pipettes are for large quantities, this would sometimes cause them to be inconveniently long. In such a case, and also whenever the liquor to be measured is contained in an open vessel, pipettes of the form of Figs. 2768, *a*, *b*, *c*, may be used. When test liquors have to be poured from a narrow-necked bottle to be taken up by a broad pipette, the most convenient form of vessel to be used is a beaked tumbler, Fig. 2765. But it is very desirable to avoid this transferral of test liquors by having them in bottles into which the pipette can be dipped.

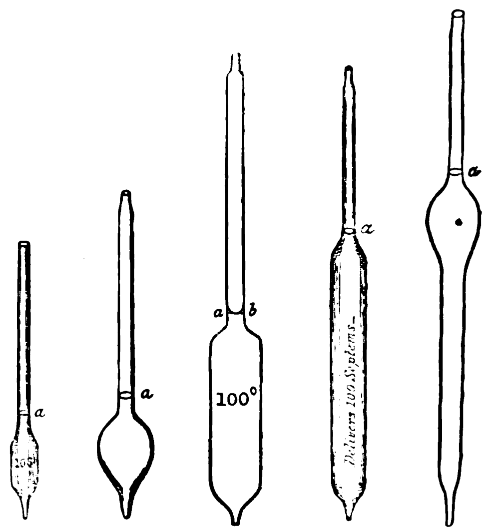


2765.

2766. *Rising and Descending Scales of Pipettes.*—The graduation of measuring pipettes is usually commenced at the bottom. Thus, Fig. 2769 *b* represents a pipette of Gay-Lussac's, adapted to deliver 1, 2, or 5 Centimetre Cubes. In imitation of this plan, Fig. 2769, *c* and *d*, are also graduated with 0° at the bottom. I do not approve of this method, because it is difficult to make such an instrument so accurately that the lowest and most important degree shall be correct. I prefer to make and use an instrument graduated like Fig. 2769 *a*, in which the degree 0 is at the top of the scale. With this pipette the liquor is sucked up to 0°, and then the required quantity is slowly dropped from it into the proper vessel. In order that the analyst may be able, during an inspiration, to watch the ascent of the liquor to the proper height, the degree of 0° should never be at less than 4 inches from the upper end of the tube. When a pipette is graduated close to the top like Fig. 2769 *c*, it should be used with a caoutchouc sucking tube, like that shown in Fig. 2770.

In reading the scales of pipettes, and indeed of all graduated instruments, you are to take, as the true indication, *the line that touches the lower part of the black curve* that is formed by the surface of the liquid, as represented by the line *a b* in Figs. 2768 *c* and 2780. The way to make the black curve most distinct has been explained at No. 2743.

2767. *Importance of the Pipette.*—I have given an extended description of the Pipette, because it is an instrument of great importance, holding the same rank in Volumetric Analysis that the **Balance** holds in Gravimetrical Analysis. It is that which sets out the quantity of material which is to be submitted to analysis, and it is therefore important that the instrument should be as correct as possible, and that the operator should understand the peculiarities upon which its accurate use depends. The more perfect the action of the Pipette, the smaller is the quantity of fluid that any analysis may be successfully made with; and, as a consequence, the smaller will be the quantity of test solutions required for the purpose, and the smaller and more delicately-graduated may be the Burette and all the other Volumetric Apparatus.



a. *b.* *c.* *d.* *e.*

2768.

2768. BULB PIPETTES, namely, Pipettes which have ONE MARK on the neck, Fig. 2768, *a*, *b*, *c*, *d*, *e*, and which serve to DELIVER ONE QUANTITY.

Graduated for Centimetre Cubes.

1.	1	cc.	4d.
2.	2	„	4d.
3.	5	„	6d.
4.	10	„	7d.
5.	15	„	8d.
6.	20	„	9d.
7.	25	„	10d.
8.	50	„	1s. 0d.
9.	75	„	1s. 3d.
10.	100	„	1s. 6d.
11.	150	„	1s. 9d.
12.	200	„	2s. 0d.
13.	250	„	2s. 6d.

Graduated for Septems.

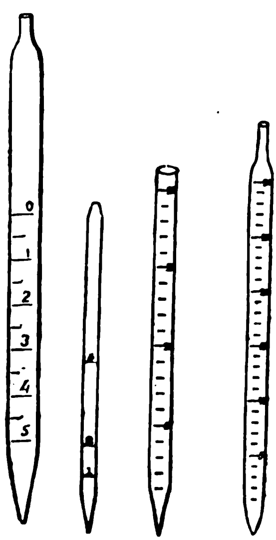
14.	1	Septem,	4d.
15.	2	„	4d.
16.	5	„	4d.
17.	10	„	7d.
18.	15	„	8d.
19.	20	„	9d.
20.	25	„	9d.
21.	50	„	1s. 0d.
22.	100	„	1s. 3d.
23.	200	„	1s. 9d.

Graduated for Decems.

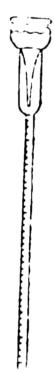
24.	1	Decem,	4d.
25.	2	„	4d.
26.	5	„	4d.
27.	10	„	8d.
28.	15	„	8d.
29.	20	„	9d.
30.	25	„	10d.
31.	50	„	1s. 2d.
32.	100	„	1s. 6d.

Graduated for Special Quantities.

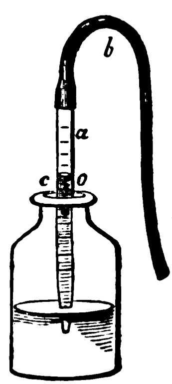
33.	1	Fluid Ounce,	10d.
34.	2	Fluid Ounces,	1s. 3d.
35.	1	Ounce Troy,	10d.
36.	1	Cubic Inch,	10d.
37.	2	Cubic Inches,	1s. 3d.
38.	100	Grains,	8d.
39.	500	Grains,	1s. 3d.
40.	1000	Grains,	1s. 6d.
41.	1	Fluid Drachm,	10d.
42.	8	Fluid Drachms,	1s. 0d.
43.	100	Test measures for Clark's Soap Test,	1s. 6d.
44.	100	Minims,	1s. 6d.



a. b. c. d.
2769.

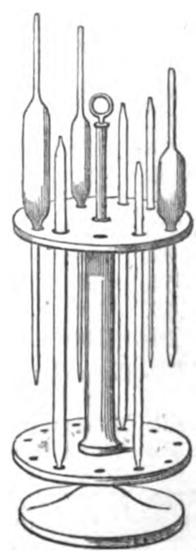


2776.



2770.

2772.



2775.

X

2769. SCALE PIPETTES, namely, Pipettes that are graduated from end to end, to afford the means of measuring ANY GIVEN QUANTITY within the Capacity of the instrument, Fig. 2769, *a*, *b*, *c*, *d*.

Graduated into Centimetre Cubes.

1.	1 CC.	in	$\frac{1}{10}$	9d.
2.	1	„	$\frac{1}{100}$	1s. 2d.
3.	2	„	$\frac{1}{5}$	9d.
4.	2	„	$\frac{1}{10}$	1s. 0d.
5.	5	„	$\frac{1}{2}$	1s. 0d.
6.	5	„	$\frac{1}{10}$	1s. 3d.
7.	10	„	$\frac{1}{2}$	1s. 4d.
8.	10	„	$\frac{1}{5}$	1s. 6d.
9.	10	„	$\frac{1}{10}$	1s. 9d.
10.	15	„	$\frac{1}{10}$	2s. 0d.
11.	20	„	$\frac{1}{5}$	1s. 9d.
12.	20	„	$\frac{1}{10}$	2s. 0d.
13.	25	„	$\frac{1}{2}$	1s. 9d.
14.	25	„	$\frac{1}{5}$	2s. 0d.
15.	25	„	$\frac{1}{10}$	2s. 6d.
16.	30	„	$\frac{1}{5}$	2s. 6d.
17.	50	„	$\frac{1}{1}$	2s. 6d.
18.	50	„	$\frac{1}{2}$	3s. 0d.
19.	50	„	$\frac{1}{5}$	3s. 6d.
20.	50	„	$\frac{1}{10}$	4s. 6d.
21.	100	„	$\frac{1}{1}$	4s. 0d.
22.	100	„	$\frac{1}{2}$	4s. 6d.
23.	150	„	$\frac{1}{1}$	5s. 0d.
24.	200	„	$\frac{1}{1}$	5s. 6d.

Graduated into Septems.

25.	1 Septem	in	$\frac{1}{10}$	6d.
26.	1	„	$\frac{1}{50}$	9d.
27.	2	„	$\frac{1}{10}$	8d.
28.	5	„	$\frac{1}{10}$	1s. 0d.
29.	10	„	$\frac{1}{1}$	9d.
30.	10	„	$\frac{1}{5}$	1s. 0d.
31.	15	„	$\frac{1}{1}$	1s. 0d.
32.	20	„	$\frac{1}{1}$	1s. 3d.
33.	20	„	$\frac{1}{5}$	1s. 3d.
34.	20	„	$\frac{1}{10}$	1s. 6d.
35.	25	„	$\frac{1}{1}$	1s. 3d.
36.	25	„	$\frac{1}{5}$	1s. 6d.
37.	30	„	$\frac{1}{1}$	1s. 3d.
38.	30	„	$\frac{1}{2}$	1s. 4d.
39.	50	„	$\frac{1}{1}$	1s. 6d.
40.	50	„	$\frac{1}{2}$	1s. 9d.
41.	80	„	$\frac{1}{1}$	2s. 0d.
42.	100	„	$\frac{1}{1}$	2s. 6d.
43.	200	„	$\frac{1}{1}$	4s. 0d.

Graduated into Decems.

44.	5 Decems	in	$\frac{1}{10}$	1s. 0d.
45.	10	„	$\frac{1}{2}$	1s. 0d.
46.	10	„	$\frac{1}{10}$	1s. 4d.
47.	25	„	$\frac{1}{1}$	1s. 3d.
48.	25	„	$\frac{1}{2}$	1s. 6d.
49.	25	„	$\frac{1}{5}$	2s. 0d.
50.	25	„	$\frac{1}{10}$	2s. 3d.
51.	50	„	$\frac{1}{1}$	2s. 0d.
52.	50	„	$\frac{1}{2}$	2s. 3d.
53.	50	„	$\frac{1}{5}$	2s. 6d.
54.	50	„	$\frac{1}{10}$	3s. 6d.
55.	100	„	$\frac{1}{1}$	3s. 6d.
56.	100	„	$\frac{1}{2}$	4s. 0d.

Special Graduations.

57.	50 Grains of Water in 50° . . .	1s. 3d.
58.	1 Cu.inch in $\frac{1}{10}$ = 10°	2s. 0d.
59.	5 Cubic inches in $\frac{1}{5}$ = 25° . . .	2s. 6d.
60.	20 Clark's Soap Test Measures in $\frac{1}{5}$ = 100° . . .	2s. 0d.
61.	100 Minims in $\frac{1}{1}$	2s. 0d.
62.	150 „ $\frac{1}{1}$	2s. 6d.
63.	200 „ $\frac{1}{1}$	3s. 0d.
64.	1 Fluid Ounce in 8 Drachms . .	2s. 0d.

2770. Caoutchouc Sucking Tube attached to any Pipette, Fig. 2770 (for its use, see No. 2761), increases the price 6d.

2771. Measuring Pipettes, with Glass Stopcock, graduated into Cubic Centimetres and subdivisions.

10 cc., 3s. 6d. | 50 cc., 6s. 6d. | 100 cc., 8s. 6d.

2772. Mohr's Safety Pipette, for measuring Chlorine Water, Prussic Acid, &c., contents 10 Centimetre Cubes, with safety tube, caoutchouc tube and pinchcock. Fig. 2772, page 305, 2s. 6d.

2773. The same apparatus, contents 20 Septems, 2s. 6d.

2774. **The same apparatus, contents 10 Decems, 2s. 6d.**

The Safety Tube is filled with a mixture of quicklime and sulphate of sodium. See No. 2823.

2775. Revolving Support for 8 Pipettes, Fig. 2775, page 305, polished black wood, 8s. 6d.

2776. Funnel Pipettes, tied over with caoutchouc, for delivering test liquors in small quantities, or in drops, Fig. 2776, page 305.

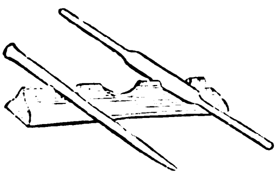
a. 20 Centimetre Cubes in $\frac{1}{2}$ CC., 2s. 6d.; *b.* 50 Centimetre Cubes in $\frac{1}{2}$ CC., 4s. 0d.

Rests for Pipettes.

2777. Porcelain Notched Rests for Stirrers and Pipettes, to keep their wet end from touching the table, Fig. 2777.

a. 3 inch, 4d. | *b.* 4 inch, 6d. | *c.* 6 inch, 9d.

2778. Porcelain Fluted Rests, Fig. 2778, to keep wet Pipettes or Stirrers from touching the table, size of slab, 3 inches square, with 4 flutes, 1s. 9d.



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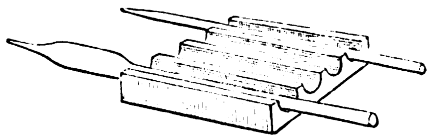


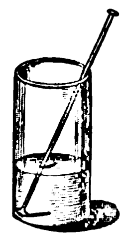
2778.

* It is convenient to have a pair of these rests, one for pipettes that are wet with Basic liquors, and another for such as are wet with Acids.

2779A. Glass Stirrers with broad knob, for preparing solutions of hard substances, such as American potash, Fig. 2779*a*, 9 or 10 inches long, 3d.

2779B. Glass Solution Jar for use with knobbed stirrers, Fig. 2779*a*, capacity 1 to 2 pints, very stout in glass, 1s.

2779. Glass Stirrers, round at one end, pointed at the other, 3 inch, per dozen, 2d.; 6 inch, per dozen, 4d.; 9 inch, per dozen, 1s.



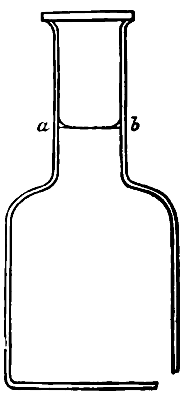
2779*a*.

MEASURING FLASKS.

2780. MEASURING FLASKS are Flasks that have one mark on the neck, when filled to which they *contain* the quantity specified.

The standard flasks which contain the normal volumes of test solutions are these three:—1. The Litre, to be used with burettes that are graduated into Centimetre Cubes. 2. The Decigallon, to be used with burettes that are graduated into Septems; and, 3. A flask to contain TEN THOUSAND GRAINS OF WATER (to which liquid mass no specific name has been yet applied), which is used with burettes graduated into Decems. With these standard flasks it is necessary to have a few that will measure decimal portions of the three standards, especially $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{5}$, $\frac{1}{10}$.

Figs. 2780 and 2781 represent measuring flasks without stoppers, and Fig. 2785, a measuring flask with a stopper.



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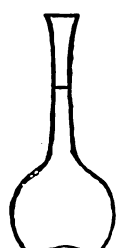


2781.

2785.

2783. Measuring Flasks, without Stoppers, and with one mark on the neck.

1.	5 Cent. Cubes,	3d.	15.	100 Septems,	9d.
2.	10 „	4d.	16.	200 „	1s. 0d.
3.	20 „	6d.	17.	250 „	1s. 0d.
4.	25 „	6d.	18.	300 „	1s. 2d.
5.	50 „	8d.	19.	500 „	1s. 3d.
6.	100 „	9d.	20.	1 Decigallon,	1s. 6d.
7.	150 „	1s. 0d.	21.	25 Decems,	6d.
8.	200 „	1s. 2d.	22.	50 „	9d.
9.	250 „	1s. 3d.	23.	100 „	1s. 3d.
10.	300 „	1s. 4d.	24.	500 „	1s. 6d.
11.	500 „	1s. 6d.	25.	1000 „	2s. 0d.
12.	1 Litre,	2s. 0d.	26.	1 Cubic inch,	6d.
13.	2 „	2s. 6d.	27.	½ Imperial pint,	1s. 3d.
14.	50 Septems,	6d.	28.	1 „	2s. 0d.

2785. Measuring Flasks with Stoppers, and a ring round the neck, Fig. 2785.

1.	100 Cent. Cubes,	1s. 3d.	4.	½ Litre,	2s. 6d.
2.	125 „	1s. 6d.	5.	1 „	3s. 0d.
3.	250 „	2s. 0d.	6.	2 „	3s. 6d.

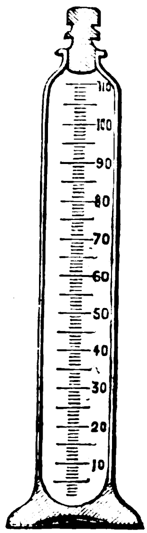
2786. Measuring Flasks with Stoppers, and a mark on the neck, Fig. 2785.

1.	1 Decigallon,	1s. 6d.	5.	1000 Grains,	1s. 3d.
2.	1000 Decems,	2s. 0d.	6.	100 Septems,	1s. 3d.
3.	1 Imperial Pint,	1s. 9d.	7.	250 Septems,	1s. 3d.
4.	1 Cubic Inch,	1s. 3d.	8.	500 Septems,	2s. 6d.

TEST MIXERS.

2790. Test Mixers are tall cylindrical bottles, with broad feet and stoppers, as represented by Fig. 2790. They are used to prepare test acids, test alkalies, and similar solutions, by the dilution of strong solutions to others of a fixed degree. Thus, supposing it to have been found by a volumetric experiment, that a certain acid possesses as much neutralising power in 70 measures as it ought to possess in 100 measures, then, to bring that acid into its normal condition, 70 measures of it are to be put into a test mixer, and diluted with water till the volume becomes 100 measures at 62° F. For this purpose, the test mixer is graduated into 100, or rather more than a 100, equal parts, and the scale upon it is written from below upwards, as represented in Fig. 2790.

From this description it will be seen that the Measuring Flask differs from the Test Mixer in this particular, that, in the former, a weighed equivalent of a solid chemical is dissolved in water and diluted till it forms a standard measure, such as a Litre, a Decigallon, or 1000 Decems; whereas in the latter, an equivalent of a dissolved chemical is diluted from a specific measure which is determined by a volumetric analysis to the standard measure of a Litre, a Decigallon, or 1000 Decems. Vessels of both sorts are required for the preparation of the test solutions which are employed in the processes of volumetric analysis.



2790.

2791. **Stoppered Test Mixers**, form of Fig. 2790, differing in price according to their capacity, but all graduated to 100 equal parts, as follows:—

1.	Contents	1	Decigallon	= 100 Spaces of	10 Septems,	5s. 0d.
2.	„	2	„	= 100 „	20 „	8s. 0d.
3.	„	5	„	= 100 „	50 „	10s. 6d.
4.	„	500	Decems	= 100 „	5 Decems,	4s. 0d.
5.	„	1000	„	= 100 „	10 „	5s. 6d.
6.	„	4000	„	= 100 „	40 „	14s. 0d.
7.	„	½	Litre	= 100 „	5 C. Cubes,	5s. 6d.
8.	„	1	„	= 100 „	10 „	8s. 6d.
9.	„	2	„	= 100 „	20 „	10s. 6d.
10.	„	2½	„	= 100 „	25 „	14s. 0d.

The Test Mixers Nos. 3, 6, 10, are the largest sizes which can be handled with convenience and safety.

2792. Cylindrical Jars, on foot, with Stoppers, graduated into Centimetre Cubes, for mixing and diluting various quantities of test solutions, Fig. 2790:—

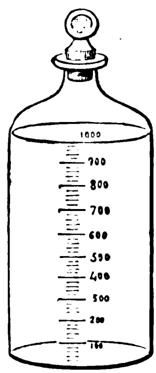
1.	25 Centimetre Cubes,	1s. 6d.	8.	300 Centimetre Cubes,	4s. 6d.
2.	50 „ „	2s. 0d.	9.	400 „ „	5s. 0d.
3.	75 „ „	2s. 6d.	10.	500 „ „	5s. 6d.
4.	100 „ „	2s. 6d.	11.	600 „ „	6s. 0d.
5.	150 „ „	3s. 0d.	12.	700 „ „	6s. 6d.
6.	200 „ „	3s. 6d.	13.	800 „ „	7s. 0d.
7.	250 „ „	4s. 0d.	14.	1000 „ „	8s. 6d.

2793. **Graduated Stoppered Bottles**, scale of 50 divisions, marked either as 100° or 1000°, the zero at the bottom. Fig. 2793. Useful as test mixers, or to store test solutions.

1.	Contents	1	Decigallon,	5s. 6d.
2.	„	1000	Decems,	6s. 6d.
3.	„	½	Litre,	5s. 6d.
4.	„	1	„	7s. 6d.

2794. **Graduated Glass Cylinders**, or Jars with Spouts, or with Flange and Feet, but without stoppers, graduated with scale of 100 divisions, having 0° at the bottom, Fig. 2794.

These serve as **Test Mixers**, but since the liquors can only be mixed in them by stirring with a glass rod, they are not so convenient or effective as the Stoppered Test Mixers.



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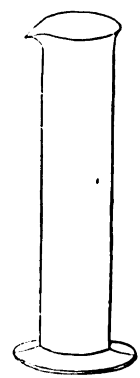

2794.

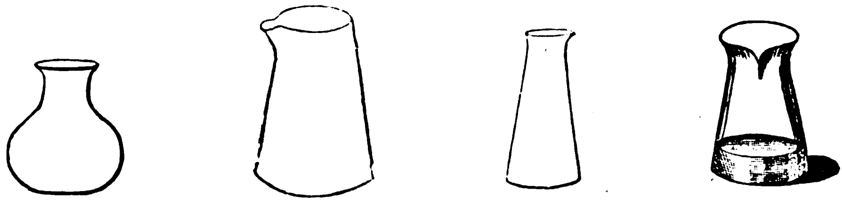
1.	Contents 1 Decigallon,	3s. 6d.	4.	Contents 1000 Decems,	4s. 6d.
2.	„ 2 „	6s. 0d.	5.	„ ½ Litre,	3s. 6d.
3.	„ 5 „	10s. 6d.	6.	„ 1 „	6s. 0d.

2795. Cylindrical Jars, on foot, with spout, in the form of Fig. 2794, or with flange, graduated into Centimetre Cubes.

1.	5 cc.	8d.	7.	150 cc.	2s. 0d.	12.	500 cc.	3s. 6d.
2.	10 „	10d.	8.	200 „	2s. 3d.	13.	600 „	4s. 0d.
3.	25 „	1s. 2d.	9.	250 „	2s. 6d.	14.	700 „	5s. 0d.
4.	50 „	1s. 6d.	10.	300 „	3s. 0d.	15.	800 „	6s. 0d.
5.	75 „	1s. 9d.	11.	400 „	3s. 3d.	16.	1000 „	7s. 0d.
6.	100 „	2s. 0d.						

MIXING JARS.

2798. MIXING JARS are vessels in which a liquid that is to be analysed volumetrically is mixed, stirred, shaken, or boiled, with the graduated test solution that is to effect the analysis. Fig. 2798, *a*, *b*, *c*, *d*, represents some of the most suitable forms for such vessels. They should be made of fine, hard, colourless German or Bohemian glass, and be thin, flat, smooth, and clear at the bottom, to permit changes of colour to be easily seen, either when you look across the vessel against the light, or down into it when it is placed upon a white ground, such as the porcelain slab No. 2800. Vessels of the forms here represented may be shaken by a careful circular motion, so as thoroughly to mix the liquors they contain, without spilling any; and when made of the proper kind of glass, they may all be safely heated till their liquors boil, over a wire grating or a rose gas burner.



a. *b.* *c.* *d.*

2798.

2798. Varieties of Mixing Jars :—

Fig. *a*. Wide-mouthed, flat-bottomed flask, of fine clear glass.

1.	3 to 4 ounce,	3d.
2.	¼ pint,	4d.
3.	½ ,,	5d.
4.	1 ,,	6d.

Fig. *b*. Conical Jar, with spout and flat bottom, fine German glass.

5.	¼ pint,	4d.
6.	½ ,,	6d.
7.	1 ,,	10d.

Fig. *c*. Tall and narrow Conical Jar, with flat bottom, fine clear Bohemian glass.

8.	¼ pint,	7d.
9.	½ ,,	9d.
10.	1 ,,	1s. 0d.

Fig. *d*. Conical Jar, with sides curved inwards, flat bottom, with spout.

11.	¼ pint,	4d.

Fig. *d*. Conical Jar, with sides curved inward, and expanding mouth without spout.

12.	¼ pint,	6d.
13.	½ ,,	8d.

For many operations in Volumetric Analysis, when the quantity of liquid operated upon is 100 Septems, 50 Cent. Cubes, or even 100 Decems, a Mixing Jar of the ¼ pint size is sufficiently large for convenient use; but in some cases it is necessary to take half pint, or even pint jars to contain the mixed liquors.

2798E. Graduated Mixing Jars, with 1, 2, or 3 marks—namely, 100, 250, and 500 Septems, Decems, or Centimetre Cubes, extra price for one mark, 6d.; for 2 marks, 9d.; for 3 marks, 1s.

It is very convenient, when testing a series of solutions, especially when colour tests are to be used, to dilute the solutions with water to a given bulk. Thus, in testing the acidity of wines and other organic coloured fluids, a considerable dilution must be effected, in order that the colour of the liquid to be tested may not interfere with the observations to be made on the action of the colour test that is used to mark the point of transition from acidity to alkalinity; and as it is best to act upon uniform masses of liquor, it is handy to have the measure marked on the mixing jar.

2799. SHAKING BOTTLE, stoppered, Fig. 2799, for mixing liquors that require considerable agitation. Such as soap test with hard water, chloride of silver, &c., 6 ounce size, flat-headed stopper, 9d.

2800. WHITE GLAZED PORCELAIN SLAB, to place below a Mixing Jar during a Volumetric Analysis, for the purpose of rendering changes of colour immediately evident, size 6 inches square, ½ inch thick, glazed all over. See *d*, Fig. 2701, and *d*, Fig. 2711, 1s.

POROUS DRYING TILES, for the rapid drying of precipitates on filters.

2801. Size 6 × 6 inches, 1s. | 2802. Size 8 × 8 inches, 2s.

2803. Size 12 × 12 inches, 3s.

2799.

INDICATORS.

2805. When a liquid is submitted to volumetric analysis, the graduated test solution is added to it, until some *visible effect* is produced, which *indicates* that enough of the test solution has been used. Whatever serves to produce this visible effect is called the *Indicator*. The success of an analysis often depends upon the operator's power of appreciating the exact point when the Indicator exhibits its decisive action. I may notice some of the chief Indicators, in order to point out their different modes of action.

2806. *Change of Colour in the Mixture.*—When a solution of permanganate of potash, which possesses a dark red colour, is added to a ferrous salt, it instantly loses its colour. When the ferrous salt is converted by the action of the test into ferric salt, that is to say, when Fe^2 has become Fec^3, the first superfluous drop of the permanganate solution gives a pink colour to the mixture. This pink colour is the Indication of the completion of the testing.

2807. *Colour Tests.*—When acids are mixed with alkalies, no *visible effect* is produced to show when neutralisation is completed, or when either acid or alkali is present in excess. The indicators that are used to remedy this defect are either litmus tincture, which becomes *red* in the presence of free acid, and *blue* in the presence of free alkali, or tincture of hematine, which becomes *yellow* in the presence of free acid, and *pink*, *crimson*, or *violet* in the presence of free ammonia.

2808. *Starch.*—When Iodine is set free in any mixture, even in an extremely small quantity, it is instantly detected by starch paste, which becomes blue. The starch paste is commonly put into the mixture.

2809. *Yellow Chromate of Potash.*—When a solution of yellow chromate of potash is tested with a solution of nitrate of silver in a neutral or slightly alkaline solution, a *dark red precipitate* is produced. But while any metallic chloride is present in the solution, no red precipitate is formed by the chromate until the whole of the chlorine has been precipitated in the condition of chloride of silver. The yellow chromate of potash serves, therefore, to indicate the completion of the volumetric testing of a chloride by a solution of silver. The indicator is generally mixed with the subject to be tested, but is sometimes tried apart. See No. 2951 *b*, and No. 2941 *a*.

2810. *Ferridcyanide of Potassium.*—A test solution of bichromate of potash, added to a solution of a ferrous salt, converts it into a ferric salt. But the mixture gives no visible indication of the completion of the operation. The Indicator to be used in this case, is a solution of the ferridcyanide of potassium, which gives a blue precipitate with a ferrous salt, but none with a ferric salt. The Indicator cannot be put into the mixture, because it acts upon the substance submitted to analysis, and not upon the testing solution, so that its action would *precede* the action of the test, instead of *indicating its conclusion*. It is necessary, therefore, from time to time, to take some of the solution out of the Mixing Jar, and try by the action of the indicator in a separate vessel when the process is completed. This is a disadvantage, because every such trial removes a certain quantity of the liquor that is subjected to analysis from the action of the test, and impairs the accuracy of the analysis. To restrict the loss of substance as much as possible, the trials are made upon very small quantities of liquor by the process described at No. 2816. This method can be used with all Indicators that give Coloured Precipitates.

QUICK FILTERS.

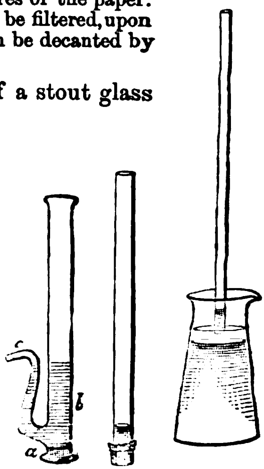
2811. When solutions of Barytic Salts are tested with solutions of sulphates, a precipitate of sulphate of barytes is produced, which, although insoluble, remains so long in suspension, that it is difficult to see when the operation is terminated. The indication is, that a further addition of test solution should give no further precipitate. But when the mixture is turbid, it cannot be seen, upon adding more test liquor, whether such additional precipitation occurs or not. It is consequently necessary to separate the sulphate of barytes from a portion of the mixture by filtration, in order to have a clear liquor for farther trial. Successive filtrations for successive trials being tedious by ordinary methods of filtering, the following attempts have been made to effect filtrations rapidly:—

2812. Beale's Quick Filter, for the rapid filtration of Liquors that contain small quantities of sulphate of barytes, &c., in suspension, form of Fig. 2812, 1s.

The bottom of the wide tube is tied over with a bit of filtering paper, covered by a slip of washed muslin *a*, and is dipped into distilled water to close the pores of the paper. The apparatus is then pressed downwards into the liquor that is to be filtered, upon which a portion of the solution rises clear into the tube *b*, and can be decanted by the spout *c*, into the test glass, No. 2817.

2813. Griffin's Quick Filter, Fig. 2813, consisting of a stout glass tube, 6 inches long, and about $\frac{1}{8}$ inch bore, 3d.

The projecting spout of Beale's Filter *c*, Fig. 2812, frequently prevents the dipping of the instrument into the mixing jar; for example, when the precipitated sulphate of barytes has been boiled in a flask like *a*, Fig. 2798. I find it more convenient to make the filter in the form of Fig. 2813, which consists of a plain tube without contraction or expansion, about $\frac{1}{8}$ inch in the bore, $\frac{1}{12}$ inch thick in the glass, and 6 inches long. The filtering paper, without muslin, is tied over the end with a thread. The tube is dipped into the mixture that is to be filtered, until two or three drops, or more when necessary, have risen within it. The top is then to be firmly closed by the finger; the tube to be lifted out of the mixture, and the liquor to be allowed to drain from the outside of the tube by gently touching the inside of the jar with the filter, after which the drops within the tube may be suddenly decanted from the upper or open end of the tube into the test glass, No. 2817, for trial by the indicator, which being in this case the graduated test liquor that is used for the analysis, the mixture can, after the trial, be returned from the test-glass to the mixing-jar, and thus avoid loss.

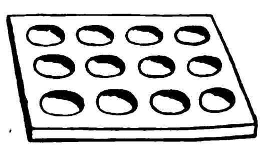


2812. 2813. 2814.

2814. Decanting Tube, Fig. 2814, 6 inches long, $\frac{1}{8}$ inch bore, smooth at both ends, three for 6d.

It often happens that when a turbid mixture has been well shaken, especially after boiling, the precipitate it contains slowly settles down and leaves a very shallow stratum of clear liquor upon its surface. By using a very narrow glass tube, cut off smooth and square at the ends, it is possible to remove from the surface of such a mixture a sufficient quantity of clear liquor for testing, without waiting till the mass of precipitate subsides. The method is exhibited by Fig. 2814. The tube is made barely to touch the surface of the liquor; it is not dipped into it; no suction is applied, because the effect of capillary attraction is alone sufficient to raise the required quantity of clear liquor. When the mixture allows this abstraction of clear liquor to be effected, it is, of course, much preferable to filtration.

2815. Porcelain Slab, for trying the action of Colour Tests in volumetric analysis, Fig. 2815, consisting of a thin slab of white glazed porcelain, containing twelve small cavities or cells about $\frac{1}{8}$ inch deep, for holding drops of liquor to be tested. Two sizes, namely:—


2815.

a. Berlin porcelain, $4\frac{1}{2}$ inches long, $3\frac{1}{2}$ inches broad, with twelve shallow cells of $\frac{3}{4}$ inch diameter, 1s. 9d.

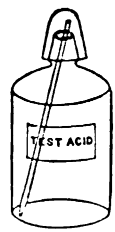
b. Thuringian porcelain, 4 inches long, 3 inches broad, with twelve deeper cells of $\frac{5}{8}$ inch diameter, 1s.

2816. For the reasons stated in No. 2810, experiments with indicators have to be made on the smallest possible quantities of liquor. The solution of the indicator should in most cases be very dilute. At the beginning of a process, the indicator should be put into each of the cavities in the slab. It is best to lift it with a plain glass tube, 6 inches long, and $\frac{1}{4}$ to $\frac{1}{8}$ inch in the bore; namely, the decanting tube, No. 2814. The tube is made barely to touch the surface of the liquor, upon which a sufficiency of liquor rises into it by capillary attraction, and is transferred to the slab, the dot upon which ought not to exceed $\frac{1}{8}$ inch in diameter. Subsequently, during the process of a volumetric analysis, the mixture to be tried is lifted with a decanting tube, No. 2814, in the same manner, and the minute drop is blown from the tube into the drop of indicator previously deposited in one of the cavities on the slab, or is made to run down by touching the edge of the cavity.

2817. Test Glass for examining small quantities of liquors, form of Fig. 2817, about 1 inch high, and 1 inch wide. *Per Dozen*, 1s. 3d.

When the indicator produces a white precipitate, such as sulphate of barium, the trial cannot be made on the porcelain slab. The best thing to use in that case is a small test glass, similar to Fig. 2817, but about one half larger. As only small quantities of liquor are to be operated upon, a large test glass ought never to be used, because it spreads the drops of liquor over too large a surface of glass.

2817.



2818.

2818. Pipette Bottle for Tincture of Litmus, Hematine, or other Colour Test, with Cap, Fig. 2818, but without inscription, 5 ounce size, 1s.

The pipette should be cylindrical, not made with a narrow point. It should be about $\frac{1}{8}$ inch in the bore, so that about half a centimetre cube or one septem of the colour-test can be readily lifted for use in each operation. It is proper to have uniformity in the quantity of colour test placed under observation in each experiment, to help in the precise detection of change of colour.

2819. Litmus Test Papers are useful in all delicate processes. See No. 2423.

PRESERVATION OF TEST LIQUORS AND THE MANNER OF FILLING BURETTES.

2823. This subject has already been partially discussed in preceding paragraphs, especially in Nos. 2690, 2692, 2693, 2704, 2710, and 2729. The Test Solutions should be kept in stoppered glass bottles, preferably in bottles of hard glass, because some of the Test Liquors act readily upon flint glass. The bottles should be kept in a cool place, and if possible in a dark place, as some liquors are acted on by light. In certain cases it is better to replace the glass stopper by a cork, carrying a chloride of calcium tube, filled with a mixture for absorbing carbonic acid, which arrangement permits the access of air, but prevents the formation of carbonates. Such safety tubes are sometimes applied to burettes that are filled with caustic alkalies. See examples in Figs. 2698, 2708, 2709, 2824. The mixture for filling these tubes is prepared as follows:—Pound in a mortar equal volumes of crystallised sulphate of sodium and fresh burnt lime. Mix the powders, and let them act on one another. Dry the mixture over a fire or gas-light, in such a manner as to cause it to form small lumps. Fill the tube with these lumps, avoiding dust, and putting a loose plug of cotton at each end of the tube to prevent the mixture falling out.

2824. Mohr's Bottle for Caustic Alkaline Test Liquors, Fig. 2824, 30-ounce size, with tube to contain the mixture for retaining carbonic acid, and delivering syphon with pinchcock, 2s. 6d.

Large Bottles can be fitted up in this style for use in chemical manufactories. See examples of the proper arrangement in Figs. 2690 and 2693.

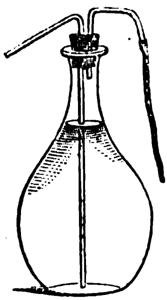
2825. **Mohr's Apparatus for Storing Test Liquors, and for filling Burettes from below, 30-ounce size, Fig. 2824, with addition of a Blowing Ball, 3s. 6d.**

This consists of the apparatus represented by Fig. 2824, with the addition of a 3-inch caoutchouc blowing ball, like that represented in Fig. 2733. This is fixed on the top of the chloride of calcium tube of Fig. 2824. The syphon of this apparatus is then placed in connection with the fittings represented in Figs. 2692 and 2693. The burette is assumed to be fixed in a stand. By opening the pinchcock connected with the T piece, *b*, Fig. 2692, and at the same time pressing the ball fixed on the apparatus, No. 2824, the solution is forced from the flask up into the burette.


2824.

2826. **Mohr's Bottle for filling Burettes with solution of permanganate of potash, iodine in iodide of potassium, and similar tests, represented by Fig. 2826, one pint size, 2s.**

2827. **Another kind, with Blowing Ball, Fig. 2827, one pint size, 3s.**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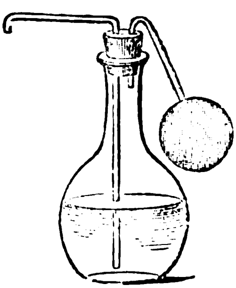
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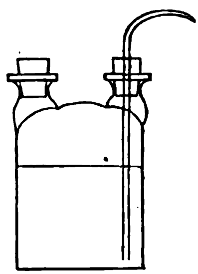
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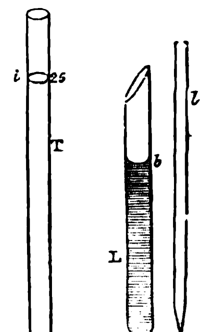


a. *b.* *c.*

2828. **Gay-Lussac's Apparatus for filling tube measures with arsenical and other poisonous solutions, 20-ounce bottle, with two necks and syphon, Fig. 2828, 2s.**

a and *b* represent tube measures, into which the liquor is decanted by the syphon tube. The exact quantity is adjusted to the mark by the small pipette *c*, or by a particular inclination given to the tube in reference to the bottle, by which an excess of solution can be made to run back into the bottle.

2829. When bottles that are only partially filled with graduated solutions remain for some time unmoved, and especially when they happen to be in a warm situation, water rises in vapour from the solutions, and condenses on the sides of the bottle, by that means giving greater concentration to the solution. The liquor in such bottles should be shaken before any is poured out for use.

It seems scarcely necessary to say that burettes, pipettes, and all vessels that serve to measure graduated liquors should be used in a *clean* and *dry* condition. When the form of a vessel is such as to render the drying of it tedious,—as it is, for example, with Binks's burette, Fig. 2736—the vessel, after being washed with water and drained, should be well rinsed with a little of the liquor that is next to be used with it.

All graduated vessels should be washed clean and dried immediately after use.

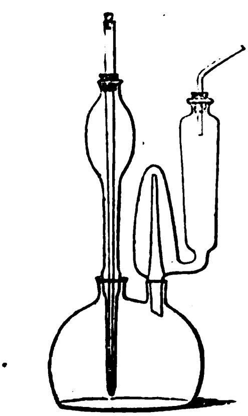
APPARATUS FOR SPECIAL OPERATIONS IN VOLUMETRIC ANALYSIS.

APPARATUS FOR THE ANALYSIS OF CARBONATES.

2833. The plan of the analyses that are executed with the help of these instruments is as follows:—In one part of the apparatus a given weight of the carbonate to be analysed is placed; in another part, a quantity of sulphuric or nitric acid. The whole is weighed. The acid is then made to flow gradually upon the carbonate, so as to disengage carbonic acid gas. This gas is made to pass either over dry chloride of calcium, or through strong sulphuric acid, in order that it may be deprived of its water, and pass away in a dry state. When the action is completed, and the flasks are cool, they are wiped dry and again weighed. The loss of weight shows the weight of the discharged carbonic acid, and as the weight of the analysed carbonate is determined at the commencement of the process, its composition can thence be readily calculated. When the carbonates are alkalies, they may be decomposed by sulphuric acid; but when they are earths, they require nitric acid,—that is to say, the apparatus must then be so contrived as to contain nitric acid for decomposing the carbonate, and sulphuric acid to dry the disengaged carbonic acid gas. The figures on page 316 exhibit a variety of methods, which have been contrived by different chemists to fulfil these conditions. I distinguish them by the names of their inventors as accurately as I am able so to do.

2834.	Fritzsche,	1s. 0d.
2835.	Rose,	1s. 6d.
2836.	„	1s. 3d.
2837.	Fresenius and Will,	1s. 0d.
2838.	„ „	2s. 0d.
2839.	Kipp,	5s. 0d.
2840.	Mohr,	2s. 0d.
2841.	Rose and Berzelius,	2s. 6d.
2842.	Rose,	3s. 6d.
2843.	Schaffner,	1s. 6d.
2844.	Rohrbeck,	4s. 0d.
2846.	Kipp,	4s. 0d.
2847.	Schrötter,	4s. 0d.
2848.	Erdmann,	4s. 0d.
2849.	Geissler,	4s. 0d.

For detailed instructions for the analysis of substances containing carbonic acid, consult Mohr's *Titrirmethode*, 1862, page 87, and Fresenius's *Quantitative Chemical Analysis*, 1860, page 260.



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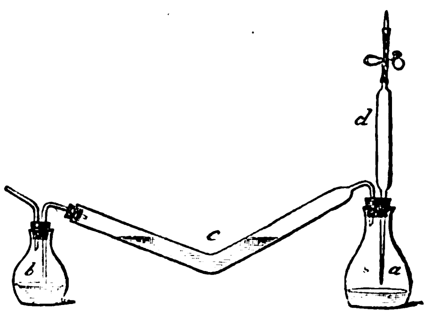

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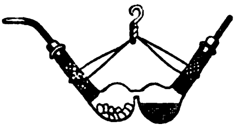

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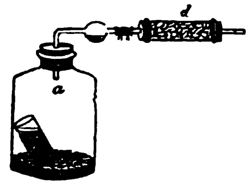

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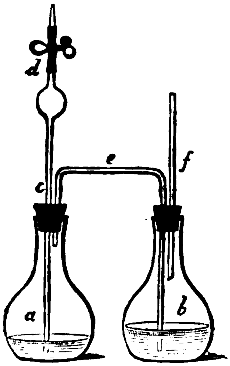

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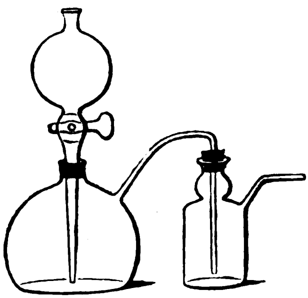

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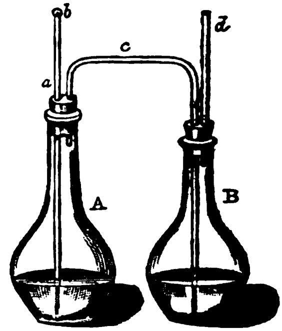

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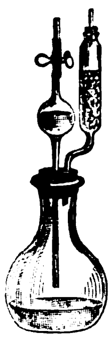

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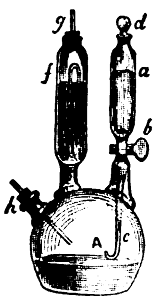

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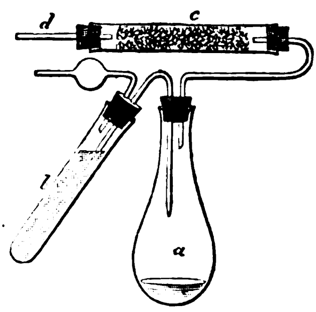

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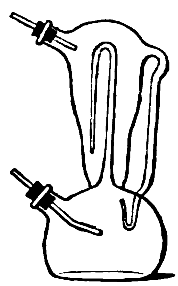

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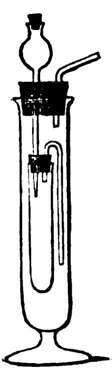

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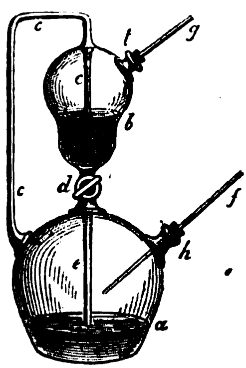

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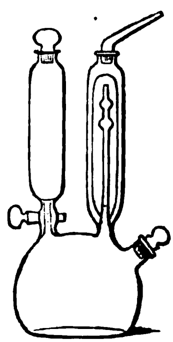

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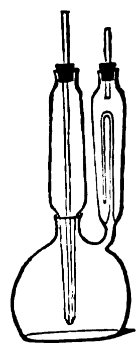


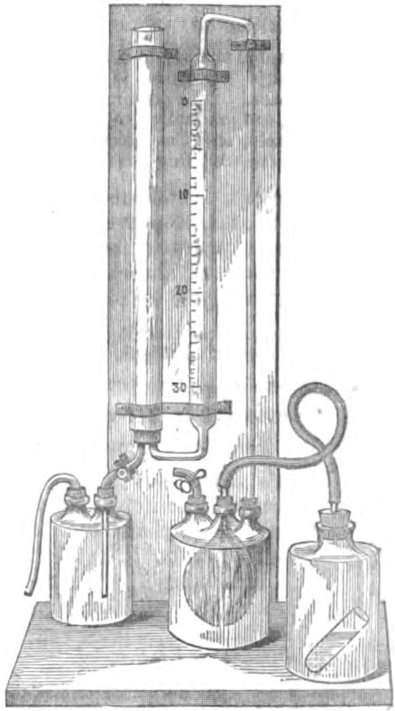
2849.

2850. Dr. C. Schiebler's Calcimeter, an apparatus for the quantitative estimation of carbonate of lime in bone black by volumetric assay —as described in No. 559, fo. 76, Vol. xxii., "Chemical News," Fig. 2850, £2, 2s.

2854. Mohr's Apparatus for estimating Carbonic Acid in Soils, Fig. 2854, 3s.

50 or 100 grains of soil are to be put into the flask *a*. The tube *d* is filled with hydrochloric acid. The tube *c*, with diluted caustic potash, containing caustic barytes. The acid from *d* is allowed to run gradually into *a*, whereupon carbonic acid is disengaged, and passes into the tube *c*, where it forms carbonate of barytes. When the hydrochloric acid is all out of the tube *d*, the pinchcock is opened, and air is sucked out of the bottle *b*, which brings all the carbonic acid from *a* into *c*. The carbonate of barytes is washed into a flask, boiled with water, and washed on a filter; after which it is estimated by graduated nitric acid and soda, as described at No. 2935A. See Mohr's *Titrirmethode*, 1862, page 481.

Dr. Mohr has recently replaced the Litmus Solution by one of Cochineal—the colour of which is not affected by the carbonic acid present, the boiling off of which is, therefore, not required.



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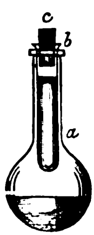

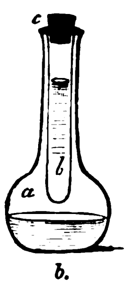

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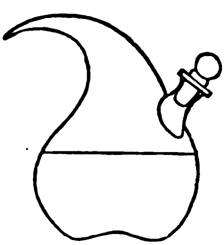

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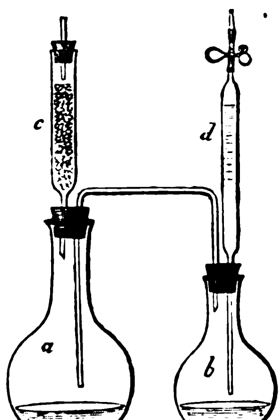

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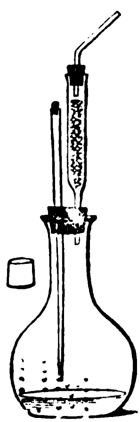


2858.

2855. Griffin's Apparatus for the Analysis of Carbonates, Fig. 2855, *a* or *b* *each* 1s. 3d.

The process is described in detail in "*Chemical Recreations*," at page 113. In the flask *a* as much volumetric nitric acid is placed as will dissolve 10 grains of pure calc-spar. The tube *b* holds cold water. *c* is a cork for lifting the tube. 10 grains of the limestone to be tested, in coarse grains, are gradually dropped into the flask. After solution, the acid is boiled to expel the carbonic acid, and the superfluous nitric acid is then tested volumetrically. The process requires only one weighing; it is rapid, and gives accurate results.

2856. Schuster's Alkalimeter, for analyses by means of weighed test liquors; 2 ounces, stoppered, Fig. 2856, 6d.

2857. Mohr's Apparatus for the estimation of Carbonic Acid by expulsion from carbonates, absorption by ammonia, conversion into carbonate of calcium, and analysis by nitric acid, Fig. 2857, 2s. 6d.

The operation is described in detail in Mohr's *Titrirmethode*, 1862, page 95; and in Fresenius's *Quantitative Chemical Analysis*, 1860, page 268.

2858. Mohr's Apparatus for the estimation of Manganese by the oxalic acid process, Fig. 2858, 2s.

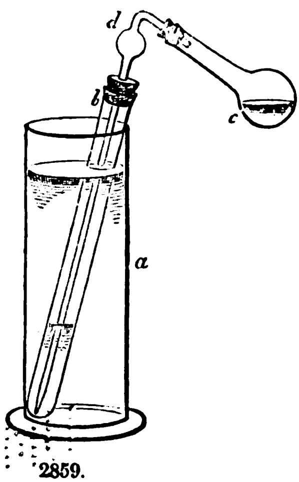
See Mohr's *Titrirmethode*, page 495.

2859. Mohr's Apparatus for distilling Chlorine into a solution of Iodide of Potassium, in order that the separated Iodine may be tested with Hyposulphite of Soda, Fig. 2850. The flask *c* is of 2 ounce size; the condensing tube *b* is 14 inches long by 1 inch wide; the cylinder *a* is 15 inches high by 3 inches wide. *The set*, 5s.

2860. Another form of Mohr's Apparatus for the distillation of Chlorine and liberation of Iodine, Fig. 2860. *The two flasks and tubes, but without the support and lamp*, 3s.

The use of this apparatus is explained in Fresenius's *Quantitative Chemical Analysis*, page 283.

2861. Fresenius's Apparatus for the distillation of Chlorine into Iodide of Potassium, Fig. 2861, 2s.



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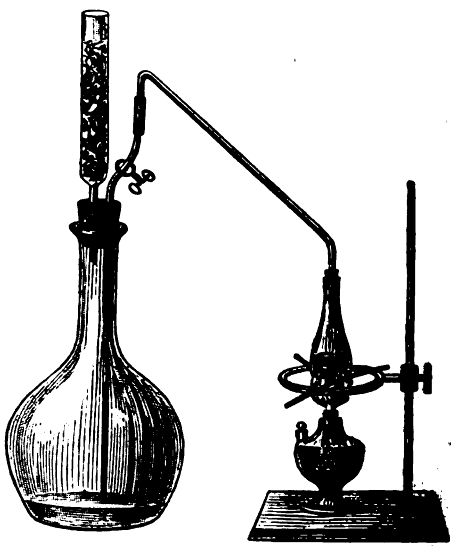
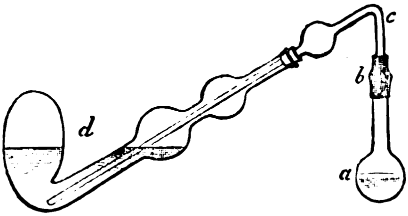


2860.

2862. Bunsen's Apparatus for the distillation of Chlorine, Fig. 2862, 2s.

2862a. The apparatus, Nos. 2859, 2861, 2862, are described in MOHR's *Titrirmethode*, page 237.

Testing of Peroxide of Manganese.—The testing of peroxide of manganese is a process that explains the use of the above distilling apparatus. A small quantity of manganese, such as 10 grains, or 8·7 grains (= $\frac{1}{5}$ atom), or 0·436 gramme when CC. measures are used, is boiled in the small flask with concentrated hydrochloric acid. Chlorine gas is given off, and passes into the receiver, to be absorbed by a solution of iodide of potassium, in which it produces chloride of potassium, and sets iodine free. There must be present enough of the iodide of potassium, not only to supply the free iodine, but also to keep it in solution—about ten parts of iodide for six parts of ore. When the distillation is ended the iodine is estimated by a solution of hyposulphite of sodium, such as Nos. 2944, 3008, or 3054. The quantity of iodine being determined, its equivalent in chlorine and in pure peroxide of manganese is calculated. See No. 2945a.



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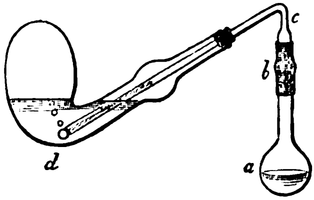


2862.

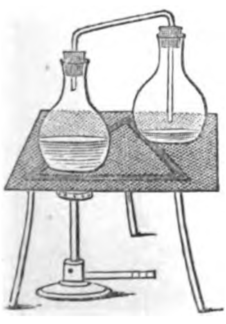
APPARATUS *to be used for preparing a* SOLUTION OF IRON *in an Acid, without permitting the iron to pass into the ferric condition:—*

2863. Mohr's Flask, with tube and caoutchouc valve, which permits the outward passage of the hydrogen of the dissolving acid, but not the inward passage of air. 5-ounce, Fig. 2863, 1s.

2864. Mohr's Apparatus, consisting of a pair of Flasks, connected by a glass tube. The hydrogen escapes through water placed in the second flask, Fig. 2864. The pair of flasks and connecting tube, 1s. 6d. Price of the tripod, 10 inches, 1s. 3d. The gauze, 10 inches, 1s. The gas burner, 1s. 6d.

2865. Fresenius's Flask, with a pair of gas tubes, Fig. 2865; by which arrangement a constant current of carbonic acid gas is passed through the flask during the solution of the iron; the tube d being connected with a carbonic acid apparatus, such as is represented by Fig. 2869 or 2870. *Price of flask and tubes, 1s.*

The Support is priced at No. 315.



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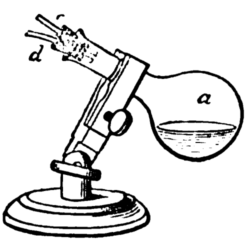

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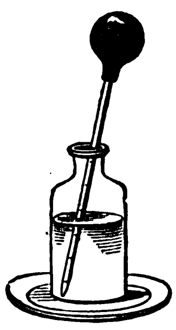

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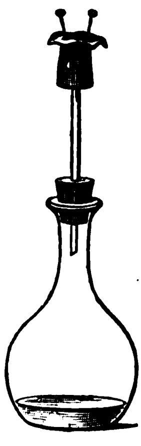
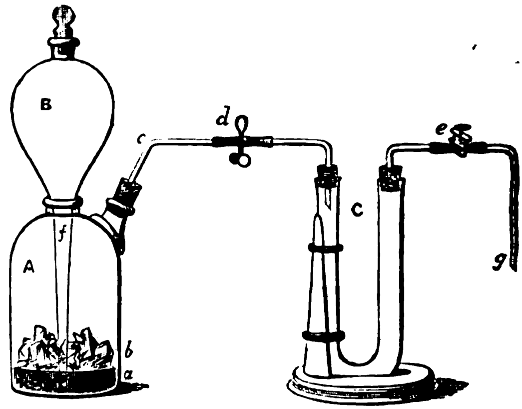


2863.

2865a. *Assay of Iron Ores.*—A solution of an iron ore is prepared in hydrochloric acid, or in nitro-hydrochloric acid; and this solution is tested either by the potassium bichromate solution or the potassium permanganate solution. The quantity of iron ore to be taken for analysis depends upon the test liquor that is to be used. It may be as much as is supposed to contain 5 or 10 grains, or 0·28 or 0·56 grammes of iron. The ore is dissolved in one of the flasks described above, so as to avoid the formation of ferric salt, because only ferrous salt is acted on by the permanganate and bichromate tests. See No. 2955.

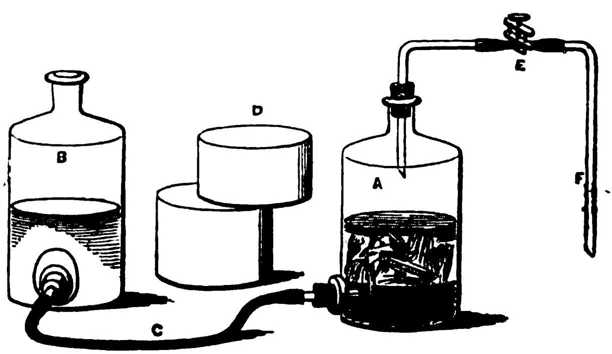
2866. Graduated Tube and Blowing Ball, for supplying a regulated quantity of sulphuric acid to substances that are to be tested with permanganate of potassium, Fig. 2866. See No. 2955. 2s. 6d.



2869.

2869. GAS APPARATUS for supplying a regulated and continuous current of Carbonic Acid gas or of Hydrogen gas when required for an Analytical operation. Form of Fig. 2869. Contents of Gas Bottle, 1½ pint; the tube C 12 inches long, 1 inch wide, mounted on a wood support, with pinchcock *d* and clamp *e*, No. 2871, fitted together as in Fig. 2869, 10s. 6d.

2869A. This apparatus consists of a Woulff's Bottle, A, with two necks, adapted to a long globular funnel B, and to a gas-delivery tube, *c*, *g*, which may have, or not have, according to necessity, in its course one or two washing or drying tubes, C. The neck *f* of the funnel B passes to the bottom of the bottle A; and this bottle contains, *first*, a stratum of small flint gravel about 1½ inch in depth, and upon that the pieces of zinc or marble, which, when acted on by the diluted acid, are to produce the required gas. The gas-delivery tube *c*, *g*, contains one or two caoutchouc tubes, upon which are placed a Mohr's pinchcock *d* (No. 2692), and a clamp or pinchcock *e* (No. 2871). When the bottle is supplied with acid, and the pinchcocks are both open, the gas escapes through the tubes in the direction *c*, *d*, C, *e*, *g*. When the pinchcock *d* is closed, the gas, not being able to escape, accumulates in the bottle A, and drives back the acid up the tube *f* into the funnel B, and the action then ceases, because the gravel at *a* separates the acid from the metal placed at *b*. If the pinchcock *e* is then screwed up to such an extent as to permit only a limited passage of gas, more or less as you may desire, and the pinchcock *d* is opened and removed from the caoutchouc tube, the acid descends from the funnel B to the bottle A, and as much gas is produced as the pinchcock *e* permits to escape, but not more, because any pressure of gas in A causes the acid to ascend into B. Hence a regulated current of gas is produced.



2870.

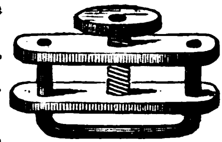
2870. Deville's Gas Generator, for preparing a continuous current of HYDROGEN GAS, CARBONIC ACID, &c., for use in Analytical processes, Fig. 2870, consisting of two bottles each of 1 litre, or 1¾ pint capacity, with pinchcock, No. 2871, 2 feet of caoutchouc tube and fittings, 8s.

The Blocks D *are priced at page* 36. *5-inch blocks suit best.*

The bottle A is filled to above the tubulure with small siliceous pebbles, or, failing them, with bits of coke. Above that bed is placed a quantity of granulated zinc (for hydrogen), or of chips of marble (for carbonic acid). The bottle B contains diluted sulphuric acid. The bottles are connected by the flexible tube C. When the bottle A is placed upon the blocks D, above the level of the acid in the bottle B, there is no action. When the bottle B is placed on the blocks and the bottle A on the table, the acid descends into the bottle A, rises through the flints, and disengages gas by action on the zinc or marble. But this action is regulated by the clamp E, which is represented of its full size by Fig. 2871. When this is closed, and the joints of the apparatus are tight, the acid cannot descend. When the pinchcock is opened, or partially opened, the acid descends more or less, and produces the gas with any desired degree of rapidity. The pressure of the acid is regulated by the height of the blocks D, upon which the bottle is raised; the force of chemical action by the state of dilution of the acid. A useful strength is 25° (see No. 2901), which is about 1 part of oil of vitriol to 10 parts of water.

2870A. Small sea gravel, suitable for the supply of the above gas bottles, *per quart*, 6d.

2871. BRASS CLAMP, for regulating the passage of Gases or Liquids through flexible tubes, form and size of Fig. 2871, 1s.



2871.

This clamp is exhibited in use in Figs. 2869 and 2870. The flexible tube is pressed between the lower wire and the middle plate, which is moved by the screw.

CLARK'S WATER TEST.

The Commissioners of Woods and Forests require, as one of the indispensable conditions to a Bill for supplying water to a town being presented by them to Parliament, that there shall be given, in reference to the waters already supplied to the town, as well as in reference to the waters proposed to be supplied,—

"A statement of the quality of the water as exhibited by chemical analysis, specifying its adaptation for domestic and manufacturing purposes, and its degree of hardness with reference to the Tests and Scale of Dr. Clark."

The water-works sanctioned by the Board of Health have all the waters submitted to the same tests.

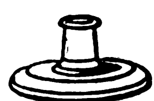
The process invented by DR. CLARK for DETERMINING THE HARDNESS OF WATERS is of easy execution, and of such extreme precision as to rank among the most exact and delicate operations of chemical analysis. The circumstances above referred to render this process of great interest, not only to professional chemists, but to engineers, manufacturers, and the public.

2872. SOLUTIONS AND APPARATUS FOR CLARK'S WATER TEST.

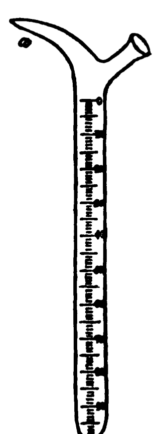
Made in strict accordance with Dr. Clark's instructions.

I. FOR TESTING THE HARDNESS OF WATER.

1. SOAP TEST, standard strength, 4s. *per pint, in a bottle.*
2. STANDARD SOLUTION, WATER of 16° of HARDNESS, 2s. *per pint, in a bottle.*
3. GRADUATED BURETTE, for measuring the quantity of Soap Test, or the Test for Alkalinity, used in each analysis. Graduated into Test Measures (each = 10 grains of water), and every Test Measure (degree) divided into fifths, form of Fig. 2872, 3. *The following varieties:—*
4. Contents, 16 Test Measures in fifths, 2s. 6d.
5. „ 20 „ in fifths, 2s. 6d.
6. „ 32 „ in fifths, 3s. 0d.
7. Mahogany Foot for the Graduated Pouret, Fig. 2872, 7, 1s. 6d.
8. Pipette to deliver 100 Test Measures of Water (= 1000 grains), Fig. 2872, 8, 1s. 6d.



2872, 7.



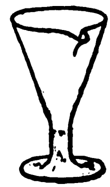
2872, 3.

When the Pipette is emptied, the drop of water at the beak must be *drained* out, as it belongs to the measured quantity. It must not be *blown* out, for that alters the quality of the water, by introducing carbonic acid.

9. Set of Six Stoppered Bottles, with glass Stoppers, accurately fitted, for mixing the water with the Soap Test, Fig. 2799. *Per set*, 4s.
10. Bent Tube, for sucking Carbonic Acid from the Bottles, 2d.
11. Five-Minutes' Sand Glass, 1s. 6d.

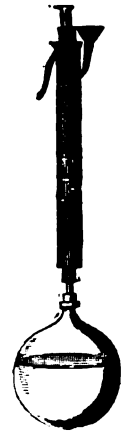
II. FOR TESTING THE ALKALINITY OF WATERS.

12. Berlin Porcelain Evaporating Basin, in which to simmer the water when under trial for Alkalinity, diameter 8½ inches, contents 1 quart, 3s.
13. FLASK to *Deliver* ONE PINT of WATER, when drained *two minutes*, 2s.
14. IRON TRIPOD, for supporting the Evaporating Basin over a Spirit Lamp, 1s.



2872, 17.

2872, 8.



2872, 21.

15. Glass Spirit Lamp, with Chimney, complete, 1s. 6d.
16. Two Glass Stirrers, 3d.
17. Set of Six Clark's Test Glasses, Fig. 2872, 17, 1s. 6d.
18. Pipette, 2d.
19. TEST FOR ALKALINITY, 2s. *per pint bottle.*
20. LITMUS TEST PAPER, 1s. 6d. *per dozen Books.*
21. Globular Flask, contents 1 gallon, with a Condenser attached. For boiling water in such a manner as to effect the decomposition of Bicarbonates without permitting the escape of steam, Fig. 2872, 21, 9s.
22. SPECIFICATION of the PATENT granted to PROFESSOR CLARK for a new method of rendering certain Waters (the water of the Thames being amongst the number) less impure and less hard, for the supply and use of manufactories, villages, towns, and cities, with an APPENDIX on the Method of Testing Waters, *sewed*, 1s.
23. Instructions for Performing the Testing operations, 1s.

2872A. PROF. WANKLYN'S WATER TESTING.

APPARATUS.

2688. Mohr's Burette, 60 cc. $\frac{1}{5}$, 5s.
2697. Stand for do., 4s.
2736. Binks's Burette, 32 Test Measures, 3s.
2737. Do. Stand, 1s. 6d.
2768. Pipette to deliver 1½ cc. 4d.
,, ,, ,, 10 cc. 7d.
,, ,, ,, 15 cc. 8d.
,, ,, ,, 50 cc. 1s.
2769. ,, with Scale 100 cc. in 100°, 4s.
2783. Flask, 1 litre, 2s.
,, ,, ½ litre, 1s. 6d.
,, ,, 70 cc. 9d.
,, ,, 100 cc. 9d.
,, ,, 150 cc. 1s.
,, ,, 200 cc. 1s. 2d.

Two Jars, 100 cc. for Nesslerising, 5s.
Twelve Jars (small), 6s.
1875. One Liebig's Condenser, 6s.
1876. One Stand for do., 6s.
1881. One small glass Condenser, 3s. 6d.
1809. One 40 oz. Stoppered Retort, 1s. 8d.
1740. One Platinum Dish, 130 cc., 4 inch diameter, say £7.
„ Cover of foil, $4\frac{1}{2}$ inch square, say £1, 10s.

N.B.—A smaller dish can be employed.

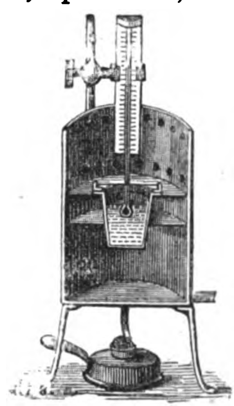
510. One Thermometer, 200 cc., narrow, solid stem, enamelled, 4s. 6d.
1276. One Rammelsberg's Hot Air Bath, 8s.
411. Balance, £16, 16s.
458. Weights, £3, 3s.
Wanklyn's Book on "Water Testing," 5s.

CHEMICALS.

1. Nessler's Ammonia Test, 1 pint bottle (blue), 6s.
2. Solution of Soda Carbonate, standard 1 pint bottle, 2s.
3. Potash Neutral Chromate, 6 oz. bottle of solution, 1s.
4. Permanganate Potash Crystals, $\frac{1}{2}$ oz. bottle, 1s. 4d.
5. Solid Caustic Potash, 1 oz. bottle, pure, 1s.
6. Standard Solution Ammonia, 1 cc. = $\frac{1}{1000}$ gramme, 1 pint bottle, 2s. N.B. $\frac{1}{2}$ gallon do., 6s.
7. Calcium Chloride, 1 cc. = 1 milligramme calcium carbonate, 1 pint bottle, 2s. N.B. $\frac{1}{2}$ gallon do., 6s.
8. Potash Soap Test, per pint 1 cc. = 1 milligramme calcium carbonate, 4s.
9. Nitrate of Silver, 1 cc. = 0·1 milligramme of chlorine, 1 pint bottle, 2s.
10. Decinormal Sulphuric Acid, 1 pint bottle, 2s.
11. Tincture of Cochineal, weak, $\frac{1}{2}$ pint bottle, 2s. 6d.

2873. PETROLEUM TESTER, for the determination of the temperature of volatilisation of Petroleum and other light and volatile oils by the *Flashing Test*, as prescribed by the Act of Parliament, with thermometer. Fig. 2873, 15s.

Lith 1254 21.8.



2873.

ASSAY OF MILK—LACTOMETER—CREMOMETER.

When new milk is set at rest for a period of from twelve to twenty-four hours, the cream separates from the other ingredients, and rises to the surface of the liquor. If the operation is performed in cylinders of glass, the thickness of the layer of cream can be seen distinctly. If the glass cylinder is graduated into 100 parts, and is filled with the new milk up to 0°, the amount of cream can then be read off in *percentages*, from which it is possible to calculate the total quantity of cream that is contained in the milk of a given cow, as taken at one milking, well mixed and measured.

The graduated glass instrument used for this purpose is commonly called a LACTOMETER. The usual form of this instrument is a cylinder on foot like Fig. 2746*a*, and sometimes a tube without foot, like Fig. 2326; but a form much to be preferred is that of the test mixer, Fig. 2790, or the graduated bottle, Fig. 2793.

The cream rises more readily in a short wide vessel, such as No. 2874 *f*, than in a long narrow one; but being then spread over a broader surface of liquor, it is not so easily measured. The larger the quantity of milk operated upon, the more trustworthy is the result; but a very good result is obtained by using a test mixer, Fig. 2790, of the capacity of a decigallon, and having a diameter of nearly 2 inches. A stoppered vessel is preferable to an open one, as it cuts off atmospheric influences, and in hot weather lessens the chance of the souring of the milk during the separation of the cream. The lactometer should be set aside, if possible, in a situation where the temperature is about 50° Fahr.; and it is better to place it up to the shoulder in cold water. When unstoppered tubes are used, they should be corked and plunged into water, and a cover, dipping into the water, be placed over them to cut off the access of air.

Although it is impossible to say what ought to be the percentage of cream in genuine milk, it may be safely said that if it prove to be under 5 per cent., the deficiency may be attributed to dilution with water.

Graduated Lactometers.

2874a. Stoppered Lactometer, form of Fig. 2790, capacity 1 decigallon, 5s.

2874b. Tube without foot, with 15 degrees, graduated at the upper part, 2s.

2874c. Set of Three such tubes in a zinc water cistern, with cover, 10s.

2874d. Cylinder on foot, similar to Fig. 2746*a*, with 15 degrees, graduated at the upper part, 2s. 6d.

2874e. Similar Cylinder, with glass stopper, Fig. 2746, with 15 degrees, graduated at the upper part, 3s.

2874f. Short, wide Cylinder, 6 inches long, and 1¼ inch wide, on foot with spout, with 15 degrees, graduated at the upper part, 2s.

Instruments for determining the specific gravity of milk have been described at page 55.

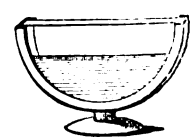
2875. The Lactoscope, or Optical Milk-Test.—Consisting of a glass trough, Fig. 2875, a glass cylinder on foot with spout, of about 300 Septems capacity, with a mark to show the measure of 100 Septems, and a pipette holding 10 Septems, graduated to show ½ Septems. *The set*, 6s. 6d.

2875a. The Trough, Fig. 2875, *alone*, 3s. 6d.

2875b. Wanklyn's Water Bath, as used by him and described in his work on Milk Analysis, see No. 1257.

Platinum capsules, see No. 1258, 14s.

Wanklyn's Work on Milk, 5s.; Do. on Tea, Coffee, and Chocolate, 5s.



2875.

Fig. 2875 represents a vessel with parallel glass sides, mounted in a brass frame. The width between the glass plates is ½ inch. When this vessel is filled with a mixture of new milk and water, and the appearance of the mixture is examined by placing a candle at three feet distance from one side of it, and your eye close to the other side, the presence of a *certain proportion of cream* renders the figure of the candle flame indistinct. The smaller the quantity of milk required to produce this indistinctness, the better is the quality of the milk.

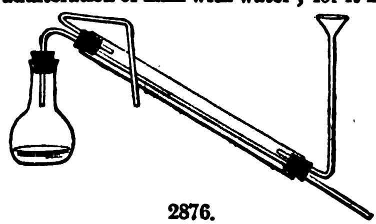
Operation.—Fill up the cylinder to 100 Septems with water. Add to the water by means of the pipette, say 3 Septems of the milk that is to be tested. Shake the mixture well; fill with it the glass trough, and examine the candle flame by looking through the trough. In doing so, your back must be turned against the window of the room. If the candle flame is clearly seen, the mixture is to be returned to the cylinder, mixed with one more Septem of milk, again agitated, and again returned to the trough to be tried against the candle flame. This must be repeated, adding at each time either 1 Septem or ½ Septem, until the candle flame disappears, which occurs somewhat suddenly. When this point is determined, you have to reckon the number of Septems of milk added to the 100 Septems of water to produce this result. The less milk needed for the purpose, the greater is the proportion of cream or butter that it contains. The following Table by Vogel (the inventor of this Lactoscope) shows the percentage of butter, corresponding to different quantities of milk made use of for this mode of trial.

Column M *represents the Septems of Milk used; Column* B *the Percentages of Butter indicated in that Milk.*

M	B	M	B	M	B	M	B	M	B	M	B
1	23·43	4½	5·38	8	3·31	13	2·01	20	1·39	40	0·81
1½	15·46	5	4·87	8½	2·96	14	1·88	22	1·28	50	0·69
2	11·83	5½	4·45	9	2·80	15	1·78	24	1·19	60	0·61
2½	9·51	6	4·09	9½	2·77	16	1·68	26	1·12	70	0·56
3	7·96	6½	3·80	10	2·55	17	1·60	28	1·06	80	0·52
3½	6·86	7	3·54	11	2·43	18	1·52	30	1·00	90	0·48
4	6·03	7½	3·32	12	2·16	19	1·45	35	0·89	100	0·46

According to the examination of the milk of 4 cows, the Septems of milk used were, maximum 5·8, minimum 2·, mean 3·7. Another set of 4 cows, maximum 5·3, minimum 3·4. Another set of 7 cows, maximum 9, minimum 3, mean 6·2. These results range from 2·80 to 11·83, or nearly from 3 to 12 per cent. of butter, a very wide range; which, assuming the experiments to be correct, show clearly the necessity incumbent upon dairy farmers to examine the produce of their cows vigilantly.

But, however useful this apparatus may be for such investigations and comparisons as the above, it fails to effect the commercial purpose of detecting the adulteration of milk with water; for it is clear that the milk of one cow, diluted with 100 per cent. of water, may still be as rich in butter as the milk of another cow presented in its genuine condition. Nevertheless, there is this point of certainty in the method, that if you fix upon a given quality, say 4 per cent. of butter, which is indicated by a mixture of 6 Septems of milk with 100 Septems of water, it is always easy to determine whether any given sample of milk is above or below this standard.



2876.

2876. Apparatus for the distillation of small quantities of liquor, such as alcohol from wines, ammonia from gas liquor, &c., Fig. 2876. Flask 3 to 5 ounces, wide tube 10 inches by ¾ inch. *The set*, 3s.

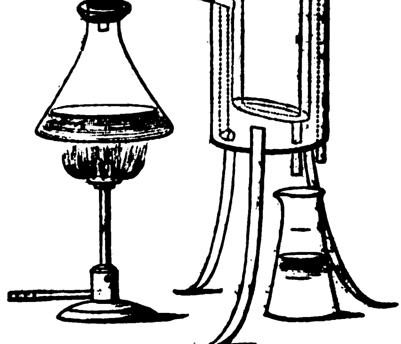
2877. Still for the Separation of Alcohol from Wines, consisting of a Glass Still, pint size, a Copper Condenser, and a glass receiving jar, graduated to show ¼ pint, ½ pint, 3000 grains, or any desired quantity. *The set*, 21s.

Price of the Gas Burner No. 973, 1s. 6d.

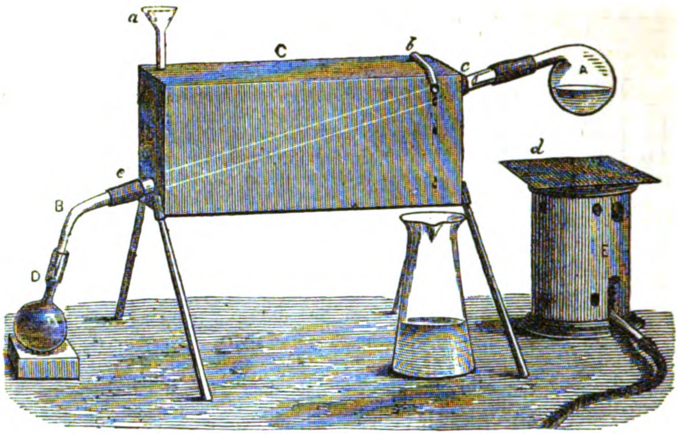
The Condenser is constructed on the plan described at length at No. 1914, page 207. The body of the condenser, made of zinc, measures 11 inches by 5 inches; the legs are 8 inches long. The interior cylinder of the condenser is made of copper, 3½ inches in diameter, with ½ inch space between its two walls. The glass still is made flat at the bottom, to afford space for the intumescence of the distilled liquors. The graduated jar serves to measure the wine, and to receive the distilled alcohol. It can have engraved upon it any two marks which the purchaser may desire, expressing grains, fluid ounces, parts of a pint, or parts of a litre.

In a special article on the chemical analysis of wines, I shall describe another form of Still and Condenser, with which less than a fluid ounce of wine can be tested for alcohol.

The present apparatus can also be used for the preparation of distilled water.



2877.



2877*a*.

2877A. Griffin's Wine Still, as adopted and used by the Customs Department of the United States of America—the simplest, cheapest, and most portable form of wine still—is fully described in "The Chemical Testing of Wines," crown 8vo., price 5s.

Price of Still, see Fig. 2877*a*, 18s.

The Revenue Standard Still for Wines and Spirits, is described at No. 1917, price £3, 10s. Keene's Wine Still, see No. 1918, £4, 4s.

2878. Geissler's Patent Vaporimeter, for estimating the Percentage of Alcohol contained in Wine, Beer, fermented Must, Vinegar, &c. The principle of this apparatus is, to convert a spirituous liquor into vapour by the heat of the steam of water, and to make the spirituous vapour force a column of mercury up against an engraved scale. Upon observing the level of the mercury on the scale, and the degree of temperature shown by the attached Thermometer, and referring these particulars to the printed Tables, it is easy to calculate the *Percentage by Volume*, according to Tralles, of the alcohol contained in the liquor submitted to trial. 45s.

2879. THE CHEMICAL TESTING of WINES and SPIRITS, by John J. Griffin, F.C.S. Crown 8vo., illustrated, price, 5s.

CONTENTS.

Analysis of 41 Wines by the processes described in this work. Table of the weight in grains of the constituents of a gallon of each Wine. Table of the percentages of the same constituents. Determination of the specific gravity of Wines and Spirits.

Alcohol Tables, an entirely new series, founded on the latest analytical investigations. Table of diluted Spirits of from 0 to 12 per cent. of absolute Alcohol by weight, showing, 1, Percentage of Alcohol; 2, Specific Gravity; 3, Weight of a centigallon of the mixture; 4, Weight of absolute Alcohol; 5, Weight of Proof Spirit; 6, Percentage according to Sikes. Table of Diluted Alcohols from 0 to 100 per cent. by weight, with similar details in six columns. Table of Percentages of Alcohol by volume, according to Tralles and Gay-Lussac, compared with percentage of Proof Spirit according to Sikes. Harmony of these various Alcoholometers. Table for the Dilution of Spirits, and for the Valuation of Proof Spirits according to Sikes. Series of Problems for calculation respecting Alcohol. Corrections for temperature required by experiments made with Alcohol.

Experimental Determination of the quantity of Alcohol in Wines. Experimental Determination of the quantity of Free Acids in Wines. Investigation of the best means of separating volatile from fixed Acids in Wines. Experimental Determination of the quantity of sugar in Wines. Process for the separate estimation of Grape Sugar and Cane Sugar. Determination of the amount of Solid Residue left when Wines are evaporated to dryness at 230° Fahr. Determination of the quantity of Ash or incombustible substances in Wines. Determination of the quantity of Free Alkali contained in the Ash of Wines. Estimate of the neutral Organic bodies contained in Wines. Programme of a Wine Analysis according to the methods described in this work.

Mutual relations of the Constituents of Wines. Conclusions respecting the proportions in which Alcohol, Acid, and Sugar ought to exist with one another to form good Wines. Testing of Spirits. Chemical notes on some special points in the manufacture of Wines. Testing of Must in good seasons and in bad seasons. Correction of Acid Must in bad seasons to render it fit to make good Wine. Preparation of good Wines from unripe Grapes. Wine-making without Grape-juice. Quick process for Maturing Wines. Blending and fortifying of Wines and Spirits. Import duty on Wines.

A Set of Apparatus and Test Solutions, for determining the following particulars respecting any sample of Wine :—

1. The quantity of Free Acid in the Wine.
2. The percentage of Alcohol.
3. The percentage of Sugar.
4. The percentage of Extract, or solid residue left by evaporation at 230° F.
5. The percentage of fixed alkaline Salts.

A. For Weighing Liquids,	£3	13s. 6d.
B. For Distillations,	1	10s. 8d.
C. For Estimation of Free Acid,	1	17s. 3d.
D. For Estimation of Sugar,		18s. 7d.
E. For Estimation of Solid Residue,		10s. 0d.
F. For Estimation of Ash,		19s. 0d.
Summary.—The complete set as enumerated,	£9	9s. 0d.
The same without the Balance and Weights,	6	6s. 0d.

A detailed price list is given at the end of the book.

2880. ECONOMY IN SUGAR-MAKING: a Collection of Apparatus and Chemical Tests for Testing the Quality of the Juice of the Sugar Cane, &c., so as to determine the exact quantity of Quicklime required to temper a given quantity of Cane-Juice, in order to produce the greatest amount of the best sugar. According to Dr. JOHN SHIER.

2881. DIRECTIONS FOR TESTING CANE-JUICE, with Practical Instructions for conducting the process of Clarification. By John Shier, Esq., LL.D., late Agricultural Chemist to the Colony of British Guiana. Illustrated with numerous woodcuts, price 3s.

This work contains full details for conducting the process of Testing, which is very simple, and such as can be followed by the workmen on a sugar estate.

THIS APPARATUS CONTAINS THE FOLLOWING ARTICLES :—

Thermometer, with scale on milk glass to 350° Fahr.

Twaddell's Hydrometer, No. 1, degree 0 to 24, or spec. grav. 1000 to 1120; ditto, No. 4, degree 74 to 102, or spec. grav. 1370 to 1510, graduated at 84° Fahr.

Two Solution Jars, for use with the hydrometers.

Pan, to hold the solution jars.

Glass Funnel, Funnel Holder, 100 Paper Filters in a case, and two pieces of Muslin, for straining the Cane-Juice.

Glass Measure for 250 Septems, or the 40th part of a gallon.

Graduated Burette for measuring the Test liquors, 100 Septems in 100°, with a support.

Furnace for Boiling the Cane-Juice rapidly; consisting of a glass spirit lamp, with supply of wick, a tin-plate furnace cylinder with door to put round the lamp, and a larger cylinder to cut off draughts of air, being the form of furnace which Dr. Shier found most useful in Demerara.

Stoppered Bottle, $\frac{1}{10}$ gallon, for Spirits of Wine.

Set of four Bohemian-beaked Tumblers, in which to boil the measured Cane-Juice.

Bottle, $\frac{1}{10}$ gallon, with Lime Water.

Bottle, $\frac{1}{10}$ gallon, filled with pure Lime.

Bottle, with 12 books of best Litmus test paper.

Pocket Case, with 1 book of Litmus test paper.

Six Test Glasses, a pipette, 6 glass stirrers, and a rest for pipettes and stirrers.

Cabinet, with Lock and Key, made with a drawer and divisions, in which this apparatus is arranged for convenient use, and for travelling with safety. Size of the Cabinet, 18 inches long, 12 inches wide, 11 inches high.

2882. Price of the Collection, when the Cabinet is of polished mahogany, £4, 4s.
2883. Price, when the Cabinet is of pine wood, stained black, £3, 10s.
2884. Price of a Packing Case to contain the Cabinet, for transport by sea, *if lined with metal*, 10s.
2885. Packing Case, when not lined with metal, 4s.

The following Advertisement, issued when Dr. Shier's Book and this Collection of Apparatus were first published, shows what may be expected from the use of this process of Testing :—

CONTENTS OF THE BOOK, No. 2881.

PART I.—Report on the Clarification of Cane-Juice. *Addressed to His Excellency Henry Barkly, Esq., Governor of the Colony of British Guiana.*—Introduction.—Process of Straining Cane-Juice.—The Hydrometer.—Processes of Clarification, with their Defects : *a.* By Cold Tempering ; *b.* By Cracking ; *c.* By Bisulphite of Lime ; *d.* By the New Chemical System, regulated by Checks and Tests.—Tables showing the Correspondence of Degrees of Baumé's and Twaddell's Hydrometers, with the Specific Gravities of Solutions.—Table of Solutions of Sugar.
PART II.—Practical Directions for Testing Cane-Juice, so as to determine the exact amount of Quicklime required to Temper a given Quantity of Cane-Juice.
PART III.—Description of the Chemical Apparatus recommended for Use in Colonial Sugar Works. Illustrated by Wood Engravings.

The Report on the Clarification of Cane-Juice, addressed by Dr. Shier to the Governor of British Guiana, is now reprinted, to accompany a collection of Chemical Apparatus, which has been prepared on a plan arranged by Dr. Shier, for the use of Planters who may be inclined to adopt his improved process of Clarification.

In order to render the operation of Testing as iutelligible as possible to those not well acquainted with Chemical Experiments, Dr. Shier drew up, during his visit to England, the Practical Directions for Testing Cane-Juice, which form the Second Part of this work; and, at his desire, there has been added an illustrated description of the Apparatus and Materials that are required to carry his method of Testing into operation.

It has been well ascertained in Britain that the beneficial produce of Chemical Works is greatly increased when the details of the manufacturing processes are regulated scientifically ; and it is but reasonable to expect that the regulation of Colonial Sugar Works by scientific processes would also prove advantageous. But it will probably surprise the Planter, who is ignorant of chemical phenomena, to find the performance of so simple and easy a process as that recommended by Dr. Shier leading to so important an improvement as an increase of *One-fifth* in the Produce of Sugar, without any increase in the Expense of Manufacture,—no change being required in the arrangement of the Coppers and other Apparatus now in use. The result is one that will no doubt excite the attention of all who are interested in the prosperity and profits of Sugar Estates.

"We beg to direct the attention of our Sugar-making friends to the Advertisement relative to Dr. Shier's Apparatus for Testing Cane-Juice, &c. If it only effects one-tenth of the benefit promised, it will be cheap at one hundred-fold the advertised cost."—*From the* Barbadoes Globe.

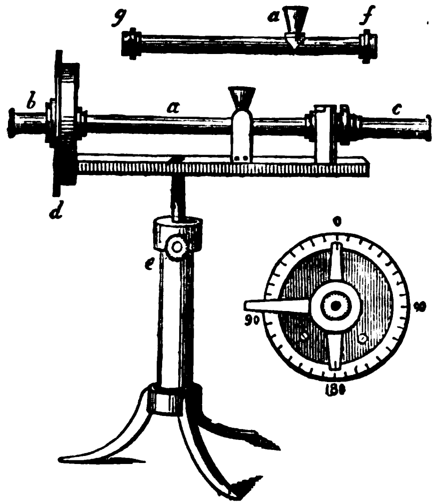
The *actual beneficial results of the process* are stated in the following summary, contained in the Official Report, presented by Dr. Shier to his Excellency Governor Barkly :—

"By following this method, I have prepared many specimens of sugar from canes of various sorts, and from many different localities in the colony. These samples have been transmitted to London, Glasgow, and other markets, to be valued, and have ranged from 3s. to 8s. per cwt. above the average price of Demerara muscovado in the market at the time. But this is not all : in consequence of the saving of juice effected by the mode of clarification being such as admitted of substituting subsidence and filtration for skimming, I obtained nearly 20 per cent. more of the juice than would have been got by the process as usually conducted, and the juice yielded from 1 lb. 4 oz. to 1 lb. 10 oz. of muscovado per gallon."

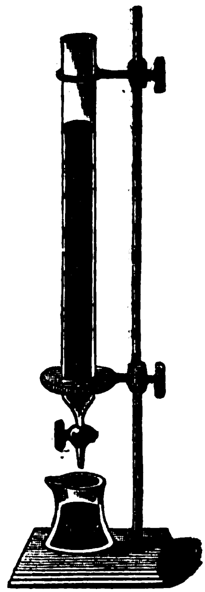
2886. Mitscherlich's Polariscope, or Optical Saccharimeter, Fig. 2887, £3, 10s.
2887. The Tube *g a f*, Fig. 2887, if made of glass, brass mounted, costs 10s.

2888. INSTRUCTIONS for the TESTING of SUGARS by the Polariscope, &c., 1s.

2888A. GLASS TUBE, for treating the Sugar Syrup with charcoal, with brass mount and stopcock; size, 24 × 2 inches, Fig. 2888*a*. Tube and Cock, only 15s. Iron Stand, with two Iron Rings, 5s.



2887.



2888*a*.

ASSAYING OF METALS AND ORES.—SETS OF APPARATUS AND TEST SOLUTIONS for the Volumetric Analysis of solutions of iron, copper, zinc, tin, lead, &c., prepared to order. *The following set for the Assay of Zinc is given as an example:—*

2889. APPARATUS FOR THE RAPID ASSAY OF ZINC ORES FOR TECHNICAL PURPOSES. The zinc is tested by a solution of sulphide of sodium. The operation is easily performed by a workman, and an analysis can be completed in less than an hour. *Price of the Set, complete, 17s.*

The instruments enumerated in the following list are described and figured in this work at the numbers specified against each article.

2688, 30.	Mohr's Burette, 100 Septems in ½, 4s.
2702.	Support for Mohr's Burette, 3s. 6d.
2783, 20.	Bottle, to measure 1 Decigallon, or 1000 Septems, 1s. 6d.
2768, 17.	Bulb Pipette, to deliver 10 Septems, 7d.
2768, 21.	Bulb Pipette, to deliver 50 Septems, 1s.
2798, 10.	Two Mixing Jars, pint size, with graduation at 5 ounces, 1s. 9d. each.
2818.	Two Pipette Bottles, with Caps and Pipettes, 1s. each.
2815*b*.	Porcelain Testing Slab, for Coloured Precipitates, 1s.
1401.	Pint Flask, for Preparing Solutions, 9d.
2813.	Griffin's Quick Filter, 3d.
2814.	Three Decanting Tubes, 6d.
2768, 16.	Small Pipette, 5 Septems, for adjusting measures, 4d.
	Detailed Instructions for performing the Analysis, 1s.
	The above set of Apparatus complete, 17s.

The following articles are required for carrying out this process. The necessary quantity of chemicals depends upon the contemplated activity of the operations :—

424. Balance, 31s. 6d.
445. Weights, 28s.
51. Agate Mortar, 3 inch, 17s.
870. Spirit Lamp, 20s.
Sulphate of Zinc, per lb., 1s.
Sulphide of Sodium, per lb., 3s.
Ferric Chloride, per oz., 1s.
Ferridcyanide of Potassium, per oz., 9d.
Ammonia Carbonate, per lb., 1s. 6d.
Ammonia, per lb., 8d.
Hydrochloric Acid, per lb., 6d.
Nitric Acid, per lb., 1s.

When Blende containing copper is to be tested, the following articles are required :—

2005. Sulphuretted Hydrogen Apparatus, 3s. 6d.
Sulphide of Iron, per lb., 6d.
Commercial Sulphuric Acid, sp. gr. 1·845 per lb., 2d.

Foreign orders should specify whether duplicates of the *breakable* glass apparatus are required.

2889A. Set of Chemical Apparatus, with re-agents and graduated test solutions suitable for the use of Paper Makers, especially in testing caustic and carbonate of soda, sulphuric and hydrochloric acids, and the amount of chlorine in solid and liquid bleach, &c. The whole in a divided stained pine cabinet containing prepared standard solutions and the necessary graduated instruments and chemical re-agents to prepare them. Price £10.

Pamphlets giving details of the apparatus and complete instructions as to their manipulation, 6d.

VOLUMETRIC ANALYSIS ACCORDING TO THE "BRITISH PHARMACOPŒIA."

2890. A. VOLUMETRIC SOLUTIONS.

These solutions are identical with the solutions described in the present work at the numbers cited below.

The PRICES *include the cost of* BOTTLES.

	No.	Pint.	Half-Gallon.
Oxalic Acid,	3035	2s. 0d.	6s. 0d.
Soda,	3040	2s. 0d.	6s. 0d.
Nitrate of Silver,	3049	3s. 6d.	12s. 0d.
Hyposulphite of Soda,	3054	2s. 0d.	6s. 0d.
Iodine,	3055	2s. 6d.	7s. 6d.
Bichromate of Potash,	3061	2s. 0d.	6s. 0d.

The composition of these solutions will be found on reference to the respective numbers.

2891. B. VOLUMETRIC APPARATUS.

The information given in the "British Pharmacopœia" on the subject of apparatus for volumetric analysis is as follows :—

a. "The tube used with the volumetric solutions is an Alkalimeter, which, when filled to 0, holds 1000 grains of distilled water at 60°, and is divided into 100 parts of equal capacity."

Each of the measures of 10 grains of water is called in this work a *Decem.*

The following sentence explains the method by which the analyst is to measure the liquid that is to be submitted to volumetric analysis :—

b. "One fluid drachm of sulphuric acid requires for neutralisation 206 measures of the volumetric solution of soda."

The "Pharmacopœia" does not define the word *measures* used in quotation *b*. I take it for granted that it means *Decems*, or measures of the bulk of 10 grains of water, similar to each of the hundred degrees on the scale of the test tube described in quotation *a*.

Neither does the "Pharmacopœia" inform us in what manner the "fluid drachm" is to be measured, whether in an ordinary conical fluid drachm measure, or how else.

Supposing it to be allowable to render the volumetric processes described in the "Pharmacopœia" more convenient in practice than it is possible for them to be, if the vague instructions which it gives are carelessly interpreted, I venture to recommend the adoption of the following instruments, the numbers prefixed to which refer to descriptions and figures given in former articles of this work:—

2688. Mohr's Burette, 100 Decems in $\frac{1}{1}$, 4s.
2688. Mohr's Burette, 35 Decems in tenths, 3s.
2702. Support for Mohr's Burette, 3s. 6d.
2736. Binks's Burette, 100 Decems in $\frac{1}{1}$, 4s.
2738. Mahogany Foot for ditto, 1s. 6d.
2768. Bulb Pipette, to deliver 1 fluid drachm, 10d.
Measure divided into 10 fluid drachms, 2s.
2769. Scale Pipette, 100 minims in $\frac{1}{1}$, 2s.
2769. Scale Pipette, 1 fluid ounce in 8 fluid drachms, 2s.
2798 *c*. Mixing Jar, half-pint, 9d.
2798 *a*. Mixing Flask, half-pint, 5d.
2815 *a*. Porcelain Testing Slab, for coloured precipitates, 1s. 9d.
2813. Griffin's Quick Filter, 3d.
2814. Decanting Tube, 2d.
2817. Test Glasses, half dozen, 8d.
2423. Litmus Test paper, 3 books, 6d.

2892. The Complete Set of Apparatus, £1, 7s.
2893. The Set of 6 Test Solutions, 1 pint each, 14s.
2894. The Apparatus and Solutions together, £2.

By Act of Parliament, the Imperial weights and measures are justified at 62° F., and the above vessels are graduated at that temperature. The "Pharmacopœia" prescribes 60°, which is a useless deviation from an established standard.

2894 *a*. Mohr's Burette can be used with all the test solutions, except that of iodine, which requires a burette without a caoutchouc tube. Binks's Burette can be used, not only with iodine, but with all the other solutions; but it is less convenient than Mohr's; and as the iodine solution is only rarely required, the most generally useful form of burette is Mohr's. The "Pharmacopœia" recommends the scale to be 100 Decems in 100 divisions; but it gives analyses with such results as 80·8, 84·74, 93·88, which read to hundredths of Decems. For analyses that require such close reading, it is better to use smaller quantities of liquors for analysis, and to apply the test solution with a smaller burette graduated to show 10ths of Decems.

2894 *b*. The quantity of liquor recommended by the "Pharmacopœia" for analysis is very frequently 1 *fluid drachm*. This quantity is absurdly large, when the liquid is concentrated. As shown in quotation *b*, 206 Decems of test solution are used in one experiment. That quantity demands three fillings of the burette; and if the process of testing is repeated, which is almost always necessary, there will be required six fillings of the burette, and a consumption of test soda amounting to 4120 grain measures, or nearly half a pint. To prevent this extravagance, it is only necessary to measure accurately 1 fluid drachm with a pipette, to dilute this with water to the bulk of 10 drachms, and to apply the test to 1 drachm of this mixture. Of course, the consumption of soda test will then be 20·6 Decems; and if great accuracy is required, this quantity is best estimated by means of a small burette which shows 10ths of Decems. The test can be easily repeated with the same diluted liquor, and an accurate result procured by the expenditure of only 41·2 Decems of soda test instead of 412 Decems, and this in less than a fifth part of the time that would have to be spent in literally obeying the instructions given in the Pharmacopœia.

The scale pipettes, showing minims and fluid drachms, are required for measuring out specific quantities of liquids for testing. Thus, with the minim pipette, you can measure out the *half*, the *quarter*, or any other aliquot part of a drachm; and, with the drachm pipette, you can readily and accurately measure such quantities as 2, 4, or 6 drachms, quantities which are frequently prescribed in the Pharmacopœia.

COLLECTIONS OF VOLUMETRIC APPARATUS FOR GENERAL USE.

2895. The applications of volumetric analysis are so numerous, and the variety of sorts and sizes of graduated instruments is so great, that it is impossible to make up a list of what could with any propriety be called "A SET" of Volumetric Apparatus. Every chemist, according to the special course of his researches, and every chemical manufacturer, according to the extent, the activity, and the accuracy of his operations, will require instruments directly suited to his peculiar processes; and these he must himself select. All that can be done in this place, is to give a few hints to guide those who have not hitherto conducted volumetric researches, in selecting collections of instruments, more or less complete, according to the course of operations which they intend to pursue.

The lists furnished with this view will be confined to instruments graduated according to the SEPTEM standard; but other collections of instruments, of similar extent, and at nearly the same prices, can be prepared to suit either the DECEM standard, or that of the CENTIMETRE CUBE.

The items in these collections can be limited or enlarged to any extent the purchaser wishes. The descriptions and figures of the instruments will be found at the numbers placed in the margin of these lists; and at the places referred to, other varieties, differing in size, form, or style of graduation, will be found of each instrument, from among which the chemist can select such as seem best to suit his purpose.

No notice is taken in these lists of instruments of common use, but which are not volumetric, such as balances, weights, mortars, boiling flasks, evaporating basins, gas bottles, lamps, gas burners, and the like; ample details respecting such instruments are given in other sections of this work.

In the article "Urinometry" examples are given of sets of volumetric apparatus suitable for a definite series of operations. See No. 4070.

2896. VOLUMETRIC APPARATUS. SET A. Price £5, 18s. 6d.

2688, 25. Pair of Mohr's Burettes, 55 Septems in $\frac{1}{5}$ s., 6s.
2688, 30. Pair of Mohr's Burettes, 100 Septems in $\frac{1}{1}$ s., 8s.
2688, 23. One Mohr's Burette, 35 Septems in $\frac{1}{10}$ s., 3s.
2698 a. Mahogany Clamp Stand for a pair of Mohr's Burettes, 7s. 6d.
2704. Metal Support for a pair of Mohr's Burettes, with three arms, 6s. 6d.
2728. Erdmann's Floats for the 5 Burettes, 1s. each.
2689, 13. Mohr's Burette, with Glass Stopcock, 55 Septems in $\frac{1}{5}$ s., 4s.
2736, 25. Binks's Burette, 100 Septems in $\frac{1}{1}$ s., 3s. 6d.
2738. Mahogany Foot for Binks's Burette, 1s. 6d.
2768. Bulb Pipettes, 2 each of 5 and 10 Septems, the set, 1s. 10d.
2768. Ditto, 1 each 15, 20, 25, 50, 100 Septems, the set, 4s. 5d.
2768, 33. Ditto, for 1 fluid ounce, 10d.
2768, 36. Ditto, for 1 cubic inch, 10d.
2768, 41. Ditto, for 1 fluid drachm, 10d.
2769, 25. Scale Pipettes, 1 Septem in $\frac{1}{10}$ s., 6d.
2769, 30. Ditto, 10 Septems in $\frac{1}{5}$ s., 1s.
2769, 33. Ditto, 20 Septems in $\frac{1}{5}$ s., 1s. 3d.
2769, 28. Ditto, 5 Septems in $\frac{1}{10}$ s., 1s.
2769, 40. Ditto, 50 Septems in $\frac{1}{2}$ s., 1s. 9d.
2769, 42. Ditto, 100 Septems in $\frac{1}{1}$ s., 2s. 6d.
2778. 2 Fluted Porcelain Rests for Pipettes, each 1s. 9d.
2783. Measuring Flask, 1 each, for 50, 100, 200, 250, 500, and 1000 Septems, 6s.
2783, 28. Ditto, 1 Imperial pint, 2s.
2786, 1. Measuring Flask, with Stopper, for 1 Decigallon, 1s. 6d.
2791, 1. Test Mixer, for 1 Decigallon, 5s.
2791, 3. Ditto, for 5 Decigallons, 10s. 6d.

2798 *a.* Mixing Jars, 2 each, Nos. 1, 2, 3, 4, *the set*, 3s.
2798 *c.* Ditto, 3 each, Nos. 8, 9, 10, *the set*, 7s.
2799. Shaking Bottles, *three*, 2s. 3d.
2800. White Glazed Porcelain Slab, *two*, 2s.
2813. Griffin's Quick Filter, *two*, 6d.
2814. Decanting Tube, *three*, 6d.
2815 *a.* Porcelain Slab, for trying Colour Tests, 1s. 9d.
2815 *b.* Ditto, with deeper cells, 1s.
2817. Small Conical Test Glasses, for white precipitates, 1 *dozen*, 1s. 3d.
2818. Pipette Bottle, for Tincture of Litmus, 1s.
2818. Ditto, for Tincture of Hematine, 1s.
2431. Litmus Test Paper, 12 books in a bottle, 3s.
1482. Set of 6 Beaked Tumblers, for Decanting Test Liquors, filling Burettes, &c., 4s.

2897. VOLUMETRIC APPARATUS. Set B. Price £3.

2688, 30. Pair of Mohr's Burettes, 100 Septems in $\frac{1}{1}$ s., 8s.
2688, 25. Mohr's Burette, 55 Septems in $\frac{1}{5}$ s., 3s.
2688, 23. Mohr's Burette, 35 Septems in $\frac{1}{10}$ s., 3s.
2689, 13. Mohr's Burette, with Glass Stopcock, 55 Septems in $\frac{1}{5}$ s., 4s.
2698. Clamp Support for 2 Mohr's Burettes, Black Wood, 5s. 6d.
2728. Erdmann's Floats, *two*, 2s.
2768. Bulb Pipettes, 1 each, 5, 10, 25, 50, and 100 Septems, *the set*, 3s. 11d.
2769, 25. Scale Pipette, 1 Septem in $\frac{1}{10}$ s., 6d.
2769, 32. Ditto, 20 Septems in $\frac{1}{1}$, 1s. 3d.
2769, 36. Ditto, 25 Septems in $\frac{1}{5}$, 1s. 6d.
2769, 40. Ditto, 50 Septems in $\frac{1}{2}$, 1s. 9d.
2778. Fluted Porcelain Rest for Pipettes, 1s. 9d.
2783. Measuring Flasks, 1 each, 50, 100, 250, 500, and 1000 Septems, 5s.
2791, 1. Test Mixture, for 1 Decigallon, 5s.
2798 *a.* Mixing Jars, 1 each, Nos. 1, 2, 3, *the set*, 1s.
2798 *c.* Ditto, 1 each, Nos. 8, 9, 10, *the set*, 2s. 3d.
2799. Shaking Bottle, 9d.
2800. White Glazed Porcelain Slab, 1s.
2813. Griffin's Quick Filter, *two*, 6d.
2814. Decanting Tubes, *three*, 6d.
2815 *a.* Porcelain Slab, for trying Colour Tests, 1s. 9d.
2817. Conical Test Glasses, *six*, 8d.
2818. Pipette Bottle, for Litmus Tincture, 1s.
2818. Ditto, for Tincture of Hematine, 1s.
1484. Set of 4 Beaked Tumblers, 2s. 4d.
2426. Box of Test Papers, 1s.

2898. VOLUMETRIC APPARATUS. Set C. Price 35s.

2688, 30. Pair of Mohr's Burettes, 100 Septems in $\frac{1}{1}$ s., 8s.
2688, 23. One Mohr's Burette, 35 Septems in $\frac{1}{10}$ s., 3s.
2689, 13. One Mohr's Burette, with Glass Stopcock, 55 Septems in $\frac{1}{5}$ s., 4s.
2697. Clamp Support for 1 Burette, Black Wood, 4s.
2768. Bulb Pipettes, 10, 25, 50 Septems, *the set*, 2s. 4d.
2769, 32. Scale Pipettes, 20 Septems in $\frac{1}{1}$, 1s. 3d.
2769, 30. Ditto, 10 Septems in $\frac{1}{5}$, 1s.
2783. Measuring Flasks, 50, 100, 500, 1000 Septems, *the set*, 3s. 9d.
2798 *a.* Mixing Jars, 1 each, Nos. 1, 2, 3, 4, *the set*, 1s. 6d.
2798 *b.* Ditto, 1 each, Nos. 5, 6, *the set*, 10d.

2800. White Glazed Porcelain Slab, 1s.
2813. Griffin's Quick Filter, *two*, 6d.
2814. Decanting Tubes, *three*, 6d.
2815 *a*. Porcelain Slab, for trying Colour Tests, 1s. 9d.
2817. Conical Test Glasses, *four*, 5d.
2818. Pipette Bottle, for Litmus Tincture, 1s.

2899. VOLUMETRIC APPARATUS. SET D. Price 20s.

2688. Mohr's Burette, 100 Septems in $\frac{1}{1}$ s., 4s.
2702. Metal Support for Mohr's Burette, 3s. 6d.
2768. Bulb Pipettes, for 10 and 50 Septems, 1s. 7d.
2769. Scale Pipettes, for 20 Septems in $\frac{1}{1}$ s., 1s. 3d.
2783. Measuring Flasks for 100, 250, and 1000 Septems, 2s. 3d.
2798. Mixing Flasks, Nos. 2, 4, 9, 1s. 7d.
2800. White Glazed Porcelain Slab, 1s.
2813. Griffin's Quick Filter, *two*, 6d.
2814. Decanting Tube, *three*, 6d.
2815 *a*. Porcelain Slab, for trying Colour Tests, 1s. 9d.
2818. Pipette Bottle, for Litmus Tincture, 1s.

Graduated Test Solutions, for Volumetric Analysis.

2900. The following Test Solutions comprise such as are chiefly in demand at the present time; but as new processes, modifications of existing processes, and adaptations to manufacturing purposes, appear almost every month, it is clear that a list of this description must be subject to very frequent revision. From time to time, therefore, supplementary catalogues will be published.

The TEST SOLUTIONS are arranged in *three classes*, corresponding to the three units of measurement,—namely, the Septem, the Centimetre Cube, and the Decem.

The PRICES *quoted in the following list are for the* IMPERIAL PINT *of* 20 *fluid ounces, and the* HALF GALLON *of* 80 *ounces. These prices include the cost of* STOPPERED GLASS BOTTLES. If the pint Bottles are of fine Germam glass, and *of* the form of Fig. 1551, the extra charge for each is 9d.

VOLUMETRIC CHEMICAL SOLUTIONS, FOR USE WITH INSTRUMENTS GRADUATED INTO SEPTEMS.

2901. One equivalent of any chemical, weighed in grains and dissolved in a Decigallon of solution at 62° Fahr., constitutes a solution of ONE DEGREE of strength, marked 1°. Every additional equivalent in grains included in this measure of solution, increases the strength by 1°: five equivalents in grains dissolved in a Decigallon, produce a solution of 5°; half an equivalent produces a solution of ½°; and so on. Since a Decigallon contains 1000 Septems, it is easy to value fractional parts of the dissolved chemical: thus, supposing the solution to be of 1° of strength,—

1000	Septems	contain	1·0	atom.
100	,,	,,	·1	,,
10	,,	,,	·01	,,
1	,,	,,	·001	,,

The acting powers of the solutions necessarily correspond with their strength in equivalents, or degrees. Thus, 100 Septems of any alkaline solution of 1°, containing the $\frac{1}{10}$ part of an atom, will neutralise the $\frac{1}{10}$ part of an atom of any monobasic acid, and 1 Septem of such a solution will neutralise the $\frac{1}{1000}$ part of an atom. Hence the weight of a quantity of any acid submitted to analysis is found by multiplying the $\frac{1}{1000}$ part of its atom in grains by the number of Septems of any alkali used to saturate it.

ACID TEST SOLUTIONS, for the estimation of ALKALIES and ALKALINE EARTHS, when in the caustic state, or in the state of Carbonates. Nos. 2903 to 2914.

TEST ACIDS OF ONE DEGREE (1°). The four TEST ACIDS, Nos. 2903 to 2906, are of the same strength. They each contain in a Decigallon one atom of ACID weighed in grains. One Septem of each contains the $\frac{1}{1000}$ part of an atom, and is competent to neutralise the $\frac{1}{1000}$ part of an atom in grains of any ALKALI or ALKALINE CARBONATE considered as monobasic.

2903. SULPHURIC ACID of 1°. HSO^2. 49. Solution containing 49 grains in a Decigallon. 1 Septem = ·049 grains of HSO^2, or ·04 grain of anhydrous acid. *Pint*, 2s.; *Half-gallon*, 6s.

2904. NITRIC ACID of 1°. HNO^3. 63. Solution containing 63 grains in a Decigallon. 1 Septem = ·063 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2905. HYDROCHLORIC ACID of 1°. HCl. 36·5. Solution containing 36·5 grains in a Decigallon. 1 Septem = ·0365 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2906. OXALIC ACID of 1°. HCO^2. 45. The crystallised acid is HCO^2 + Aq. 63. Solution containing 45 grains of HCO^2 or 63 grains of the crystallised acid in a Decigallon. 1 Septem = ·045 grain of HCO^2 = ·063 grain of HCO^2 + Aq. or ·036 grain of $\frac{1}{2}$ C^2O^3, the anhydrous acid. *Pint*, 2s.; *Half-gallon*, 6s.

TEST ACIDS OF FIVE DEGREES (5°). The four acids, Nos. 2908 to 2911, are of equal strength. They each contain, in a Decigallon, five atoms of acid, weighed in grains; that is to say, they are five times as strong as the acids described above, 1 Septem of each contains the $\frac{5}{1000}$ part or the $\frac{1}{200}$ part of an atom of ACID, and it is competent to neutralise the $\frac{5}{1000}$ or the $\frac{1}{200}$ part of an atom, weighed in grains, of any ALKALI or ALKALINE CARBONATE, estimated as monobasic.

2908. SULPHURIC ACID of 5°. HSO^2. 49 × 5. Solution containing 245 grains in a Decigallon. 1 Septem = ·245 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2909. NITRIC ACID of 5°. HNO^3. 63 × 5. Solution containing 315 grains in a Decigallon. 1 Septem = ·315 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2910. HYDROCHLORIC ACID of 5°. HCl. 36·5 × 5. Solution containing 182·5 grains in a Decigallon. 1 Septem = ·1825 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2911. OXALIC ACID of 5°. HCO^2. 45 × 5. Solution containing 225 grains or 63 × 5 = 315 grains of crystals in a Decigallon. 1 Septem = ·225 grain of HCO^2, or ·315 grain of crystallised acid. *Pint*, 2s.; *Half-gallon*, 6s.

2912. SULPHURIC ACID of 10°. HSO^2. 49. Solution containing 49 × 10 = 490 grains of hydrated sulphuric acid, or 400 grains of anhydrous sulphuric acid in a Decigallon. *Pint*, 2s.; *Half-gallon*, 6s.

2912*a*. USE OF THIS TEST LIQUOR. 1 Septem contains 0·49 grain of HSO^2, and neutralises—

0·31	grain of	Anhydrous Soda.
0·40	,,	Hydrate of Soda.
0·53	,,	Anhydrous Carbonate of Soda.
0·47	,,	Anhydrous Potash.
0·56	,,	Hydrate of Potash.
0·69	,,	Carbonate of Potash.
0·17	,,	Ammonia.

Accordingly, if 40 grains of crude hydrate of soda are dissolved and tested with this acid, the number of Septems of acid used indicates the *percentage of pure substance* contained in the crude sample; and so on of the other salts.

2912*b*. ESTIMATION OF THE DIFFERENT CONSTITUENTS OF CRUDE CAUSTIC SODA.—The following is an example of a more intimate examination of caustic soda performed with one weighing and with dilute test solutions :—Weigh 40 grains of crude soda, and make with it a solution of 1000 Septems. Of this solution use 100 Septems for each testing process. 1. Neutralise with nitric acid of 1º, using Mohr's Burette. The Septems of acid used show the percentage of caustic soda in the sample. The same number multiplied by ·031 (see table 2913) shows the weight of anhydrous soda in $\frac{40}{10}$=4 grains of the crude soda. 2. Precipitate 100 Septems with a slight excess of chloride of barium, filter off the carbonate of barytes, and test the residual liquor with nitric acid of 1º. The number of Septems of acid used indicate the alkalinity due to hydrate of soda, not including that due to carbonate of soda. 3. Neutralise 100 Septems with nitric acid (example 1 shows how much is to be added), and precipitate sulphuric acid with nitrate of barium of 1º (Nos. 2935 and 2935*b*). 4. Neutralise 100 Septems with nitric acid, and precipitate chlorine by nitrate of silver of 1º (No. 2948). There yet remains 600 Septems of solution, with which, if required, other estimates can be made, such as those of sulphide, hyposulphite, silica, &c. In this analysis, experiments 1 and 2 can be made with graduated sulphuric or oxalic acid ; but as nitric acid is indispensable for experiments 3 and 4, the use of that acid for experiments 1 and 2 also saves the time and trouble of cleaning and drying additional burettes.

2912*c*. INTERFERENCE OF CARBONIC ACID WITH THE COLOUR TESTS IN PROCESSES OF ALKALIMETRY.—When carbonates of the alkalies, or alkalies reputed to be caustic, but which commonly contain some carbonate, are tested with graduated acids, the liberated carbonic acid reddens the litmus before the alkali is quite saturated with the test acid. To remove this difficulty, the solution must be boiled, and the testing be completed while the liquor is boiling hot. When many samples have to be tested, the most rapid and effectual way of proceeding is to mount two burettes, one with test acid and another with test alkali of equal strength. Then to overdose the alkali with the test acid, boil thoroughly to get rid of the carbonic acid, and conclude by bringing back the mixture to the neutral point, by adding the test alkali. The Septems of test acid used, minus the Septems of test alkali, show the true degree of the alkali that is submitted to analysis.

Dr. Mohr has recently replaced the Litmus Solution by one of Cochineal, the colour of which is not affected by the carbonic acid present, the boiling off of which is therefore not required.

All the crude salts of potash and soda, caustic and carbonated, can be tested by the above process.

2912*d*. Chemical manufacturers are much in the habit of using strong test solutions, such as No. 2912 ; but I take the liberty to suggest, that if they study the use of the pipette, which I have described in sections 2760-2766, and conduct their testing in the manner shown above, they will find it preferable to work with dilute solutions, especially such as are here described as of 1º of strength.

2913. ALKALIES AND ALKALINE EARTHS ESTIMATED BY ACID TEST SOLUTIONS.

The Quantities are expressed in Grains.

	Atomic Weight.	A. 1 Septem of Acid of 1º =	B. 1 Septem of Acid of 5º =
Ammonia, NH^3	17	·017	·085
Ammonium, NH^4	18	·018	·09
Barium, Ba	68·5	·0685	·3425
„ Oxide, Barytes, BaBaO	153	·0765	·3825
„ Hydrate, BaHO	85·5	·0855	·4275
„ Carbonate, Ba^2CO^3	197	·0985	·4925
Calcium, Ca	20	·020	·1
„ Oxide, anhydrous lime, CaCaO	56	·028	·14
„ Hydrate, CaHO	37	·037	·185
„ Carbonate, Ca^2CO^3	100	·050	·25
Potassium, K	39	·039	·195
„ Oxide, anhydrous potash, KKO	94	·047	·235
„ Hydrate, caustic potash, KHO	56	·056	·28
„ Carbonate, K^2CO^3	138	·069	·345
„ Bicarbonate, $HKCO^3$	100	·100	·5
Sodium, Na	23	·023	·115
„ Oxide, anhydrous soda, NaNaO	62	·031	·155
„ Hydrate, caustic soda, NaHO	40	·040	·2
„ Carbonate, Na^2CO^3	106	·053	·265
„ Do. cryst., $Na^2CO^3 + Aq.^{10}$	286	·143	·715
„ Bicarbonate, $HNaCO^3$	84	·084	·42

2914. USE OF THE TABLE, No. 2913.—When any alkaline solution is submitted to volumetric analysis against an acid of 1° or 5°, the number of Septems of test acid used, multiplied by the number given in this table, is the weight in grains of the real alkali of the substance that was submitted to analysis, or of its equivalent in a corresponding salt.

Example.—If an arbitrary quantity of a solution of soda requires 20 Septems of acid of 1° (it is of no consequence which of the four acids is used), then 20, if multiplied by ·031, gives the corresponding weight of anhydrous soda; if multiplied by ·04, it gives the weight of hydrated soda; if by ·053, it gives the weight of carbonate of soda; and if by ·084, it gives the weight of bicarbonate of soda; and so forth. It will be noticed that the anhydrous oxides and the carbonates are symbolised as Bibasic, while the hydrates and bicarbonates are Monobasic. This is necessarily the case when the atom of oxygen is held to weigh 16. The acids that saturate one monobasic atom, act only upon half an atom of bibasic substance. In fixing upon quantities of alkalies or their carbonates to be submitted to trial, this difference must be attended to, as it has been in framing the table, No. 2913. 100 times the quantity of any substance named in column A, subjected to trial with an acid of 1°, will give *per cents.* of pure substance. Thus, 6·9 grains of carbonate of potassium and 10 grains of bicarbonate will, if pure, each neutralise 100 Septems of any acid of 1°; but if they are impure, the percentage of impurity will be equal to the difference between 100 Septems of acid, and the number of Septems actually used in the trial.

The strongest possible alkaline solutions that can exist at 62° F. are these:—

Caustic Ammonia,	125°	Carbonate of Potash,	83·54°
Caustic Potash,	101·7°	Carbonate of Soda,	23·3°
Caustic Soda,	88·26°	*Both considered Monobasic.*	

Hence, for example, 1 Septem of Ammonia saturated at 62° F. requires 125 Septems of any acid of 1° to neutralise it, and the quantity of ammonia contained in it is 125 × ·017 = 2·125 grains; whereas, 1 Septem of concentrated solution of carbonate of soda requires only 23¼ Septems of acid of 1° to saturate it.

ALKALINE TEST SOLUTIONS, for the estimation of FREE ACIDS. Nos. 2916 to 2932.

TEST ALKALIES OF ONE DEGREE (1°). The five Test Alkalies, Nos. 2916 to 2920, are of the same chemical strength. They each contain in a Decigallon one atom of ALKALI weighed in grains. 1 Septem of each contains the $\frac{1}{1000}$ part of an atom, and is competent to neutralise the $\frac{1}{1000}$ part of an atom in grains of any monobasic ACID.

2916. POTASSIUM HYDRATE of 1°. Caustic Potash. KHO.56. Solution containing 56 grains in a Decigallon. 1 Septem = ·056 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2917. SODIUM HYDRATE of 1°. Caustic Soda. NaHO. 40. Solution containing 40 grains in a Decigallon. 1 Septem = ·04 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2918. POTASSIUM CARBONATE of 1°. Carbonate of Potash. K^2CO^3. 138. But used as monobasic. Atomic weight $\frac{138}{2} = 69$. Solution containing 69 grains in a Decigallon. 1 Septem = ·069 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2919. SODIUM CARBONATE of 1°. Carbonate of Soda. Na^2CO^3. 106. But used as monobasic. Atomic weight $\frac{106}{2} = 53$. Solution containing 53 grains in a Decigallon. 1 Septem = ·053 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2920. AMMONIA of 1°. NH^3. 17. Solution containing 17 grains in a Decigallon. 1 Septem = ·017 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2921. COPPER AMMONIA-SULPHATE of 1°. Formula probably $NH^4SO^2 + NH^4CucO$ = 131·75; but the test solution is made equivalent to Nitric Acid of 1°. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.

2921A. This test is an azure blue solution, which on being neutralised by an acid, loses its colour and gives a pale green precipitate. Its chief use is for testing acetic acid, the chemically neutral salts of which acid are not neutral in their action upon colour tests, and for determining the quantity of free sulphuric acid of the solutions in galvanic batteries, and other mixtures of free acid and metallic salts, as it acts on free acids only, and not on acid combined with zinc, copper, or other metals. 1 Septem of it is equal to the $\frac{1}{1000}$ part of an atom in grains of any acid. It is not quite permanent, and its degree requires to be occasionally checked against nitric acid of 1°.

TEST ALKALIES of FIVE DEGREES (5°). The six Alkalies, Nos. 2923 to 2928, are of the same strength. They each contain in a Decigallon five atoms of alkali weighed in grains; that is to say, they are five times as strong as the alkalies described above. 1 Septem of each contains the $\frac{5}{1000}$ part, or the $\frac{1}{200}$ part, of an atom of ALKALI, and it is competent to neutralise the $\frac{5}{1000}$ part, or the $\frac{1}{200}$ part of an atom, weighed in grains, of any monobasic ACID.

2923. POTASSIUM HYDRATE of 5°. Caustic Potash. KHO. 56 × 5. Solution containing 280 grains in a decigallon. 1 Septem = ·28 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2924. SODIUM HYDRATE of 5°. Caustic Soda. NaHO. 40 × 5. Solution containing 200 grains in a Decigallon. 1 Septem = ·2 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2925. POTASSIUM CARBONATE of 5°. Carbonate of Potash. K^2CO^3. 138. But used as monobasic. Atomic weight $\frac{138}{2}$ = 69 × 5. Solution containing 345 grains in a Decigallon. 1 Septem = ·345 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2926. SODIUM CARBONATE of 5°. Carbonate of Soda. Na^2CO^3. 106. But used as monobasic. Atomic weight $\frac{106}{2}$ = 53 × 5. Solution containing 265 grains in a Decigallon. 1 Septem = ·265 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2927. AMMONIA of 5°. NH^3. 17 × 5. Solution containing 85 grains in a Decigallon. 1 Septem = ·085 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2928. COPPER AMMONIA-SULPHATE of 5°. Five times as strong as No. 2921. 1 Septem of it neutralises $\frac{5}{1000}$ atom, or $\frac{1}{200}$ atom of any acid. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.

2929. AMMONIA of $\frac{2}{3}$°. NH^3. 17 × $\frac{2}{3}$. Solution containing 11·33 grains of ammonia in a Decigallon. 1 Septem = ·0133 grain. *Pint*, 2s.; *Half-gallon*, 6s.

This test solution is equal in strength to a solution of 50 grains of crystallised tartaric acid in a decigallon. It is a useful strength for testing the acidity of wines. See article on the Chemical Testing of Wines.

2930. AMMONIA of 7°. NH^3. 17 × 7. Solution containing 119 grains in a Decigallon. 1 Septem = ·119 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2931. SODIUM HYDRATE of 7°. Caustic Soda. NaHO. 40 × 7. Solution containing 280 grains in a Decigallon. 1 Septem = ·28 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2931A. *Testing of Vinegars.*—Alkaline solutions of 7° are equal in strength to the Excise proof vinegar, the commercial No. 24.

2932. ACIDS ESTIMATED BY ALKALINE TEST SOLUTIONS.

The Quantities are expressed in Grains.

	1 Septem of Alkali of 1° =	1 Septem of Alkali of 5° =
Sulphuric Acid, HSO^2 Atomic Weight 49	·049	·245
„ anhydrous, S^2O^3. 80	·04	·2
Hydrochloric Acid, HCl. 36·5	·0365	·1825
Nitric Acid, HNO^3. 63	·063	·315
„ anhydrous N^2O^5. 108	·054	·027
Oxalic Acid, HCO^2. 45	·045	·225
„ cryst., HCO^2 + Aq. 63	·063	·315
Acetic Acid, H, $C^2H^3O^2$. 60	·06	·3
„ anhydrous, C^2H^3, $C^2H^3O^3$. 102	·051	·255
Tartaric Acid, cryst., H, $C^2H^2O^3$. 75	·075	·375
Carbonic Acid, CO^2 in Na^2CO^3 = 44	·022	·11

2932A. The strongest solutions of the chief acids that can exist at 62° F. have the following degrees:—

Sulphuric Acid,	263·7°	Acetic Acid,	123·5°
Hydrochloric Acid,	94°	Oxalic Acid,	11·88°
Nitric Acid,	169°		

1 Septem of concentrated sulphuric acid requires 263$\frac{7}{10}$ Septems of any alkali of 1° to neutralise it, and the quantity of hydrated acid it contains is 263·7 × ·049 = 12·922 grains. This example shows that when a concentrated acid is to be tested, the first step in the operation is to dilute

the acid from 1 volume to 10 volumes; that is to say, 10 Septems to 100 Septems, or 100 Septems to 1000 Septems, measuring the acid with a bulb pipette, No. 2768, and diluting it with water in a measuring flask, No. 2783. A portion of this dilute acid is then to be tested, and the result to be multiplied by 10. A step, even preliminary to this, may be taken with strong acids. Put 9 Septems of water into a small mixing jar, and add 1 Septem of the acid to be tested. Mix and take 1 Septem of the mixture, and test it with the proper alkaline solution. The result in Septems, multiplied by 10, gives a rough idea of the strength of the acid. The apparatus being already set up for the careful trial, this preliminary experiment can be performed in two minutes, and it saves much test liquor.

TEST SOLUTIONS containing BARIUM and LEAD, for the estimation of CARBONATES and SULPHATES. Nos. 2933 to 2937.

2933. BARIUM CHLORIDE of 1°. BaCl. 104. Solution containing 104 grains in 1 Decigallon. 1 Septem = ·104 grain or $\frac{1}{1000}$ atom. *Pint*, 2s.; *Half-gallon*, 6s.

2934. BARIUM CHLORIDE of 5°. BaCl. 104 × 5. Solution containing 520 grains in a Decigallon. 1 Septem = ·52 grain or $\frac{5}{1000}$ atom, or $\frac{1}{200}$ atom. *Pint*, 2s.; *Half-gallon*, 6s.

2935. BARIUM NITRATE of 1°. $BaNO^3$. 130·5. Solution containing 130·5 grains in 1 Decigallon. 1 Septem = $\frac{1}{1000}$ atom or ·1305 grain. *Pint*, 2s.; *Half-gallon*, 6s.

2935*a*. ESTIMATION OF CARBONATES.—*Process* 1. Suppose that you have carbonic acid in solution with excess of alkali, and that you wish to estimate the carbonic acid only. Precipitate the carbonic acid with excess of barytes solution, filter and wash the precipitate, and then dissolve it in a slight excess of nitric acid of 1°, using an even number of Septems of that acid. After complete solution estimate the excess of nitric acid by an alkaline solution of 1°. Suppose 40 Septems of nitric acid and 4 Septems of alkali to be used, the product is 40 − 4 = 36. This number, multiplied by ·022, gives the equivalent of carbonic acid contained in the solution submitted to examination.

Process 2. If you have a solution of caustic alkali and carbonated alakli, and you wish to estimate the quantity of alkali present in each condition, follow the process described in section 2912*b*, expts. 1 and 2. The quantity of carbonated alkali being thus found, that of the carbonic acid is to be calculated.

2935*b*. ESTIMATION OF SULPHATES.—The solution containing the sulphate is tested with a solution of nitrate or chloride of barium until it ceases to give a precipitate. The method of finding the neutral point has been treated of in sections 2811 to 2817. 1 Septem of barytic solution of 1° throws down ·04 grain of anhydrous sulphuric acid.

2936. LEAD NITRATE of 1°. $PbNO^3$. 165·5. Solution containing 165·5 grains in a Decigallon. 1 Septem contains 0·1655 grain of $PbNO^3$ and 0·1035 grain of Pb, and is equal to 0·049 grain of hydrated sulphuric acid = HSO^2, or 0·040 grain of anhydrous sulphuric acid = $\frac{1}{2}$ S^2O^3. *Pint*, 2s.; *Half-gallon*, 6s.

2937. POTASSIUM BICHROMATE of $\frac{1}{4}$°. $2KCrO^2 + Cr^2O^3$. 295. Solution containing $\frac{295}{4}$ = 73·75 grains in a Decigallon; being equal to the preceding solution of Lead Nitrate. 1 Septem contains 0·07375 grain of bichromate of potassium, and precipitates 0·1035 grain of lead. *Pint*, 2s.; *Half-gallon*, 6s.

2937*a*. ESTIMATION OF SULPHURIC ACID.—The solution of sulphate to be submitted to analysis must contain no chloride, phosphate, nor arseniate; nor any compound that renders sulphate of lead soluble, such as nitrate and acetate of ammonia.

Process.—Take in a graduated jar a measured quantity of the solution of sulphate,—10, 20, or 50 Septems, according to its presumed strength. Add from a burette the nitrate of lead of 1°, No. 2936, until an excess is added, stopping at an even number on the scale of the burette. Shake the mixture thoroughly, and add water to it, until the liquid is brought to an even number of Septems, according to the scale on the graduated jar. Allow it to settle completely. Pipette off an aliquot part of the mixture, say $\frac{1}{2}$, $\frac{1}{4}$, or $\frac{1}{8}$ part of the whole. Add to this separated portion an excess of acetate of soda, and then precipitate the excess of lead by the bichromate of potassium of $\frac{1}{4}$°, No. 2937, applied by another burette. The indicator is drops of nitrate of silver applied as explained in the note, No. 2941*a*.

Result.—The Septems of lead solution made use of, *minus* the Septems of bichromate used in counteraction, indicate so many times 0·040 grain of anhydrous sulphuric acid present in the subject of assay.—SCHWARZ.

2937*b*. ESTIMATION OF LEAD.—Lead can be estimated by the Test Solutions now under consideration. The lead is to be dissolved in nitric acid, the solution to be carefully neutralised with carbonate of soda, and the clear solution is to be mixed with an excess of acetate of soda. This solution, or a given number of Septems of it, is then to be treated with the bichromate of potassium solution, as described above. 1 Septem of the Bichromate Test, No. 2937, precipitates 0·1035 grain of lead.—SCHWARZ, *Zeitschrift der Chemie*, 1863.

TEST SOLUTIONS containing LEAD and URANIUM, for the estimation of PHOSPHORIC ACID in alkaline and earthy Phosphates. Nos. 2938 to 2943.

2938. LEAD NITRATE of 3°. $PbNO^3$. 165·5. Solution containing 496·5 grains in a Decigallon; being equal to a solution of phosphoric acid of 1°. 1 Septem contains 0·4965 grain of nitrate of lead, and = 0·071 grain of anhydrous phosphoric acid. *Pint*, 2s.; *Half-gallon*, 6s.

2939. POTASSIUM BICHROMATE of $\frac{3}{4}$°. $2KCrO^2 + Cr^2O^3$. 295. Solution containing 221·25 grains in a Decigallon, being equal to the foregoing solution of nitrate of lead. 1 Septem = ·4965 grain of nitrate of lead. *Pint*, 2s.; *Half-gallon*, 6s.

2940. LEAD NITRATE, *Empirical.* $PbNO^3$. 165·5. Solution containing 349·65 grains in a Decigallon, being equal to 50 grains of anhydrous phosphoric acid. 1 Septem contains 0·34965 grain of nitrate of lead, and = 0·05 grain of anhydrous phosphoric acid. *Pint*, 2s.; *Half-gallon*, 6s.

2941. POTASSIUM BICHROMATE, *Empirical,* but equal to the preceding solution of nitrate of lead, No. 2940. It contains 155·81 grains in a Decigallon. 1 Septem = 0·34965 grain of nitrate of lead = 0·05 grain of anhydrous phosphoric acid. *Pint*, 2s.; *Half-gallon*, 6s.

2941*a*. ESTIMATION OF PHOSPHORIC ACID.—The solutions Nos. 2940 and 2941 (or those Nos. 2938, 2939) are used for the estimation of phosphoric acid. The method is applicable to alkaline phosphates, and earthy phosphates, when the latter are dissolved in the smallest quantity of nitric acid. The solutions are to be mixed with an excess of acetate of soda solution. To a measured quantity of the solutions to be tested, the lead solution is to be run from a burette *in excess.* Tribasic phosphate of lead is precipitated. It is then necessary to determine how much of the lead solution that has been run in remains in excess. This is done by means of the solution of bichromate of potassium, which is also added from a burette. The indication of a sufficient addition of this test is afforded by means of drops of solution of nitrate of silver, used with the testing slab No. 2815. A drop of the mixture, first filtered with the tube No. 2813, and then added to the nitrate of silver, gives no precipitate as long as any lead remains in the solution; but as soon as the lead is all precipitated, and bichromate of potassium becomes residual, the drops of nitrate of silver show a red precipitate. The process is shortened by performing the precipitation with the lead solution in a graduated cylinder, diluting with water to an even quantity, and after allowing the precipitate to subside, pipetting off 25 Septems, or any aliquot part, of the supernatant solution for testing with the chromic solution.

Result (supposing the solutions No. 2940 and 2941 to be used).—The Septems of lead solution, *minus* the Septems of chromic solution, give so many times 0·05 grain of anhydrous phosphoric acid.—*Schwarz* and *Mohr.* This process is not so applicable to the estimation of phosphoric acid in Urine, as the method with Uranium. For details, see Schwarz and Mohr in Fresenius's *Zeitschrift*, 1863, pages 379 and 392.

2942. SODIUM PHOSPHATE, *Empirical.* $HNa^2PO^4 + Aq^{12}$. 358. (Anhydrous Phosphoric Acid = $\frac{1}{2}$ PPO^5 = 71.) Solution containing 100·85 grains in a Decigallon. This solution contains 20 grains of anhydrous phosphoric acid. 1 Septem = 0·02 grain of the acid. *Pint*, 2s.; *Half-gallon*, 6s.

2943. URANIC NITRATE, *Empirical.* $Uc^3NO^4 + Aq^3$. 252. Solution containing 141·98 grains in a Decigallon, that quantity being equal to the above solution of phosphate of sodium. 1 Septem = 0·02 grain of anhydrous phosphoric acid. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.

2943*a*. Nos. 2942 and 2943 are used for the estimation of phosphoric acid. See Mohr's *Titrirmethode*, page 390; Neubauer's *Analyse des Harns*, page 148; Sutton's *Volumetric Analysis*, page 201; and No. 4020 in the article *Urinometry* in this work. The Uranium test is found to be the most accurate for use in the examination of urine; but the cheaper lead test can be successfully used in the examination of alkaline and earthy phosphates.

TEST SOLUTIONS for the estimation of IODINE, BROMINE, and CHLORINE, and for SULPHIDES, SULPHITES, HYPOSULPHITES, &c. Nos. 2944 and 2945.

2944. SODIUM HYPOSULPHITE of 2°. NaSO + HSO + Aq^2. 124. (Ordinary formula NaO, $S^2O^2 + 5HO = 124$.) Solution containing 248 grains in a Decigallon. 1 Septem = ·248 grain or $\frac{2}{1000}$ atom, being the equivalent of $\frac{1}{1000}$ atom or ·127 grain of iodine. *Pint*, 2s.; *Half-gallon*, 6s.

2944a. *Use.*—For the estimation of iodine set free in a solution, and indirectly the estimation of chlorine. The latter is set free and distilled over into a solution of iodide of potassium, where it sets iodine free. The distilling apparatus is described at Nos. 2859 to 2862. The solution containing the free iodine is mixed with a solution of starch, by which it is coloured blue. The sodium hyposulphite is then added till the blue colour disappears. See No. 2862a.

2945. IODINE of 1°. I. 127. Solution containing 127 grains of iodine dissolved in iodide of potassium in a Decigallon of solution. 1 Septem = ·127 grain or $\frac{1}{1000}$ atom of iodine, that being equal to sodium hyposulphite of 2°. *Pint*, 3s.; *Half-gallon*, 10s.

2945a. *Use.*—To check the degree of the sodium hyposulphite, which is a little subject to change, and to act as equivalent counter test to that solution, when it has been added in an overdose. It is also used to test sulphides, sulphites, and hyposulphites, arsenites, and the solutions of certain metals. See Mohr's *Titrirmethode*, and other analytical works. The iodine solution must not be used with caoutchouc pinchcocks, nor come into contact with cork, paper, or other organic matter. Fig. 2826 represents a flask adapted to contain the iodine solution, and supply it to burettes conveniently.

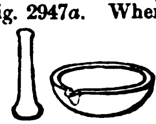
2945b. ESTIMATION OF TIN, IN THE CHLORIDES OR MURIATES.—Dissolve the Chloride of Tin in a solution of one part of *tartarus natronatus* with eight parts of crystallised carbonate of soda. Or mix a solution of tin in hydrochloric acid with this alkaline solution. As much of the latter must be used as will in all cases make the tin solution clear. Dilute with water to a fixed volume. Take of this mixture 10 Septems; add to it some solution of starch, and then test with Iodine solution, No. 2945, till the liquor becomes blue. Multiply the Septems of Iodine used by ·059. The product is the number of grains of tin contained in the 10 Septems of solution submitted to the test. *See* LEUSSEN, in MOHR's *Titrirmethode*, page 263.

TEST SOLUTIONS for the estimation of BLEACHING POWDER. Nos. 2946, 2947.

2946. SODIUM ARSENITE; namely, Arsenious Acid dissolved in an excess of Carbonate of Sodium. The acting ingredient is Arsenious Acid = As^2O^3. 198. Strength of the solution $\frac{1}{4}$° or 49·5 grains in a Decigallon, that quantity producing a solution equivalent to the corresponding Iodine solution of 1°, No. 2945. 1 Septem = ·127 grain of iodine, or ·0355 grain of chlorine. *Pint*, 2s.; *Half-gallon*, 6s.

2947. SODIUM ARSENITE, *Empirical*. Solution containing 69·718 grains of Arsenious Acid dissolved in excess of Carbonate of Sodium in a Decigallon. This is equivalent to 50 grains of chlorine, so that 1 Septem indicates 0·05 grain of chlorine, or 100 Septems = 5 grains. *Pint*, 2s.; *Half-gallon*, 6s.

2947a. ESTIMATION OF CHLORINE IN BLEACHING POWDER.—Take 100 grains of bleaching powder, grind it in a flat mortar with a good spout, such as is represented by Fig. 2947a. When it is finely ground, add water, mix it well, allow it to settle a little, and then decant the thin portion of the turbid liquor into a Decigallon Measuring Flask, No. 2783, 20. Add more water to the powder in the mortar, grind again, and decant as before. When the bleaching powder has thus by several affusions been all brought into the bottle, dilute the mixture to 1 Decigallon, shake it well, and measure off 100 Septems by a bulb pipette into a mixing jar for testing. Meanwhile fill a Mohr's burette with the arsenical test solution, No. 2947, and run the solution thence into the mixing jar. The indicator is a clear decoction of starch, with which a little iodide of potassium has been mixed. Drops of this indicator are put upon the testing slab, No. 2815, and from time to time drops of the mixture of bleaching powder and arsenic are to be transferred by means of the decanting tube, No. 2814, into the cavities in the testing slab. At first, the indicator becomes greenish blue, and then blue, which abates in colour with succeeding drops of the mixture, until at last the drops of mixture produce no change in the indicator. The operation is then at an end.



2947a.

Result.—Observe how many Septems of the test liquor have been used. Multiply that number by 0·5, or divide it by 2: the product is the percentage of chlorine in the bleaching powder. Thus, if 60 Septems are used, the percentage of chlorine is 30.

TEST SOLUTIONS for the estimation of SILVER and of CHLORIDES, BROMIDES, IODIDES, and CYANIDES. Nos. 2948 to 2951.

2948. SILVER NITRATE of 1°. $AgNO^3$. 170. Solution containing 170 grains in 1 Decigallon. 1 Septem = ·17 grain, and precipitates the following quantities of chlorides, *in grains* :—

Chlorine,	Cl.	=	·0355
Potassium Chloride,	KCl.	=	·0745
Sodium Chloride,	NaCl.	=	·0585
Ammonium Chloride,	NH^4Cl.	=	·0535
Silver Chloride,	AgCl.	=	·1435

Pint of this solution, 4s. 6d.; *Half-gallon*, 16s.

2949. SILVER NITRATE, *Empirical*, for the standard in Testing Photographic Baths. Solution containing 100 grains of silver nitrate in a Decigallon. 1 Septem $= \frac{1}{10}$ grain (= 0·1) of silver nitrate. *Pint*, 3s. 6d.; *Half-gallon*, 12s.

2950. SODIUM CHLORIDE of 1°. NaCl. 58·5. Solution containing 58·5 grains in 1 Decigallon. 1 Septem = ·0585 grain, equal to 0·17 grain of nitrate of silver. *Pint*, 2s.; *Half-gallon*, 6s.

This solution is equal to Silver Nitrate, No. 2948.

2951. SODIUM CHLORIDE, *Empirical*, for testing Photographic Silver Baths. Solution containing 34·412 grains in 1 Decigallon. 1 Septem = ·034412 grain of sodium chloride, equal to 0·1 grain of silver nitrate. *Pint*, 2s.; *Half-gallon*, 6s.

This solution is equal to Silver Nitrate, No. 2949.

2951*a*. ESTIMATION OF SILVER. *First Process.*—The solution of silver, measured with a pipette, is put into a mixing bottle, such as No. 2799, and this is heated in a water bath, such as No. 1235. The chloride of sodium solution is then run into it from a Mohr's burette, until it ceases to give a precipitate. When the bottle is taken from the water bath to receive the salt test, it should be wiped with a cloth, and put into a cylinder of brown paper to shield it from the light. After receiving the salt test, it is to be well shaken; upon which the chloride of silver conglomerates, and leaves the liquor clear. A single drop of the salt test is then to be added. If no precipitate appear, the test is concluded. If a precipitate appear, more salt test is to be added, and the process continued till the silver is all precipitated.

2951*b*. *Second Process.*—The silver solution is made *very slightly* alkaline by the addition of a few drops of a solution of carbonate of soda. As much of the graduated solution of sodium chloride is then added as precipitates all the silver, and leaves a little of the salt test in excess. This is known by heating and shaking the mixture as in the first process, and then trying whether a drop of the salt test gives any more precipitate. The salt test is to be added to an even number of Septems. A few drops of a solution of yellow potassium chromate are then to be added to the mixture, and after that the solution of silver that corresponds to the salt test that has been used,—namely, 2948 against 2950, or 2949 against 2951. When the extra salt of the salt test is all precipitated by the silver test, the first superfluous drop of the latter produces, with the indicating chromate, a *red precipitate*, which marks the conclusion of the operation. After abstraction of the Septems of silver test used in the second part of the process, the Septems of salt test indicate the amount of silver nitrate present in the subject of assay. Thus, every Septem of the salt solution, No. 2950, indicates 0·17 grain of silver nitrate, and every Septem of No. 2951 indicates 0·1 grain of silver nitrate. Namely, these numbers, multiplied by the number of Septems of salt test used, indicate the weight of silver nitrate contained in the quantity of silver solution measured off by a pipette for analysis.

2951*c*. EXAMINATION OF PHOTOGRAPHIC SILVER BATHS.—Silver Baths are commonly made with 30 grains of nitrate of silver to the ounce, which is 480 grains to the Decigallon (of 16 ounces). A convenient solution for testing such baths is No. 2951, to be used alone, with process 1, No. 2951*a*, or in combination with No. 2949, if the rapid second process, No. 2951*b*, is followed. Take 10 Septems of the solution of the silver bath, dilute it with 100 Septems of water, heat the mixture, add the salt test, and shake the bottle as above described, and repeat these operations till you have determined how many Septems of the salt solution, No. 2951, are required to saturate

the 10 Septems of silver solution submitted to assay. That number, multiplied by 10, shows the grains in a Decigallon of silver nitrate contained in the silver bath submitted to analysis. If multiplied by 0·625, it shows the number of grains of silver nitrate contained in 1 fluid ounce of the solution. Thus, suppose the number of Septems of salt test required to precipitate 10 Septems of the silver bath to be 48, then :—

48 × 10 = 480 grains of silver nitrate in the Decigallon, or 16 fluid ounces.
48 × ·625 = 30 grains in 1 fluid ounce.

2951*d*. *Testing the Purity of Nitrate of Silver.*—Weigh 5 grains of the salt, dissolve it in 100 Septems of water, and test it as above described with the salt solution, No. 2951. It should take 50 Septems. If it takes fewer Septems, twice the deficient number is the percentage of impurity. Thus, if 5 grains of the nitrate of silver are precipitated by 48 Septems of the salt test, then the impurity is twice 2 = 4 per cent.

2951*e*. ESTIMATION OF CYANOGEN.—Solution of silver nitrate is also used for the estimation of cyanogen and hydrocyanic acid. When a dilute solution of nitrate of silver is added to a solution of potassium cyanide, or of hydrocyanic acid first neutralised with potash, the silver combines with cyanogen, and the silver cyanide which is produced combines with potassium cyanide to form the double salt AgCy + KCy, which is soluble, so that no precipitate appears; but when all the potassium is thus combined, the first extra drop of nitrate of silver produces a precipitate. This indicates the point at which one atom of silver has acted on *two* atoms of cyanogen; and from the quantity of nitrate of silver used, that of the cyanogen present is calculated. Every Septem of silver nitrate of 1°, No. 2948, indicates ·052 grain of cyanogen, ·054 grain of hydrocyanic acid, and ·130 grain of cyanide of potassium.

TEST SOLUTIONS OF BICHROMATE AND PERMANGANATE OF POTASSIUM, for the estimation of IRON, MANGANESE, TIN, and other metals. No. 2952 to 2958.

2952. POTASSIUM BICHROMATE. $2\ KCrO^2 + Cr^2O^3$. 295.

This salt converts Ferrous salts into Ferric salts. The indicator used is ferridcyanide of potassium, which gives a blue precipitate with the mixture as long as any ferrous salt is present. See Nos. 2810, 2815. The acting quantities in weight of Iron and Bichromate are as follow :—

EMPIRICAL QUANTITIES :—		SYSTEMATIC QUANTITIES :—	
Bichromate used.	Iron indicated.	Bichromate used.	Iron indicated.
·878	1 grain.	24·585	28 grains = 1 atom.
8·78	10 ,,	49·17	56 ,, 2 ,,
43·9	50 ,,	147·5	168 ,, 6 ,,
87·8	100 ,,	295·	336 ,, 12 ,,

The following equations explain the reaction upon which analyses with this salt are founded :—

First Equation. O = 8. Fe = 28. Cr = 26·25. Water, HO = 9.

$$6\ FeCl + 7\ HCl + KO.\ 2\ CrO^3 = 3\ Fe^2Cl^3 + KCl + Cr^2Cl^3 + 7\ HO.$$

Second Equation. O = 16. Fe = 28. Fec = 18·66. Cr = 26·25. Crc = 17·5. Water, HHO = 18.

$$12\ FeCl + 14\ HCl + 2\ KCrO^2 + Cr^2O^3 = 18\ FecCl + 6\ CrcCl + 2\ KCl + 7\ HHO.$$

It is evident from these equations, that for every 6 atoms of iron present, there must be added 7 atoms of free hydrochloric acid, to afford hydrogen to take up the oxygen of the chromate.

2953. POTASSIUM BICHROMATE of ½°. See No. 2952. Solution containing 147·5 grains in a Decigallon. 1 Septem indicates ·168 grain of iron. *Pint*, 2s.; *Half-gallon*, 6s.

2954. POTASSIUM BICHROMATE, *Empirical*. See No. 2952. Solution containing 87·8 grains in a Decigallon. 1 Septem indicates 0·1 grain of iron. *Pint*, 2s.; *Half-gallon*, 6s.

2955. POTASSIUM PERMANGANATE. $KMnc^3O^4$. 158.

This salt converts Ferrous salts into Ferric salts. The theory of the action is as follows :—

First Equation. O = 8. Fe = 28. Mn = 27·5. Water, HO = 9.

$$\left.\begin{matrix}10\ FeO,SO^3 + KO.MnO^7\\ +8\ HO,SO^3\end{matrix}\right\} = \left\{\begin{matrix}5\ Fe^2O^3,\ 3\ SO^3 + KO,SO^3\\ +2\ MnO,SO^3 + 8\ HO.\end{matrix}\right.$$

Second Equation. O = 16. Fe = 28. Fec = 18·66. Mn = 27·5. Mnc = 18·33. Water, HHO = 18.

$$10\ FeSO^2 + KMnc^3O^4 + 8\ HSO^2 = 15\ FecSO^2 + KSO^2 + 2\ MnSO^2 + 4\ HHO.$$

One equivalent of the Permanganate of Potash acts upon 10 equivalents of iron, or 158 parts of Permanganate upon 280 parts of iron. The 10 atoms of iron require the presence of 8 atoms of free sulphuric acid. Less than 8 atoms will not answer the purpose, and a great excess leads to errors. An apparatus for supplying sulphuric acid in these assays is described at No. 2866. Nitric acid and hydrochloric acid must be avoided. The acting quantities in grains are as follow:—

Empirical Quantities.		Systematic Quantities.	
Permanganate used.	Iron indicated.	Permanganate used.	Iron indicated.
·5643	1 grain.	15·8 = $\frac{1}{10}$ atom.	28 grains = 1 atom.
2·8215	5 ,,	31·6 = $\frac{1}{5}$,,	56 ,, = 2 ,,
5·643	10 ,,	158· = 1 ,,	280 ,, = 10 ,,
28·215	50 ,,		
56·43	100 ,,		

The phenomena exhibited by the action of the Permanganate of Potassium upon Ferrous salts is described at No. 2806. When ferric salts have to be tested, they must first be reduced to the condition of ferrous salts, or else they must be heated with a mixture of iodide of potassium and hydrochloric acid, which sets free iodine, and this free iodine must be tested with hyposulphite of sodium. According to Mohr, this is the most correct way of testing salts of iron, inasmuch as both the ferrous and ferric portions can be estimated in one solution. See Fresenius's *Zeitschrift für Analytische Chemie*, 1863, page 243.

The Permanganate of Potassium, being subject to change its degree of strength, must be tested occasionally against pure ferric salts, or against oxalic acid; for which instructions are given by Mohr, Fresenius, &c.

2956. Potassium Permanganate of $\frac{1}{5}$°. See No. 2955. Solution containing 31·6 grains of Permanganate of Potassium in a Decigallon. Equivalent to 56 grains or two atoms of iron. 1 Septem = ·056 grain of iron. 100 Septems = 5·6 grains of iron. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.

2957. Potassium Permanganate, *Empirical*. Solution containing 56·43 grains in a Decigallon, equal to 100 grains of iron. 1 Septem = 0·1 grain of iron. 100 Septems = 10 grains of iron. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.

2958. Potassium Permanganate, *Empirical*. Solution containing 28·215 grains in a Decigallon, equal to 50 grains of iron. 1 Septem = 0·05 grain of iron. 100 Septems = 5 grains of iron. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.

Test Solution for the estimation of Lead and Barium. No. 2959.

2959. Potassium Sulphate of 1°. KSO^2. 87. Solution containing 87 grains in a Decigallon. 1 Septem = ·087 grain, indicating ·1035 grain of lead. *Pint*, 2s.; *Half-gallon*, 6s.

2959*a*. *Estimation of Lead.*—This solution is used to precipitate lead from neutral solutions. The indicator is test paper prepared with a solution of iodide of potassium mixed with a little hyposulphite of sodium. This paper turns yellow when wetted with the mixture, until the lead is all precipitated. There must be no free nitric acid present. The process is not quite correct, as it shows 1 to 1½ per cent. too little lead; but is useful for technical purposes.

2959*b*. A better method of estimating lead is described at No. 2937*b*.

2959*c*. *Estimation of Barium.*—The estimation of Barium by a Sulphate is the reverse of the estimation of a Sulphate by a salt of Barium, as described at No. 2935*b*. The factors showing the quantities of Barytic salts that are equivalent to 1 Septem of a Sulphate of 1°, are given in the table No. 2913.

2960. Tincture of Litmus, in 3-ounce stoppered bottle, 1s.

2961. Tincture of Hematine, in 3-ounce stoppered bottle, 1s. 6d.

The Hematine tincture is useful in testing acidity in organic compounds, such as wine. In a dilute pure acid it has a lemon-yellow colour. When the acid is neutralised by dilute ammonia, the colour first turns brown, then a drop more of ammonia makes it pink, and larger quantities of ammonia make the colour crimson, violet, and blue. The brown colour seems to be the neutral point, and pink to indicate the presence of free acid. The colouring matter of wines interferes with the action of this test, especially that of port wine. In testing such liquors, they must be greatly diluted. See article on the *Chemical Testing of Wines*.

VOLUMETRIC CHEMICAL SOLUTIONS FOR USE WITH INSTRUMENTS GRADUATED INTO CENTIMETRE CUBES.

2986. The solutions that are commonly called NORMAL *Solutions* contain one atomic weight of the active chemical, weighed in Grammes, and dissolved in a Litre of solution at 62° F.

DECINORMAL *Solutions* are of one-tenth part of that strength.

1 Centimetre Cube of any Normal solution contains the $\frac{1}{1000}$ part of an atom of the dissolved chemical expressed in grammes. 1 Centimetre Cube of a Decinormal solution contains the $\frac{1}{10000}$ part of an atom in grammes.

The choice of the quantity of substance to be chosen for analysis by means of these test liquors, is explained at No. 2683*b*.

NORMAL TEST ACIDS. The four solutions, Nos. 2988 to 2991, are of the same strength. They each contain in a Litre one atom of ACID weighed in grammes. 1 Centimetre Cube of each = $\frac{1}{1000}$ atom, and is competent to neutralise $\frac{1}{1000}$ atom in grammes of any monobasic ALKALI or ALKALINE CARBONATE.

2988. SULPHURIC ACID. HSO^2. 49. Normal solution, containing 49 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{1000}$ atom = ·049 gramme of HSO^2, or ·04 gramme of S^2O^3. *Pint*, 2s.; *Half-gallon*, 6s.

2989. NITRIC ACID. HNO^3. 63. Normal solution, containing 63 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{1000}$ atom, or ·063 gramme of hydrated acid, or ·054 of anhydrous acid. *Pint*, 2s.; *Half-gallon*, 6s.

2990. HYDROCHLORIC ACID. HCl. 36·5. Normal solution, containing 36·5 grammes in a Litre, 1 Centimetre Cube = $\frac{1}{1000}$ atom, or ·0365 gramme. *Pint*, 2s.; *Half-gallon*, 6s.

2991. OXALIC ACID. HCO^2, 45. The crystallised acid HCO^2 + Aq., 63. Normal solution, containing 45 grammes of HCO^2, or 63 grammes of the crystals, in a Litre. 1 Centimetre Cube = $\frac{1}{1000}$ atom, or ·045 gramme of HCO^2. *Pint*, 2s.; *Half-gallon*, 6s.

NORMAL TEST ALKALIES. The four solutions, Nos. 2995 to 2998, are of the same strength. They each contain in a Litre one atom of ALKALI, weighed in grammes, 1 Centimetre Cube of each = $\frac{1}{1000}$ atom, and is competent to neutralise $\frac{1}{1000}$ atom in grammes of any monobasic ACID.

2995. POTASSIUM CARBONATE. Carbonate of Potash. K^2CO^3. 138. Used as monobasic: $\frac{1}{2}(K^2CO^3) = 69$. Normal solution containing 69 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{1000}$ atom, or ·069 gramme. *Pint*, 2s.; *Half-gallon*, 6s.

2996. POTASSIUM HYDRATE. Caustic Potash. KHO, 56. Normal solution containing 56 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{1000}$ atom, or ·056 gramme. *Pint*, 2s.; *Half-gallon*, 6s.

2997. SODIUM HYDRATE. Caustic Soda. NaHO, 40. Normal solution containing 40 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{1000}$ atom, or ·04 gramme. *Pint*, 2s.; *Half-gallon*, 6s.

2998. SODIUM CARBONATE. Carbonate of Soda. Na^2CO^3. 106. But used as monobasic, atomic weight $\frac{106}{2} = 53$. Normal solution containing 53 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{1000}$ atom of a monobasic acid. *Pint*, 2s.; *Half-gallon*, 6s.

2999. COPPER AMMONIA-SULPHATE. $NH^4SO^2 + NH^4CucO$, 131·75. Normal solution containing 131·75 grammes in a Litre. But the solution is practically made equal to Normal Nitric Acid. 1 Centimetre Cube = $\frac{1}{1000}$ atom of any free acid. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.

MISCELLANEOUS TEST SOLUTIONS:

3003. BARIUM CHLORIDE. BaCl. 104. Normal solution, containing 104 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{1000}$ atom, or ·104 gramme. *Pint* 2s.; *Half-gallon*, 6s.

3004. SILVER NITRATE. $AgNO^3$. 170. Decinormal solution, containing 17 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{10000}$ atom of chlorine = $\frac{2}{10000}$ atom of cyanogen. *Pint*, 3s. 6d.; *Half-gallon*, 12s.

3005. SODIUM CHLORIDE. NaCl. 58·5. Decinormal solution, containing 5·85 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{10000}$ atom of silver. *Pint*, 2s.; *Half-gallon*, 6s.

3008. SODIUM HYPOSULPHITE. NaSO + HSO + Aq^2. 124. [Usual formula, NaO, $S^2O^2 + 5$ HO = 124.] Solution $\frac{1}{5}$ normal, containing $\frac{1}{10}$ of 2 atoms of the salt, $\frac{124}{5}$ = 24·8 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{10000}$ atom, or ·0127 gramme of iodine. *Pint*, 2s.; *Half-gallon*, 6s.

3009. IODINE. I. 127. Decinormal solution, containing 12·7 grammes in a Litre, the iodine dissolved in iodide of potassium. 1 Centimetre Cube = $\frac{1}{10000}$ atom, or ·0127 gramme of iodine. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.

3011. SODIUM ARSENITE. As^2O^3. 198. Decinormal solution, containing 4·95 grammes of arsenious acid, with an excess of carbonate of soda, in a Litre. The solution is equivalent to the Decinormal solution of Iodine, No. 3009. 1 Centimetre Cube = $\frac{1}{10000}$ atom of chlorine, iodine, &c.; namely, = 0·00355 gramme of chlorine. *Pint*, 2s.; *Half-gallon*, 6s.

3014. POTASSIUM SULPHATE. KSO^2. 87. Decinormal solution, containing 8·7 grammes in a Litre, used in the technical analysis of lead, to precipitate lead from neutral solutions. 1 Centimetre Cube = ·01035 gramme of lead. *Pint*, 2s.; *Half-gallon*, 6s.

3015. POTASSIUM BICHROMATE. See No. 2952. Solution containing 4·917 grammes of the salt in a Litre. 1 Centimetre Cube = 0·0056 gramme of iron. *Pint*, 2s.; *Half-gallon*, 6s.

3016. POTASSIUM PERMANGANATE. See No. 2955. $\frac{1}{50}$ Normal, namely, containing $\frac{158}{50}$ = 3·16 grammes of crystals in a Litre. This is equal to 5·6 grammes or $\frac{1}{10}$ atom of iron. 1 Centimetre Cube = ·0056 gramme of iron. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.

3018. LEAD NITRATE. $PbNO^3$. 165·6. $\frac{3}{10}$ solution, containing 49·65 grammes in a Litre. 1 Centimetre Cube = $\frac{1}{10000}$ atom, or 0·0071 gramme of anhydrous phosphoric acid. *Pint*, 2s.; *Half-gallon*, 6s.

3019. POTASSIUM BICHROMATE. 2 $KCrO^2 + Cr^2O^3$. 295. $\frac{3}{40}$ solution, containing 22·125 grammes in a Litre. This solution is equivalent to the Lead Nitrate $\frac{3}{10}$ solution, No. 3018. *Pint*, 2s.; *Half-gallon*, 6s.

The process of testing for Phosphoric Acid by means of the above solutions is explained at No. 2941*a*.

3021. SODIUM PHOSPHATE. $HNa^2PO^4 + Aq^{12}$. 358. [Anhydrous Phosphoric Acid = $\frac{1}{2}$ PPO^5 = 71.] Solution containing 50·423 grammes in a Litre, including some acetate of sodium. This solution contains 10 grammes of anhydrous phosphoric acid. 1 Centimetre Cube = ·01 gramme of that acid. *Pint*, 2s.; *Half-gallon*, 6s.

3022. URANIC NITRATE. $Uc^3NO^4 + Aq^3$. 252. Solution containing 71 grammes in a Litre, that quantity being equal to the above solution of phosphate of sodium. 1 Centimetre Cube = ·01 gramme of anhydrous phosphoric acid. *Pint*, 5s. 6d.; *Half-gallon*, 18s.

VOLUMETRIC CHEMICAL SOLUTIONS, FOR USE WITH INSTRUMENTS GRADUATED INTO DECEMS.

3030. The solutions that are commonly called NORMAL *Solutions* contain ten times the atomic weight of the active chemical, weighed in grains, and dissolved in 1000 Decems of solution at 62° Fahr. DECINORMAL *Solutions* are of $\frac{1}{10}$ part of that strength.

100 Decems of any normal solution contain an atom, weighed in grains, of the dissolved chemical.

One Decem contains the $\frac{1}{100}$ part of an atom, and one decem of a decinormal solution contains the $\frac{1}{1000}$ part of an atom, weighed in grains.

The choice of the quantity of substance to be taken for analysis by means of these test solutions is explained at No. 2683*b*.

The solutions Nos. 3035, 3040, 3049, 3054, 3055, and 3061, are those prescribed for use in the British Pharmacopœia. See page 330 of this work.

NORMAL TEST ACIDS.—The four solutions Nos. 3032 to 3035 are of the same strength. They each contain ten atoms of ACID, weighed in grains, and dissolved in 1000 Decems of solution. 1 Decem of each contains the $\frac{1}{100}$ of an atom. 100 Decems are competent to neutralise 1 atom in grains of any monobasic ALKALI or ALKALINE CARBONATE.

3032. SULPHURIC ACID. HSO^2. 49. Normal solution, containing 490 grains in 1000 Decems. 1 Decem = $\frac{1}{100}$ atom, or ·49 grain. *Pint*, 2s.; *Half-gallon*, 6s.

3033. NITRIC ACID. HNO^3. 63. Normal solution, containing 630 grains in 1000 Decems. 1 Decem = $\frac{1}{100}$ atom, or ·63 grain. *Pint*, 2s.; *Half-gallon*, 6s.

3034. HYDROCHLORIC ACID. HCl. 36·5. Normal solution, containing 365 grains in 1000 Decems. 1 Decem = $\frac{1}{100}$ atom, or ·365 grain. *Pint*, 2s.; *Half-gallon*, 6s.

3035. OXALIC ACID. HCO^2. 45. Cryst. = HCO^2 + Aq. 63. Normal solution, containing 450 grains of HCO^2, or 630 grains of crystals in 1000 Decems. 1 Decem = $\frac{1}{100}$ atom, or ·45 grain of HCO^2. *Pint*, 2s.; *Half-gallon*, 6s.

NORMAL TEST ALKALIES.—The four solutions Nos. 3038 to 3041 are of the same strength. They each contain in 1000 Decems ten atoms of ALKALI, weighed in grains. 1 Decem of each contains the $\frac{1}{100}$ part of an atom. 100 Decems are competent to neutralise 1 atom in grains of any monobasic ACID.

3038. POTASSIUM CARBONATE. Carbonate of Potash. K^2CO^3. 138. Used as monobasic. $\frac{1}{2}$ (K^2CO^3) = 69. Normal solution, containing 690 grains in 1000 Decems. 1 Decem = $\frac{1}{100}$ atom, or ·69 grain. *Pint*, 2s.; *Half-gallon*, 6s.

3039. POTASSIUM HYDRATE. Caustic Potash. KHO. 56. Normal solution, containing 560 grains in 1000 Decems. 1 Decem = $\frac{1}{100}$ atom, or ·56 grain. *Pint*, 2s.; *Half-gallon*, 6s.

3040. SODIUM HYDRATE. Caustic Soda. NaHO. 40. Normal solution, containing 400 grains in 1000 Decems. 1 Decem = $\frac{1}{100}$ atom, or ·4 grain. *Pint*, 2s.; *Half-gallon*, 6s.

3041. SODIUM CARBONATE. Carbonate of Soda. Na^2CO^3. 106. But used as monobasic. Atomic weight $\frac{106}{2}$ = 53. Normal solution, containing 530 grains in 1000 Decems. 1 Decem = $\frac{1}{100}$ atom, or ·53 grain. *Pint*, 2s.; *Half-gallon*, 6s.

3042. Copper Ammonio-Sulphate. $NH^4SO^2 + NH^4CucO$. 131·75 ? Normal solution, containing 1317·5 grains in 1000 Decems. But the solution is made practically equal to normal nitric acid. 1 Decem = $\frac{1}{100}$ atom of any free acid. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.

3046. Barium Chloride. BaCl. 104. Normal solution, containing 1040 grains in 1000 Decems. 1 Decem = $\frac{1}{100}$ atom, or 1·04 grain. *Pint*, 2s.; *Half-gallon*, 6s.

3049. Silver Nitrate. $AgNO^3$. 170. Decinormal solution, containing 170 grains in 1000 Decems. 1 Decem contains ·17 grain, and = $\frac{1}{1000}$ atom of chlorine, = $\frac{2}{1000}$ atom of cyanogen. *Pint*, 3s. 6d.; *Half-gallon*, 12s. 6d.

3050. Sodium Chloride. NaCl. 58·5. Decinormal solution, containing 58·5 grains in 1000 Decems. 1 Decem = $\frac{1}{1000}$ atom of silver. *Pint*, 2s.; *Half-gallon*, 6s.

3054. Sodium Hyposulphite. NaSO + HSO + Aq^2. 124. [Usual formula NaO, S^2O^2 + 5 HO = 124.] Solution $\frac{1}{5}$ normal, containing $\frac{1}{10}$ of 20 atoms of the salt, $\frac{1240}{5}$ = 248 grains, in 1000 Decems. 1 Decem = $\frac{1}{1000}$ atom, or ·127 grain of iodine. *Pint*, 2s.; *Half-gallon*, 6s.

3055. Iodine. I. 127. Decinormal solution, containing 127 grains in 1000 Decems, the iodine dissolved in iodide of potassium. 1 Decem = $\frac{1}{1000}$ atom, or ·127 grain of iodine. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.

3057. Sodium Arsenite. As^2O^3. 198. Decinormal solution, containing 49·5 grains of arsenious acid, with excess of carbonate of sodium, in a solution of 1000 Decems. 1 Decem = ·127 grain of iodine, or ·0355 grain of chlorine. *Pint*, 2s.; *Half-gallon*, 6s.

3060. Potassium Bichromate. See No. 2952. Solution containing 49·167 grains in 1000 Decems. 1 Decem contains ·04917 grain of bichromate, and indicates ·056 grain of iron. *Pint*, 2s.; *Half-gallon*, 6s.

3061. Potassium Bichromate. Solution containing 147·5 grains in 1000 Decems. 1 Decem contains ·1475 grain, and indicates ·168 grain of iron. *British Pharmacopœia*. *Pint*, 2s.; *Half-gallon*, 6s.

3062. Potassium Bichromate. Solution containing 87·8 grains in 1000 Decems. 1 Decem indicates 0·1 grain of iron. *Percy*. *Pint*, 2s.; *Half-gallon*, 6s.

3065. Potassium Permanganate. See No. 2955. $\frac{1}{50}$ Normal, containing $\frac{158}{5}$ = 31·6 grains of crystals in 1000 Decems. This is equal to 56 grains of iron. 1 Decem = ·056 grain of iron. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.

3066. Potassium Permanganate. See No. 2955. Empirical solution, containing 56·43 grains in 1000 Decems, equal to 100 grains of iron. 1 Decem = ·1 grain of iron. *Pint*, 2s. 6d.; *Half-gallon*, 7s. 6d.

3070. Lead Nitrate. $PbNO^3$. 165·5. $\frac{3}{10}$ solution, containing 496·5 grains in 1000 Decems. 1 Decem = ·071 grain of anhydrous phosphoric acid. *Pint*, 2s.; *Half-gallon*, 6s.

3071. Potassium Bichromate. 2 $KCrO^2$ + Cr^2O^3. 295. $\frac{3}{40}$ solution, containing 221·25 grains in 1000 Decems, being equal to the foregoing solution of nitrate of lead. 1 Decem = ·4965 grain of nitrate of lead. *Pint*, 2s.; *Half-gallon*, 6s.

3072. Sodium Phosphate. HNa^2PO^4 + Aq^{12}. 358. [Anhydrous phosphoric acid = $\frac{1}{2}$ PPO^5 = 71.] Solution of 504·23 grains in 1000 Decems. This solution contains 100 grains of anhydrous phosphoric acid. 1 Decem = 0·1 grain. *Pint*, 2s.; *Half-gallon*, 6s.

3073. Uranium Nitrate. Ur^3NO^4 + Aq^3. 252. Solution containing 710 grains in 1000 Decems, that quantity being equal to the above solution of phosphate of sodium. 1 Decem = 0·1 grain of anhydrous phosphoric acid. *Pint*, 5s. 6d.; *Half-gallon*, 18s.

Any Test Solutions differing from those contained in the preceding Lists can be prepared to Order.

URINOMETRY.

GRADUATED TEST SOLUTIONS and APPARATUS for the Volumetric Analysis of Urine, according to the method of NEUBAUER and VOGEL, as described in their "*Anleitung zur qualitativen und quantitativen Analyse des Harns,*" Fourth Edition, 1863, an English translation of which work has been published by The Sydenham Society.

The Test Solutions belonging to this set are all made on the Litre standard, in order that they may agree with the instructions given in the above-named work, and the measurements of small quantities are all directed to be made in Centimetre Cubes, marked CC.

Only such Test Liquors have been prepared for sale as are in current request. In the work above referred to other kinds are mentioned, which can be supplied if desired, as can also the pure chemicals and apparatus required for effecting analyses of urine by gravimetrical methods.

4000. Estimation of CHLORIDE OF SODIUM.

The estimation of Chloride of Sodium in urine requires the Barytic solution, No. 4004; the Mercuric nitrate solution, No. 4005; the Sodium Chloride solution, No. 4006; the Urea solution, No. 4007; and the Sodium Sulphate solution, No 4008.

4001. *Process.*—Mix 40 CC. of Urine with 20 CC. of the barytic solution. Shake the mixture well, and filter it through a dry filter. Measure off 15 CC. of the clear liquor into a mixing jar. See No. 2798. If it is alkaline to test paper, it must be neutralised with nitric acid, so as to have the slightest possible excess of that acid. If the filtered solution is found to be acid, before adding the nitric acid, the quantity of barytes added to the urine was, perhaps, too little. To test this, add to a little of the filtered non-acidified liquor, a few drops of the barytic solution. If this produces a precipitate, you must begin afresh:—Mix 20 CC. of urine with 20 CC. of the barytic liquor, and measure off 20 CC. of the filtered mixture for analysis. The 15 CC. of the mixture contain 10 CC. of urine separated from sulphates and phosphates. To this mixture, the mercuric solution is to be run gradually from a Mohr's burette, until, after well stirring and shaking the mixture in the jar, there appears a permanent precipitate. This precipitate is produced by the action of the mercury on the urea in the urine, after the action of the salt on the mercury is concluded. The operation is then finished. The number of CC. of mercuric solution used, as shown by the scale on the burette, indicates so many times 10 milligrammes (0·010) of chloride of sodium contained in 10 CC. of the urine.

4002. *Comparative Analyses.*—It is in all cases desirable to check the result of the Volumetric analysis of a mixed organic liquid, by a comparative experiment made with a pure solution of known strength of the chemical substance, the quantity of which it is attempted to estimate by the volumetric process. For this reason, I shall in this section cite the test liquors and processes that are suitable for performing comparative volumetric analyses of the chemical substances that are chiefly interesting in the practice of Urinometry. I will describe these as experiments of *Control.*

4003. *Control of the Estimation of Sodium Chloride in Urine.*—This consists in a repetition of the volumetric process upon a pure solution of Sodium Chloride. The solutions required are the Sodium Chloride, No. 4006; the Urea solution, No. 4007; the Sodium Sulphate solution, No. 4008.—Take in a mixing jar 10 CC. of the normal solution of Chloride of Sodium, No. 4006; 3 CC. of the Urea solution, No. 4007; and 5 CC. of the Sodium Sulphate solution, No. 4008. Then add from a Mohr's Burette the Mercuric Nitrate solution, No. 4005, under continual agitation of the mixture, until a permanent precipitate is produced, as described in No. 4001. This precipitate is caused by the Urea, but it is not produced until all the Sodium Chloride has acted, as far as it can, on the Mercuric solution. The Sodium Sulphate is used to prevent the disappearance of the compound of Urea and Mercury when first precipitated from the mixture, which is, without that addition, liable to occur from the presence of the Nitric Acid that is set free by the decomposition of the Mercuric Nitrate.—The 10 CC. of Sodium Chloride solution, containing 0·200 of that salt, must take 20 CC. of the Mercuric Nitrate solution, No. 4005, before a precipitate of Urea occurs in the mixture.

4004. Barytic Solutions for Precipitating Phosphates and Sulphates from Urine, composed of one volume of saturated solution of Nitrate of Barium and two volumes of saturated Barytic Water. See No. 4001. *Pint bottle,* 2s.; *Half-gallon bottle,* 6s.

4005. MERCURIC NITRATE Solution, for estimating CHLORIDE of SODIUM in Urine. It contains 17·06 grammes of Mercury in a Litre. 1 CC. is = 10 milligrammes (0·010) of Chloride of Sodium. *Pint*, 3s.; *Half-gallon*, 10s.

4006. SODIUM CHLORIDE. Normal solution, containing 20 grammes in 1 Litre. 10 CC. = 200 milligrammes (0·200). 1 CC. = 20 milligrammes (0·020) of Sodium Chloride. Used as a standard to regulate the analysis of Chlorides by the Mercuric Nitrate solution, No. 4005. *Pint*, 2s.; *Half-gallon*, 6s.

4007. UREA. Solution to be prepared when required. It must contain 4 grammes in 100 CC. 1 CC. = 40 milligrammes (0·040) of Urea. *Bottle with* 1 *oz. pure Urea*, 5s.

4008. SODIUM SULPHATE. Saturated solution. Used in the analysis of Sodium Chloride by Mercuric Nitrate. See No. 4003. *Pint*, 2s.; *Half-gallon*, 6s.

4009. ESTIMATION OF UREA.

The estimation of Urea requires the Barytic solution, No. 4004; the Mercuric Nitrate solution, No. 4012; a saturated solution of Sodium Carbonate, No. 4013; and a solution of Urea, No. 4014.

4010. *Process.*—Mix 40 CC. of Urine with 20 CC. of the Barytic solution, shake the mixture thoroughly, filter it through a dry filter, measure off 15 CC. into a mixing jar; but do not, as directed in No. 4001, neutralise it with nitric acid. On the contrary, if the solution is found to be acid to test paper, it must have a few drops of Carbonate of Soda added, to render it alkaline. To the mixture in the jar, which contains 10 CC. of urine, run in slowly the Mercuric Nitrate solution, No. 4012; stirring the mixture continually until the precipitation seems no longer to be produced by additional test liquor. The indication of the completion of the process is afforded by the Sodium Carbonate, No. 4013. Drops of the mixture of Urine and Mercuric solution are brought upon the testing slab, No. 2815, and drops of the Sodium solution are added to them. If the mixture remains white, the urine requires more of the Mercuric solution to be added to it. When the mixture on the slab becomes distinctly yellow, the process is completed. The quantity of Urea is calculated from the number of CC. of the Mercuric solution required to precipitate it. 1 CC. = 10 milligrammes (= 0·010) of Urea. But a correction is required for the quantity of the Mercuric test liquor destroyed by the Sodium Chloride present in the urine before the test liquor begins to act upon the Urea. LIEBIG recommends the deduction of 2 CC. from the quantity of test liquor used as an average compensation. Professor HARLEY (*Medical Times*, April 30th, 1864, page 475) prefers to add to the filtered urine *a few drops* of Nitrate of Silver, to precipitate the chloride before the Mercuric solution is applied. MOHR directs us to add *exactly* as much Nitrate of Silver of known strength as serves to precipitate all the Chloride of Sodium that has been estimated by the process No. 4001. The above experiment and calculation show the quantity of Urea contained in 10 CC. of the analysed urine. That quantity, multiplied by 100, gives the weight of Urea in a Litre.

4011. *Control.*—Take in a mixing jar 10 CC. of the Urea solution, No. 4014, which quantity contains 200 milligrammes of Urea. Test it with the Mercuric Nitrate solution, No. 4012. At first run in about 18 CC. of the test liquor; then add it in small quantities of ½ or ¼ CC., shaking the mixture thoroughly, and testing it with Carbonate of Soda, as directed in No. 4010. These solutions are so graduated, that 20 CC. of the Mercuric solution, No. 4012, are equal to 10 CC. of the Urea solution, No. 4014.

4012. MERCURIC NITRATE Solution, for estimating UREA in Urine. It contains 71·48 grammes of Mercury, or 77·2 grammes of Mercuric Oxide, in 1 Litre. 1 CC. is = 10 milligrammes (0·010) of Urea. 20 CC. = 200 milligrammes of Urea. *Pint*, 3s. 6d.; *Half-gallon*, 12s.

4013. SODIUM CARBONATE. Saturated Solution. Used as indicator of an excess of Mercuric Nitrate, as explained in No. 4010. *Pint*, 2s.; *Half-gallon*, 6s.

4014. UREA. Solution containing 4 grammes of pure Urea, dried at 100° C. in 200 CC. 10 CC. of this solution = 200 milligrammes (0·200) of Urea. To be prepared when required. *Price*, see No. 4007.

4020. ESTIMATION OF PHOSPHORIC ACID.

The most accurate and the most easily-executed process for estimating Phosphoric Acid in urine is by means of Nitrate of Uranium. It requires the following solutions:—Uranic Nitrate, No. 4023; Sodium Super-acetate, No. 4024; Potassium Ferrocyanide, No. 4025; and Sodium Phosphate, No. 4026.

4021. *Process.*—Put into a mixing jar, having a thin bottom to admit of boiling, 50 CC. of filtered urine. Add to it 5 CC. of the Sodium Super-acetate solution, No. 4024. It is important to take the liquors in these proportions. Heat the mixture in a water-bath to about 200° Fahr. (90 to 100° C.), and add the Uranic Nitrate solution, No. 4023, from a Mohr's Burette that is graduated into 10ths of CC. When the precipitate ceases to increase in quantity, which can be pretty easily perceived, if the action of each new drop of the test liquor is watched on the edge of the solution, it is time to apply the indicator. To this end drops of the mixture, without filtration, are transferred to the cells of the porcelain slab, No. 2815; and are there tested with small drops of the weak solution of Potassium Ferrocyanide, No. 4025. The colour of the Indicator is pale yellow; but if an excess of the Uranic solution is present in the mixture, it imparts to the indicator a reddish-brown colour. Every CC. of Uranic test liquor made use of indicates 5 milligrammes of Phosphoric Acid in the 50 CC. of Urine.

4022. *Control.*—Take in a mixing jar 50 CC. of the Sodium Phosphate solution, No. 4026, which is = 100 milligrammes of Phosphoric Acid; add 5 CC. of the Sodium Super-acetate solution, and heat the mixture in a water-bath to about 200° Fahr. Then add the Uranic Nitrate solution from a Mohr's Burette graduated into 10ths of CC. At first add 18 CC. of the test, then proceed with ½ or ¼ CC. at a time, and test with Potassium Ferrocyanide on the porcelain slab. The reddish-brown colour should appear on the slab, when 20 CC. of the Uranic test liquor have been added to 50 CC. of the Sodium Phosphate.

4023. **Uranic Nitrate** Solution, for the estimation of **Anhydrous Phosphoric Acid** in Urine. It contains 20·3 grammes of Uranic Oxide (= 35·495 grammes of crystallised Uranic Nitrate) in a Litre. 1 CC. is = 5 milligrammes (0·005) of Anhydrous phosphoric Acid. 20 CC = 0·100 gramme of the Acid. *Pint*, 3s. 6d.; *Half-gallon*, 12s.

4024. **Sodium Super-Acetate**, consisting of Acetate of Soda and free Acetic Acid. Solution to be added to Urine, in the proportion of 5 CC. to 50 CC. of Urine, to insure the precipitation of Uranic phosphate of constant composition. *Pint*, 2s.; *Half-gallon*, 6s.

4025. **Potassium Ferrocyanide.** Indicator of the completion of the precipitation of Phosphoric Acid by Uranic Nitrate. The solution should be weak and newly made, and be used with the porcelain slab, No. 2815. It is best to keep the salt in crystals, and to make an extemporaneous solution when it is required, in one of the cells of the testing slab, No. 2815. *Bottle with 2 oz. of pure crystals*, 1s. 6d.

4026. **Sodium Phosphate.** Solution containing 10·085 grammes of the crystallised salt, equal to 2 grammes of Anhydrous Phosphoric Acid, in 1 Litre. 1 CC. = 2 milligrammes (0·002), and 50 CC. = 100 milligrammes (0·100) of Anhydrous Phosphoric Acid. Used as a standard to regulate the analysis of phosphates by the Uranic solution, No. 4023. 50 CC. of this Sodium Phosphate solution are equal to 20 CC. of Uranic Nitrate solution, No. 4023. *Pint*, 2s.; *Half-gallon*, 6s.

4031. Estimation of SULPHURIC ACID.

The estimation of Sulphuric acid in Urine requires the Barium Chloride solution, No. 4034, and the Potassium Sulphate solution, No. 4035.

4032. *Process.*—Take a mixing jar with a narrow neck and a thin bottom that will bear boiling, such as No. 2798, *a* or *c*. Put into it a hundred CC. of Urine, and 20 or 30 drops of Hydrochloric Acid, the latter in order to keep the solution acid during the succeeding operation, and thus prevent the precipitation of phosphates. Boil the mixture, and then add the Barium Chloride solution, No. 4034, until the Sulphuric Acid is all precipitated. The indication of the completion of the assay is, that the Barytic solution ceases to give any precipitate with the mixture. The method of managing the exact precipitation of sulphates by barytic salts, has been described in detail in Nos. 2811 to 2817, and need not be repeated. A second operation should always be performed, in which, to 100 CC. of urine, mixed with 20 or 30 drops of Hydrochloric Acid, the greater part of the Barytic liquor shown by the first operation to be required is added at once, the mixture well shaken and boiled; and the rest of the test liquor then added in drops under frequent filtration and testing. Every CC. of the Barytic test solution used indicates 10 milligrammes of Anhydrous Sulphuric Acid present in 100 CC. of the Urine submitted to trial.

4033. *Control.*—Boil in a similar mixing jar, a mixture of 100 CC. of water, and 20 CC. of the Potassium Sulphate solution, No. 4035. Test as above with the Barytic solution, No. 4034. As these two solutions are made equivalent, 20 CC. of the one should exactly precipitate 20 CC. of the other.

4034. BARIUM CHLORIDE. Solution containing 30·5 grammes of crystallised Barium Chloride in a Litre. 1 CC. is = 10 milligrammes (0·010) of Anhydrous Sulphuric Acid. *Pint*, 2s.; *Half-gallon*, 6s.

4035. POTASSIUM SULPHATE. Solution containing 21·778 grammes of Potassium Sulphate in 1 Litre. 1 CC. is = 10 milligrammes (0·010) of Anhydrous Sulphuric Acid. *Pint*, 2s.; *Half-gallon*, 6s.

4036. ESTIMATION OF FREE ACID.

The acid reaction of Urine may be due to the presence of Acid Phosphate of Soda, free Lactic Acid, or other organic acids. It is commonly estimated by comparison with crystallised Oxalic Acid. The volumetric testing of free Acid in Urine requires the Sodium Hydrate solution, No. 4039; the Oxalic Acid solution, No. 4040; and Litmus test paper, No. 2423.

4037. *Process.*—Take in a mixing jar 100 CC. of Urine; add to it from a narrow burette graduated to show tenths of CC., the Soda solution, No. 4039, in very small quantities; even at first not above ½ CC. at once, and speedily reducing that quantity to single drops. Shake the mixture after each addition of test liquor, and test the neutrality of the mixture by applying it with a glass stirrer to a piece of blue, red, or neutral litmus test paper. At last the mixture becomes neutral, and will not make the blue litmus red, nor the red litmus blue. Every CC. of Soda solution, used to effect this result, indicates 10 milligrammes of crystallised Oxalic Acid in 100 CC. of the Urine submitted to trial, or as much free acid of some sort as is equivalent to that quantity of oxalic acid.

In a case like this, where a *degree of acidity* is to be estimated and described, without particularising the chemical body which causes the acidity, it is convenient to use the method of describing the acidity in degrees, as explained at No. 2901. Thus, ACIDITY OF 1° would indicate the presence of *one atom weighed in grains* of any acid, or mixture of acids, contained in a *Decigallon* of the liquid examined.

4038. *Control.*—The alkaline solution, No. 4039, and the acid solution, No. 4040, being of equal power in equal measures, serve to check one another.

4039. SODIUM HYDRATE. *Caustic Soda.* Solution containing 6·35 grammes of Caustic Soda in 1 Litre. 1 CC. is = 10 milligrammes (0·010) of crystallised Oxalic Acid. 10 CC. = 0·100 gramme of Acid. *Pint*, 2s.; *Half-gallon*, 6s.

4040. OXALIC ACID. Solution containing 10 grammes of crystallised Acid in 1 Litre. 1 CC. is = 10 milligrammes (0·010) of Acid. 10 CC. = 0·100 gramme of Acid. *Pint*, 2s.; *Half-gallon*, 6s.

4042. ESTIMATION OF LIME.

The method of estimating the Lime contained in Urine is based on these facts. If oxalate of ammonia is added to a solution of phosphate of lime in acetic acid, the lime is all precipitated as oxalate of lime. If oxalate of lime is ignited, it is converted into a mixture of quicklime and carbonate of lime. This mixture can be dissolved in a measured quantity of graduated hydrochloric acid; and the excess of hydrochloric acid being estimated by a graduated solution of caustic soda, the difference shows the quantity of hydrochloric acid neutralised by the lime, and from this the weight of the lime can be calculated. This method of testing earthy carbonates has been described at No. 2935*a*.

4043. *Process.*—Put 100 CC. of filtered Urine into a mixing jar; add to it caustic ammonia as long as it produces a precipitate; next, add acetic acid to redissolve this precipitate; but do this so cautiously as not to give in excess more than a few drops of acetic acid. To this mixture add oxalate of ammonia, till it ceases to give a precipitate. Cover the mixing jar, and set it in a warm place for 6 or 8 hours, or until the precipitate has entirely subsided and the liquor become clear. Decant the liquor with a syphon, or a large pipette; bring the precipitate on a small filter, and wash it well with hot water. Add the wash water to the decanted liquor, and set this mixture apart for the estimation of the magnesia present in it, when that estimation is desired. Put the washed precipitate, with the filter, into a small platinum crucible, dry it, and ignite it until the paper is burnt away. Put the calcined lime into a small mixing jar; dissolve it in 10 CC. of the Hydrochloric Acid, No. 4044; boil it to drive off the carbonic acid, add a few drops of litmus solution, and neutralise the excess of acid with the Sodium Hydrate solution, No. 4045.

Result.—Deduct the CC. of Soda test from the 10 CC. of Acid test made use of. The remaining CC. of Acid test each indicate 10 milligrammes of lime, as contained in the 100 CC. of urine submitted to analysis. If the lime is to be estimated as milligrammes of phosphate of lime $= Ca^3PO^4$ (or 3 CaO, PO^5), it is necessary to multiply the CC. of acid used by 18·45.

4044. HYDROCHLORIC ACID. Solution containing 13·04 grammes of Hydrochloric Acid, equal to 10 grammes of Anhydrous Lime, and to 18·93 grammes of Anhydrous Carbonate of Soda, in 1 Litre. 1 CC. is = 10 milligrammes (0·010) of Lime. *Pint*, 2s.; *Half-gallon*, 6s.

4045. SODIUM HYDRATE. *Caustic Soda.* Solution containing 14·29 grammes of Sodium Hydrate in a Litre. 1 CC. is = 1 CC. of the Hydrochloric Acid, No. 4044. *Pint*, 2s.; *Half-gallon*, 6s.

4046. ESTIMATION OF SUGAR.

The alkaline solution of Copper, No. 4050, is diluted and boiled. It is then tested with very dilute urine, under the action of which the Copper solution loses its blue colour, and affords a red-coloured precipitate of cuprous oxide.

4047. *Process.*—Put 10 CC. of the Copper solution, No. 4050, into a mixing jar, such as No. 2798*c*; add to it 40 CC. of distilled water, and boil the mixture. In the meantime, dilute 10 CC. of urine with distilled water to the volume of 200 CC. With this diluted urine, fill a Mohr's Burette, and supply it thence gradually to the boiling solution of dilute Copper test. The first action of the test is to render the mixture turbid with a greenish or reddish brown precipitate, which does not settle readily. As the action proceeds, the precipitate becomes of a more decided red colour, and towards the end it settles down more readily, and the liquid finally loses its blue tint, and becomes colourless. During the whole period of testing, the mixture is to be kept gently simmering. You should from time to time, after shaking the mixture, allow the precipitate to settle, and then look through the solution towards a window, or downwards towards the white slab, No. 2800. When the blue colour becomes faint, you must be cautious in adding urine, in order not to overdose it. Finally, one or two drops take away the last residue of the blue colour, and the bright red precipitate settles down in the colourless mixture. The operation is then ended.

4048. *Control.*—Filter a few drops of the boiling mixture into 3 Test tubes. No. 1. Acidify with Hydrochloric Acid, and add Hydrosulphuric Acid. No. 2. Acidify with Acetic Acid, and add Solution of Ferrocyanide of Potassium. If the mixture in No. 1 blackens, or that in No. 2 becomes brown, the solution still retains copper. If both remain colourless, the copper has all been reduced. No. 3. To this tube add a few drops of the copper solution, No. 4050, and heat to boiling. If it gives a red precipitate, too much urine has been added. After these points have been determined, the analyses can be repeated easily, as the approximate constitution of the urine will be known.

4049 *Result.*—The 10 CC. of Copper solution used is equivalent to 50 milligrammes (0·050) of sugar. The experiment shows how many CC. of urine are demanded to supply this quantity of sugar. 200 CC. of the mixture, prepared for use in the burette, contain only 10 CC. of urine. The number of CC. shown by the scale of the burette must be divided by 20, to show the true number of CC. of urine that contain 50 milligrammes of sugar.

4050. FEHLING'S COPPER SOLUTION, for the estimation of DIABETIC SUGAR, containing 34·65 grammes of crystallised Sulphate of Copper, 173 grammes of Tartrate of Potash and Soda, and 80 grammes of Caustic Potash, in 1 Litre. Of this solution 10 CC. = 50 milligrammes (= 0·050) of Diabetic Sugar. *Pint*, 4s.; *Half-gallon*, 15s.

4050*a*. This mixture is readily decomposed by the action of light, air, and carbonic acid, and rendered fallacious in its indications. The following narrative affords an example of its spontaneous decomposition. It is given by Dr. BENCE JONES, in the *Medical Times and Gazette*, for January 21, 1865:—

"A physician sent me some urine of a supposed diabetic patient, asking me to determine the amount of sugar. I told him I found no sugar present. He gave me an analysis, in which sugar was determined to the second decimal place. I took the urine I had examined to the analyst, and asked him to repeat his test. For convenience he had made a Winchester quart of Fehling's standard solution, and, on testing the urine, reduction occurred to an immense extent, and the analyst thought I was wrong, until I heated his standard solution without adding any urine to it. Then the tartaric acid reduced the oxide of copper just as if sugar had been present."

This difficulty can be overcome certainly for some time—though I cannot say how long—by keeping the materials for the test mixture in two separate bottles, from each of which a proper quantity of liquor is measured by pipettes for every analysis that is to be made; as follows:—

4051A. COPPER SOLUTION. Containing 34·65 grammes of crystallised Sulphate of Copper in a Litre. 10 CC. = 50 milligrammes (0·050) of Sugar.

4051B. TARTARIC ALKALINE SOLUTION. Containing 173 grammes of Tartrate of Potash and Soda, and 80 grammes of Hydrate of Potash, in a Litre. 10 CC. of this liquor are required for action with every 10 CC. of the Cupric solution, 4051A. *A Pint bottle of each of these two Solutions*, 5s.; *Half-gallon Bottle of each*, 16s.

4052. METHOD OF USING THESE LIQUORS.—[*Variation of the Process described in No.* 4047.]—Into a mixing jar, No. 2798c, put 30 CC. of distilled water, 10 CC. of the Tartaric Alkali, No. 4051B; and 10 CC. of the Cupric Sulphate, No. 4051A. Stir the mixture, and bring it to a boiling heat. Then proceed as directed in No. 4047.

4053. LITMUS. *For the ascertainment of the* NEUTRAL POINT *in mixing Acid and Alkaline Liquors,* LITMUS INFUSION is required. It should be occasionally prepared fresh, and may be kept in a pipette bottle, such as No. 2818. *Bottle, with 2 ounces of dry Litmus,* 1s.

4054. Cochineal Solution for the same service as the Litmus Solution, No. 4053, but having the great advantage, as described at 2912c, of not being affected by the presence of carbonic acid. Bottle with 2 ounces of dry Cochineal, 1s. 6d.

4054A. Tincture of Cochineal, in 3 ounce stoppered bottle, 1s. 6d. *See note at* 2912*c page* 336.

4070. COLLECTION OF GRADUATED TEST SOLUTIONS FOR THE VOLUMETRIC ANALYSIS OF URINE, according to NEUBAUER and VOGEL.

For particulars, consult the articles referred to in the marginal numbers.

*** THE PRICE IS FOR A BOTTLE CONTAINING 1 PINT.

For the Estimation of Chloride of Sodium :—

4004. Barytic Solution for precipitating Phosphates, 2s.
4005. Mercuric Nitrate for estimating Chlorides, 3s.
4006. Sodium Chloride, standard solution, 2s.
4007. Urea, 1 ounce in bottle, 5s.
4008. Sodium Sulphate, saturated solution, 2s.

For the Estimation of Urea :—

4004. Barytic Solution, same as above, No. 4004.
4012. Mercuric Nitrate for estimating Urea, 3s. 6d.
4013. Sodium Carbonate, saturated solution, 2s.
4014. Urea. See No. 4007.

For the Estimation of Phosphoric Acid.

4023. Uranium Nitrate for precipitating Phosphoric Acid, 3s. 6d.
4024. Sodium Super-Acetate, 2s.
4025. Potassium Ferrocyanide, 2 oz. cryst. in bottle, 1s. 6d.
4026. Sodium Phosphate, standard solution, 2s.

For the Estimation of Sulphuric Acid :—

4034. Barium Chloride, 2s. | 4035. Potassium Sulphate, 2s.

For the Estimation of Free Acid :—

4039. Sodium Hydrate, 2s. | 4040. Oxalic Acid, 2s.

For the Estimation of Lime :—

4044. Hydrochloric Acid, 2s. | 4045. Sodium Hydrate, 2s.

For the Estimation of Diabetic Sugar :—

4051, A *and* B. Fehling's Copper Test, *in 2 Pint bottles*, 5s.

For the ascertainment of Acidity or Alkalinity :—

4053. Litmus, 2 ounces in a bottle, 1s.

4071. THE SET OF 17 TEST LIQUORS [see No. 4070], IN PINT BOTTLES, 39s.

Dry substances in addition, 4007. Urea, 5s.

„ „ 4025. Ferrocyanide of Potassium, 1s. 6d.

„ „ 4053. Litmus, 1s.

4072. The complete set, 46s. 6d.

4074. APPARATUS REQUIRED FOR USE WITH THE FOREGOING GRADUATED TEST SOLUTIONS, IN THE VOLUMETRIC ANALYSIS OF URINE.

⁂ Descriptions or Figures of the Instruments will be found in this Work at the Nos. referred to in the Margin.

COMPLETE SET OF APPARATUS, £3, 12s.

Any single Instrument supplied at the Price quoted.

2688, 6. Pair of Mohr's Burettes, 35 CC. $\frac{1}{10}$, 8s.
2688, 7. Pair of Mohr's Burettes, 55 CC. in $\frac{1}{2}$, 7s.
2698. Wooden Support for a pair of Burettes, 5s. 6d.
2704. Metal Support for a pair of Burettes, 6s. 6d.
The prices of various supports for Burettes, single and double, will be found between Nos. 2694 and 2711 in this work.
2768. Bulb Pipettes to deliver respectively 5, 10, 15, 20, 25, 50, 100 CC., 6s.
2769. Scale Pipette, for 20 CC. in $\frac{1}{5}$, 1s. 9d.
2769. Scale Pipette, for 50 CC. in $\frac{1}{2}$, 3s.
2798A. Mixing Flasks, $\frac{1}{4}$ and $\frac{1}{2}$ pint, 9d.
2798C. Mixing Jars, $\frac{1}{4}$ and $\frac{1}{2}$ pint, 1s. 4d.
2800. White glazed Slab, to show up Colours in liquors under trial, 1s.
2813. Griffin's Quick Filter, *two*, 6d.
2814. Decanting Tube, *three*, 6d.
2815. Porcelain Testing Slab for Indicators, 1s. 9d.
2817. Small Test Glasses, *six*, 8d.
2818. Bottle for Litmus tincture, 1s.
1626. Funnels, one each, $1\frac{1}{2}$ inch, 2 inch, and $2\frac{1}{2}$ inch, 7d.
1626. 100 Circular Filters, $2\frac{3}{4}$ and $3\frac{3}{4}$ inches, to fit these funnels, 9d.
1626. Japanned Box to hold the Filters, 6d.
342. Black Wood Funnel Holder, 1s. 4d.
2427. Litmus Test Papers, 12 books in a box, 2s.
2400. Test Tubes, 6 inches by $\frac{3}{4}$ inch, *twelve*, 1s.
372. Support for 8 Test Tubes, 2s.
1466. Set of 8 Bohemian Glass Beakers, 4s.
115. Glass Stirrers, 3, 6, and 9 inch, 12 *assorted*, 6d.
1401. Boiling Flask, one each, 5, 10, 15, 20 ounces, 1s. 6d.
2783. Measuring Flasks, with a mark on the neck, for 1, $\frac{1}{2}$, $\frac{1}{4}$, $\frac{1}{5}$ Litre, 6s.
2791, 7. Test Mixer for diluting liquors, 500 CC. in 100 spaces of 5 CC., 5s.
1726. Bottle for washing precipitate with hot water, 2s. 6d.

4075. VOLUMETRIC APPARATUS, *Limited set*, containing only the articles most indispensable for the analysis *of* URINE. *The Set*, £1, 16s. 6d.

The purchaser may enlarge this collection by selections from the collection, No. 4074, so as to give it any degree of completeness that may suit his purpose.

2688. Mohr's Burette, 55 CC. in $\frac{1}{2}$, 3s. 6d.
2702. Iron Support for the Burette, 3s. 6d.
2768. Bulb Pipettes, to deliver 10, 15, 20 CC., *the set*, 2s.
2769. Scale Pipette, 25 CC. in $\frac{1}{2}$, 1s. 9d.
2769. Scale Pipette, 2 CC. in $\frac{1}{5}$, 9d.

2798. Mixing Jars, Nos. 3 and 9, 2s.
2813. Griffin's Quick Filter, 3d.
2814. Decanting Tubes, *three*, 6d.
2815. Porcelain Slab for Indicating Tests, 1s. 9d.
2817. Small Test Glasses, *six*, 8d.
1626. Funnels, one each, 1½ and 2 inch, 5d.
— 100 Circular Filters for each size, 10d.
— Japanned Box to hold the Filters, 6d.
342. Black Wood Funnel Holder, 1s. 4d.
2426. Box of Test Papers, 1s.
2400. Test Tubes, 6 inch by ¾ inch, *six*, 6d.
358. Support for six Test Tubes, 5d.
1465. Set of five Bohemian Glass Beakers, 2s. 6d.
115. Glass Stirrers, 6 inch, *six*, 2d.
1400. Boiling Flasks, one each, 5, 10, 20 ounces, 1s. 1d.
2783. Measuring Flasks, 1 Litre and ⅕ Litre, 3s. 2d.
2792. Jar on foot, ½ Litre graduated into spaces of 5 CC., 3s. 6d.
1726. Bottle for washing precipitates, 2s. 6d.
2800. White glazed Slab to show up Colours in liquors under trial, 1s.
2818. Bottle and Pipette for Litmus tincture, 1s.

4080. APPARATUS REQUIRED FOR MISCELLANEOUS OPERATIONS IN URINOMETRY.

I place here instruments required for various operations in the analysis of urine; some of them volumetric and others gravimetric; including those necessary for qualitative experiments.

4081. LARGE GLASS BOTTLE, 12 inches high, 5 inches wide, for collecting the urine of a patient during 24 hours; wide ground mouth, 2½ inch bore, covered with a ground glass plate. Contents about 5 pints, or 3 Litres, graduated into spaces of 100 CC., Fig. 4081, 7s.

4082. Similar Bottle, containing Five Pints, graduated into fluid ounces, 7s.

4083. Similar Bottle, Five Pints, divided into Decigallons and spaces of 100 Septems, 7s.

4084. Similar Bottle, not graduated, 2s. 6d.

4085. Extra for Wicker Basket Case, for one of the Five Pint bottles with handles, for Hospital use. Fig. 4085, 3s.

4085. 4081.

4087. URINOMETERS [*Small Hydrometers*], for determining the specific gravity of Urine. See page 56. The Instrument recommended by Neubauer is that described at No. 633. It is more delicate, but much larger than the Instrument commonly used in England, No. 630.

4088. Picnometers, or Specific Gravity Bottles, for the more exact determination of the specific gravity of Urine, are fully described at page 48.

4089. THERMOMETERS. See description of the following at page 47.

508. Thermometer, with Milk Glass Scale, to 100° C., 3s. 6d.

517. Thermometers for Testing the Heat of the Human Body in Fevers, &c.

Apparatus for the Application of Heat where Coal Gas is available:—

4090. Rose Gas Burner, second size, No. 974, stoneware cylinder, No. 1210, and square of Wire gauze, No. 1196, and Sand bath, No. 1197, *together*, 5s.

This little furnace serves for boiling solutions in the mixing flasks, as required in many volumetric processes, also for evaporation in small porcelain basins; but if a red heat is required, as for the ignition of crucibles, the following furnace is preferable.

4091. Complete Gas Furnace, No. 985, with No. 2 Burner and arrangements, both for evaporating and igniting. *The set*, 18s.

Apparatus for the Application of Heat by means of Spirit Lamps:—

4092. Glass Spirit Lamp, No. 852, 1s. 4d. Cotton Wick, in a box, 2d. Stoneware Cylinder, No. 1191, 8d. Wire gauze, No. 1196, 2d. Sand bath, No. 1197, 4d.—*together*, 2s. 8d.

4093. Berzelius's Spirit Lamp on Stand, No. 870, for various degrees of heat, serving either for boiling flasks or for igniting crucibles, 20s.

A reference to the article on Apparatus for the Production and Application of Heat, commencing on page 70 of this work, will supply the reader with all further necessary information on this subject, but the following are a few of the most useful articles:—

1320, 3. Platinum Crucible, with cover, 1 inch diameter, ½ oz. capacity, *about* 30s.

1323. Berlin Porcelain Crucibles, Nos. 0, 1, 2, 3; contents, ⅜, ½, 1, and 2 ounces, with Covers. *The set*, 3s. 6d.

1743. Berlin Porcelain Evaporating Basins:—

No. 2. 4 oz., 3¾ inch, 10d.	No. 5. 10 oz., 4¾ inch, 1s. 8d.
No. 3. 6 oz., 4 inch, 1s.	No. 6. 16 oz., 6 inch, 2s. 0d.

1296. Exsiccator, closed glass, to contain oil of vitriol, 4s. 6d.
1273. Air Bath, Fresenius's pattern, 21s.
121. Tongs for lifting hot Crucibles, iron, 1s. 6d.

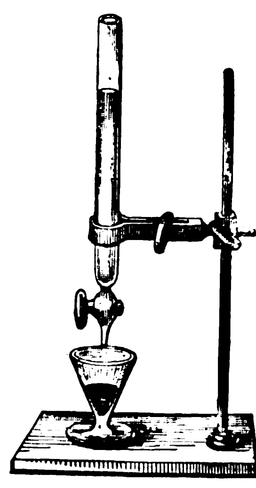
1286.	Desiccating Pan, for oil of vitriol, 8 inches,	1s. 3d.	*Together*, 10s.
1287.	Trellis Top, 8 inches,	1s. 9d.	
657.	Glass Cover, 9 inches wide, 5 inches high,	4s. 0d.	
1295.	Square Glass Plate, 10 inches,	3s. 0d.	

1240. Porcelain Water Bath with Capsule, 5 inches, adapted to the gas or spirit lamp furnace described above, 3s. 6d.

4094. Burette for use with Solutions of Iodine or Chamæleon, which act upon caoutchouc pinch-cocks.

The solutions described between Nos. 4000 and 4051 are not of this character; but when such solutions have to be used, the proper kinds of burette for use with them are those described in this work at Nos. 2689, 2731, 2736, 2739, 2740, and 2746. The capacity and graduation to be about 50 CC. in ¼ or 35 CC. in $\frac{1}{10}$.

4095. Dr. Basham's Sediment Tube, with Glass Stopcock, Fig. 4095, 3s. 6d. Metal Stand for it, 2s. 6d.



4095.

4100. Pure Chemical Tests in Solution, necessary for the Qualitative Analysis of Urine according to Neubauer and Vogel; twenty tests, selected from the list at page 279, where the strength of the solutions is stated.

The prices quoted in the following list are for bottles that contain 2 fluid ounces:—

4101. The set of 20 Tests in 2 ounce bottles, of Class A, 13s.
4102. The set of 20 Tests in 2 ounce bottles, of Class B, 21s.

		s.	d.			s.	d.
2447.	Acetic Acid,		10	2499.	Ferric Chloride,		8
2448.	Alcohol,	1	1	2510.	Lead Acetate,		6
2449.	Ammon. Carbonate,		7	2522.	Nitric Acid,		8
2450.	Ammonia,		6	2523.	Oxalic Acid,		7
2453.	Ammon. Oxalate,		8	2536.	Potassium Hydrate,		9
2462.	Barium Chloride,		6	2540.	Potassium Sulphocyanide,		8
2470.	Calcium Chloride,		6	2550.	Silver Nitrate,	1	2
2471.	Calcium Hydrate,		6	2555.	Sodium Acetate,		6
2477.	Copper Sulphate,		6	2560.	Sodium Hydrate,		8
2496.	Hydrochloric Acid,		7	2571.	Sulphuric Acid,		7

DR. BEALE'S URINE SET.

4106. APPARATUS and TEST LIQUORS for the Volumetric estimation of Urea, Chlorides, Sulphates, Phosphates, and Sugar, in URINE, according to LIEBIG, as described by Dr. M. VON BOSE, in Dr. BEALE'S *Archives of Medicine* for 1858.

The corrections made upon the processes described in the above paper consist in putting the solution for Fehling's Copper Test for Sugar into two bottles, for the reason stated at No. 4050a in this work, and in supplying the test liquors Nos. 4023, 4024, and 4026, for testing phosphoric acid by uranium, instead of those necessary for the iron test.

Contents of the Collection :—

A. GRADUATED TEST SOLUTIONS.—1 pint of each in a stoppered glass bottle. [The marginal numbers refer to the descriptions in the preceding pages.]

4005. Mercuric Nitrate for Chlorides.
4012. Mercuric Nitrate for Urea.
4004. Baryta Solution to separate Phosphates.
4051A and 4051B Fehling's Copper Test for Sugar.
4013. Sodium Carbonate.
4023. Uranic Nitrate for Phosphoric Acid.
4026. Phosphate of Soda Standard Solution.
4024. Super-acetate of Sodium.
4034. Barium Chloride.
4008. Sodium Sulphate.
4025. Potassium Ferrocyanide in Crystals.

B. APPARATUS.

Two of Mohr's Burettes, 50 CC. in ⅛ CC.
Two Wooden Supports for the Burettes.
Bulb Pipette to deliver 25 CC.
Jar on foot, with Spout, ½ Litre in 100 divisions.
Beale's Filter.
Berlin Porcelain Basin, 3 inch.
Ditto, 4 inch.
Test Paper Books, red, blue, and neutral.
Set of 5 Beaker Glasses.
6 Glass Stirrers, 6 inch.
Spirit Lamp, 4 ounce.
Tripod Stand, No. 295.
Sand Bath, 5 inch.
Funnels, 2 inch and 1½ inch.
Black Wood Funnel Stand.
100 Filters for each Funnel.
Japanned Box for the Filters.
Piece of Muslin for Filters.
2 extra Caoutchouc Burette Joints.

4107. The above Collection of Apparatus and Test Solutions, complete, but not packed, £3, 3s.

4108. The same, arranged in a divided cabinet of pine wood, stained black, £4, 4s.

DR. PAVY'S URINE SET.

4109. APPARATUS and GRADUATED TEST SOLUTIONS for the estimation of DIABETIC SUGAR, according to the process of Dr. PAVY, as described in his work, "*Researches on the Nature and Treatment of Diabetes,*" London, 1862. Comprehending the articles from No. 4109 to 4115; *the set*, 21s. Separately as follows :—

4109A. CUPRIC SULPHATE SOLUTION, of such strength that 100 minims of it are decomposed by ½ grain of Diabetic Sugar.

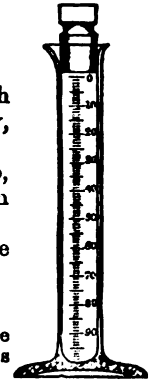
4109B. TARTARIC ALKALINE SOLUTION, corresponding in strength to the Cupric Sulphate Solution 4109A.

A Pint of each Solution, in Stoppered Glass Bottles, the pair, 5s.

Apparatus for use with the above Solutions.

4110. Scale Pipette, Fig. 2769*a*, graduated to 100 minims, 2s.
4111. Bulb Pipette, to deliver 100 minims, 1s. 6d.
4112. Graduated Measure, Stoppered, with 100 marks, in which Urine can be diluted with water, as directed by Dr. Pavy, Fig. 4112, 3s.
4113. Lamp Furnace, or Boiling Apparatus, consisting of a spirit lamp, a stoneware cylinder, wire gauze top, and a 3½ inch Berlin Porcelain Evaporating Basin, 2s. 9d.
4114. Mohr's Burette, No. 2688, 49, graduated to 100 minims, for use instead of the Pipette, 4110, 3s. 6d.
4115. Clamp Support for the Burette, No. 2697, 3s. 6d.

The articles No. 4114 and 4115 are not prescribed by Dr. Pavy, but are here recommended as having (over No. 4110) the advantage of leaving the operator's hands at liberty to attend to the heating and shaking of the mixture.



4112.

4117. Pavy's Apparatus for experiments on the Fermentation of Sugar with Yeast, consisting of a conical jar Water Bath, a glass tube still, a bent glass Connector, and a test glass, Fig. 3 *in his book*, 2s.

4118. *Dr. Pavy's Process.*—The urine to be tested is well mixed, a portion is diluted with water, in the tube No. 4112, from 1 part to 5. With this diluted urine, the scale pipette, No. 4110, or the burette, No. 4114, is filled. 100 minims of the copper solution, No. 4109A, are measured out into the porcelain capsule, No. 4113, 100 minims of the alkaline tartaric solutions, No. 4109B, are added, and the mixture is made to boil gently over the lamp furnace, No. 4113. The diluted urine is then slowly dropped in from the graduated pipette or burette. When the hot mixture loses its blue colour, and the suboxide of copper is thrown down in the capsule as a bright red precipitate, the operation is ended. The number of Minims of urine used to produce this effect represent ½ grain of sugar. As the urine was diluted from 1 volume to 5 volumes, of course the undiluted urine is five times as strong in sugar. The number of minims of urine which contain ½ grain of sugar being thus found, it is easy to calculate the quantity of sugar in any measure of urine, reckoning 480 minims to the fluid ounce, and 20 fluid ounces to the pint.

DR. GOLDING BIRD'S URINE SET.

Apparatus and **Tests** for the Qualitative Analysis of **Urinary Deposits**, according to the processes of Dr. **Golding Bird**, as described in his work on "*Urinary Deposits.*"

4119. The following Collection complete, *but not packed*, 30s.
4120. The same, arranged in a mahogany cabinet, 52s. 6d.

Contents:—Lamp Furnace, consisting of a Spirit Lamp, Lamp Cylinder, Pair of Iron Rings, Wire Trellis, Sand Bath, Water Bath, and support for tubes on the Sand Bath; Three Watch Glasses, Three Porcelain Capsules, Eight Test Tubes, Three Stirrers, Funnel and 100 Filters, Two Filter Rings for filtering without a funnel, Porcelain Crucible, Platinum Capsule and Tongs for holding it; Gravimeter for testing specific gravities, with solution Tube in Case; Three Books of Neutral Test Paper, which indicate either the acidity or alkalinity of urine; Balance and Weights; Graduated Measure to show half drachms; Four Glass Slides, with cells, for use in testing small quantities of liquids; Glass Pipette; Two Test Tubes, 4 by 1 inch; Lamp wick. And the following Tests in stoppered bottles:—Hydrochloric Acid, Nitric Acid, Solution of Caustic Potash, Liquid Ammonia, Fused Chloride of Zinc, Nitrate of Barytes, Nitrate of Silver, Oxalate of Ammonia, Sulphate of Copper, Carbonate of Ammonia, Acetic Acid.

4121. Dr. **Headland's Urine Set.** This consists of a small, neat, polished mahogany cabinet, with lock, for use in the consulting room. It contains: 3 bottles filled with nitric acid, Fehling's Copper Test, Potash Liq., B. P., Small Spirit Lamp, Urinometer and Trial Jar in Case, Test Paper, Pipette, Stirrer, Test Tubes, and Glass Tubes. Price £1, 11s. 6d.
4122. **Griffin's Cheap Portable Set** consists of a black deal box with sliding lid, containing 3 Stoppered Bottles, empty, 1 Glass Spirit Lamp, 8 Test Tubes, Stirrers and Test Papers. Price, 10s. 6d.

Blowpipe Apparatus,

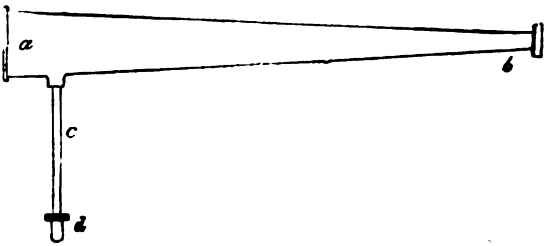
And Apparatus for Micro-Chemical Operations.

BLOWPIPES.

4200. CONICAL BLOWPIPE, Fig. 4200. GRIFFIN's modification of BLACK's Blowpipe, japanned tin plate, *a*, *b*, with brass pipe, *c*, and movable brass nozzle, *d*, 7 inches long, price 8d.

4201. Ditto, same pattern, but 8½ inches long, 8d.

This form of blowpipe is easier to use than instruments of smaller internal dimensions. The choice of the length depends upon the eyesight of the person who is to use the blowpipe. An instrument that is found to be too short, may be lengthened by a bit of vulcanised caoutchouc tube put on the end *b*.



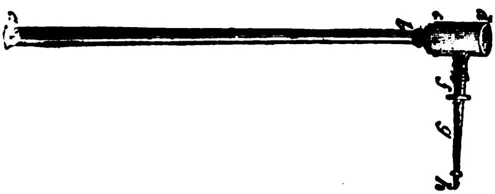
4200.

4202. Conical Blowpipe, Griffin's form, Fig. 4200, made of German silver finely polished, with a platinum nozzle, 10s.

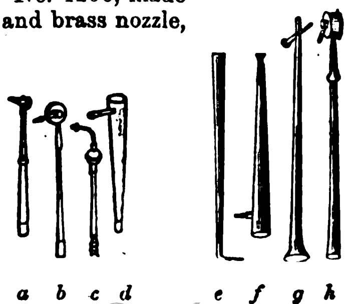
4203. Blowpipe of the form used by Berzelius, Plattner, and Regnault, Fig. 4203, brass, with two brass nozzles, 5s.

4203A. Plattner's Blowpipe, form of Fig. 4203, made of highly polished German silver, with expanding horn mouthpiece, and 3 solid platinum jets, 18s.

4204. Conical Blowpipe, of smaller capacity than No. 4200, made of polished brass, with bone mouthpiece and brass nozzle, Fig. 4204 *d* and *f*, 2s.



4203.



4204.

4205. **Conical** Blowpipe, without condenser or separate nozzle, Fig. 4204 *e*, brass, not polished, 6d.

4206. **Bergmann's** Blowpipe, with spherical condenser, Fig. 4204 *c*, brass, with brass nozzle, 2s.

4207. Bergmann's Blowpipe, Fig. 4204 *c*, with ivory mouthpiece and two brass nozzles, 3s.

4208. Tennant's Blowpipe, with flattened cylindrical condenser, Fig. 4204 *b* and *h*, made of brass, with ivory mouthpiece and two brass nozzles, 5s.

4209. Portable Blowpipe, as used by Wollaston and Mitscherlich, which folds up into the size of a small pencil-case for the pocket, Fig. 4204 *a* and *g*, made of brass, 3s. 6d.

4210. Portable Blowpipe, same as last, but made of German silver, 4s. 6d.

4211. Griffin's Flexible Blowpipe, by means of which the volatile products of a blowpipe combustion can be blown in any desired direction, form of Fig. 4211, very portable, 1s.

The tube and nozzle *a* are of brass; *b* is a flexible caoutchouc blowing tube; *c* is a cork by which the blowpipe is held and directed.

4212. Griffin's Flexible Blowpipe, with condenser, form of Fig. 4212, 3s.

The cylinder *c*, by which the blowpipe is held, is of brass, about 1 inch in diameter and 1¼ inch in length; the nozzle *a* is of brass, the blowing tube *b* of caoutchouc. In consequence of the large size of the reservoir *c*, this blowpipe is easier to use than the more portable blowpipe, No. 4211.

NOZZLES AND MOUTHPIECES FOR BLOWPIPES.

4213. Nozzles for Blowpipes, brass, such as *d*, Fig. 4200, *each* 4d.

4214. Nozzles of Brass tipped with Platinum, *each* 1s. 6d.

4215. Nozzles of Solid Platinum, *each* 2s. 6d.

The nozzles of solid platinum possess the advantage that when stopped in the bore by oil or soot, they can be easily cleansed by being heated to redness on charcoal before the blowpipe.

4216. Mouthpiece for a Blowpipe, cylindrical form, made of polished bone, 6d.

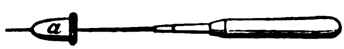
4217. Plattner's Trumpet-formed Mouthpiece for Blowpipes, polished bone, 1s. 3d.

4218. Blowpipe Drill of hard steel, four-square, with sharp edges, in handle; used for opening the orifice of the nozzle of the blowpipe when stopped by dirt, Fig. 4218, 8d.

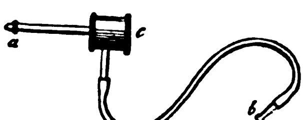
In using the drill, the jet should be taken from the blowpipe, and the drill be inserted into the orifice, from within the jet, as shown by Fig. 4218. It must be used gently, in order not to cut the hole too large.

4219. Brass Blowpipe, fixed on a stand, Fig. 4219, 10s. 6d.

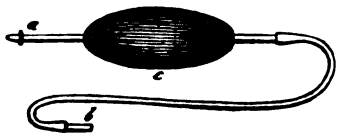
This blowpipe can be fixed in any desired position; higher or lower in the upright slide, or at any angle from the table. The blowpipe is fixed to the support by the screw *c*, and the frame to the table by the screw *d*. The jet *b* is in duplicate, with orifices of different sizes. At *a* is a bone mouthpiece.



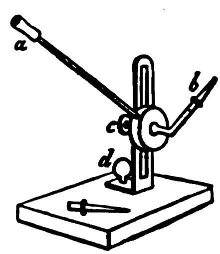
4218.



4212.



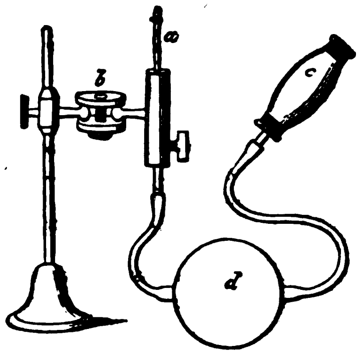
4211.



4219.

4220. **Blowpipe fixed to a support, and accompanied by a caoutchouc blowing apparatus, Fig. 4220, price 20s.**

Fig. 4220, letter c, represents a blowing machine to be worked either by the hand or the foot; it forces air into the expanding regulator d, and thence in a regular blast into the blowpipe a. The force of the blast is regulated by the stopcock, which forms part of the blowpipe. The position of the blowpipe and the direction of the blast are regulated by the universal joint b, and the thumbscrew and collar on the support.



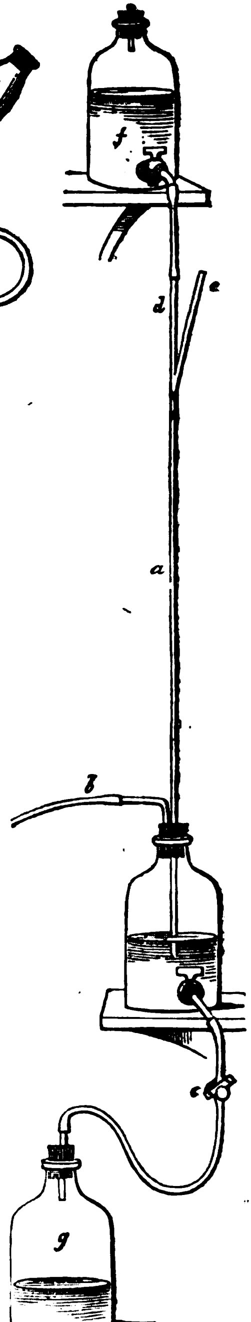
4220.

4221. Sprengel's Catalan Blowpipe, which gives a constant stream of air sufficient for all analytical operations with the blowpipe, complete as represented in Fig. 4221, with the omission of the two bottles *f* and *g*, 12s.

4222. The same, with the addition of the two stoneware water bottles, 2-gallon size, with brass taps, 24s.

Other sizes of water bottles are described at page 21. A smaller size than 2 gallons does not give air enough for a long blowpipe operation. Larger sizes are troublesome to lift up when full of water.

4223. *Action of Sprengel's Blowpipe*, Fig. 4221.—Suppose the central bottle or regulator (of one gallon capacity) to be half full of water, so as to cover the lower end of the pipe *a*, the bottle *f* to be full of water, and the bottle *g* to be empty. Then, if you open the stopcock between *f* and *d*, the water runs from *f* into the regulator, and thence into the bottle *g*. By a proper adjustment of the clamp *c* (see No. 2871), the water can be made to run from the regulator into *g*, as fast as it runs from *f* into the regulator, so that the water in the regulator remains nearly at the same level. When this is the case, air enters by the tube *e*, bubbles up through the water in the regulator, and escapes by the tube *b*. If the flow of the water is well regulated by the stopcock *d* and the clamp *c*, this current of air is quite regular, and sufficiently powerful for most blowpipe experiments. To use it, the blowpipe is simply attached to the caoutchouc tube which is connected with the bent tube *b*. It serves for most of the mouth blowpipes, and for the gas blowpipes, Nos. 4250 and 4252. If the water passes out of the regulator less rapidly than it passes into it, the pressure of the air is increased, but the gain of power is only of short duration, because the regulator then rapidly fills with water. When the water has all run from *f* into *g*, the bottles *f* and *g* must be made to change places. The bottle *g* is provided with a neck and stopcock that are not represented in the figure.



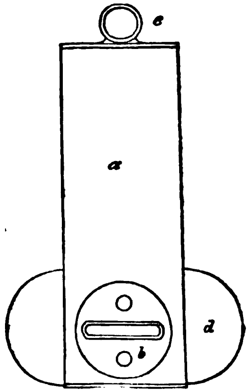
4221.

Blowing Apparatus of other sizes and forms are given at page 115.

BLOWPIPE LAMPS.

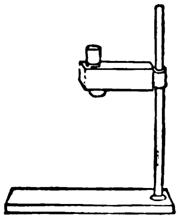
4226. Blowpipe Lamp, form of Fig. 4226, made of japanned tinplate, with pull-off cap and support for the fingers, 1s.

a is the lamp; *b*, the wick-holder; *c*, a cylinder holding a perforated cork, by which the lamp is held on a wooden support, as represented by Fig. 4228; *d* is a support, the right hand side of which supports the hand that holds the blowpipe, while the left hand side supports the hand that holds objects in the blowpipe flame.



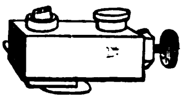
4226.

4227. Blowpipe Lamp, similar to the above, with collar and thumbscrew to attach it to a slender brass support, the support being such as is represented by Fig. 4232, although in that figure the cork support is represented, 1s. 4d.

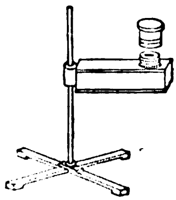


4228.

4228. Wooden Support for the Lamp, No. 4226, form of Fig. 4228, black wood, 8d.
4229. Wooden Lamp Support, same pattern, mahogany, 1s.
4230. The Lamp, No. 4226, with the black wood support, as represented by Fig. 4228, 1s. 8d.
4231. The Lamp, No. 4226, with the mahogany support, 2s.
4232. Blowpipe Lamp, japanned tinplate, with brass cap to screw on, and prevent escape of oil in travelling, form of Fig. 4232, but with collar and thumbscrew similar to that shown by Fig. 4233, to adjust it to the brass rod, 2s. 6d.
4233. Blowpipe Lamp, japanned tinplate, form of Fig. 4233, having an extra neck to admit of the addition of oil without disturbing the wick-holder; both necks provided with brass screw caps. Also with finger-plate and brass collar and screw, 3s.

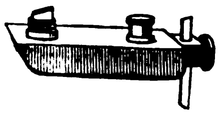


4233.

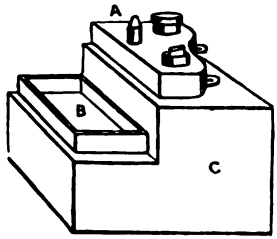


4232.

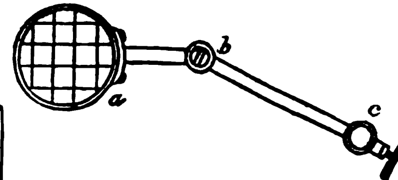
4234. Blowpipe Lamp, polished brass, with one neck, like Fig. 4232, but with collar and thumbscrew, 5s. 6d.
4235. Blowpipe Lamp, Plattner's pattern, Fig. 4235, polished brass, with extra opening for oil, brass screw caps to both necks, with collar and thumbscrew, 7s. 6d.
4236. Laboratory Blowpipe Lamp, for use where Gas is unattainable; form of A, Fig. 4236, made of japanned tinplate, with three necks; the large one for the usual large flat blowpipe wick, the small one for a single small round wick, to be used when a small flame is required for experiments on phosphorescence and coloured flames; the third neck for the insertion of oil; all three necks provided with pull-off caps, 2s. 6d.
4237. Table to support the Laboratory Blowpipe Lamp, form of Fig. 4236, consisting of a wooden box C, upon the top of which the lamp A can be screwed. B is a tinplate tray, the bottom of which should be covered with a plate of glass, to receive objects that fall from the blowpipe. The box C can be fitted with drawers to hold the blowpipe apparatus. These drawers may be made to pull out, either in front or on the right hand side. Price according to style of fitting up.



4235.



4236.

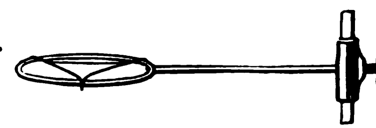


4242.

4241. Portable Brass Support for the Blowpipe Lamp, as used by Berzelius and Plattner, and represented in Fig. 4232, in three pieces, polished brass, formed to unscrew and fold up for travelling, 3s.

This support suits all the Lamps that are described as being provided with a brass collar and thumbscrew.

4242. Plattner's Support for small capsules over the Blowpipe Lamp, or the Spirit Lamp, Fig. 4242, consisting of a brass ring with iron or brass trellis, adapted by a collar and thumbscrew to the rod of the brass support, No. 4241, or Fig. 4232. Price of the branch as represented by Fig. 4242, 6s.



4243.

4243. Crucible Support for use with a vertical Blowpipe flame, form of Fig. 4243, consisting of an iron ring, arm, and thumbscrew, adapted to the Support No. 4241, the iron ring fitted with a triangle, for sustaining crucibles, &c., that are to be ignited, 3s.

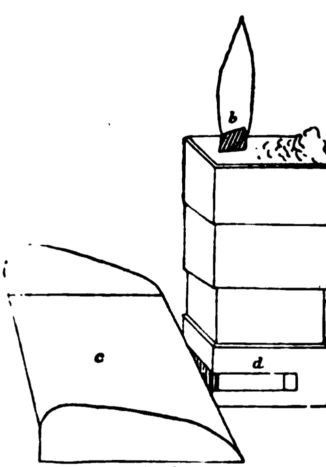
4243A. Major Ross's Portable Glass Spirit Lamp and Wick, see "Pyrology," No. 4534 and Fig. 4243a. Price, 1s. 6d.

4244. Fuel for Blowpipe Lamps.

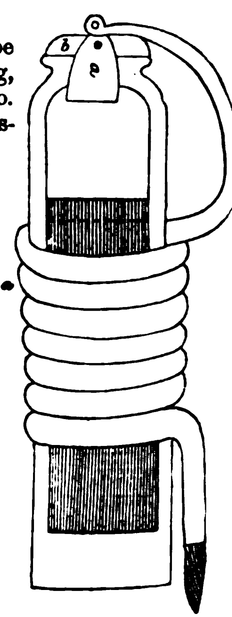
1. Mix alcohol of 85 per cent. 6 volumes, Spirit of Turpentine 1 volume, with a few drops of ether.

2. Mix Wood spirit 4 volumes, with turpentine 1 volume.

Both must be clear, without excess of turpentine. With these mixtures a blowpipe has power to melt 30 or 40 grains of copper, or 300 grains of silver.



4249a.



4243a.

Duflos recommends for the production of a good reducing flame a mixture of 12 parts of strong spirit of wine with 1 part of turpentine.

Plattner uses refined olive oil, but rejects any that gives a blowpipe-flame with a yellow edge.

4245. Japanned Metal Bottle for carrying Oil to feed the Blowpipe Lamp, form cylindrical, 5 inches long, 1½ inch wide, with brass screw cap, 3s. 6d.

4246. Similar Bottle to carry spirits of wine, 3s. 6d.

4247. Spirit Lamp, glass, small size, for heating glass tubes and glass bulbs in the examination of substances for water and volatile compounds. *Any of those described at page* 78, *at from* 1s. *upwards.*

The lamp with rack, No. 860, is very handy for the regulated evaporation of small quantities of solutions; but it is too large for portable cabinets of blowpipe apparatus.

4248. Glass Spirit Lamp, small size, with brass cap, ground to fit the glass neck, to prevent the escape of spirit in travelling, 2s. 6d.

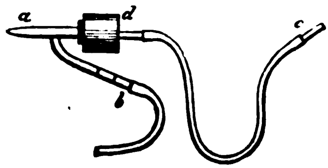
4249. Cotton Wick for Blowpipe Lamps and Spirit Lamps, ½ inch wide, per yard, in a box, 2d.

4249a. Major Ross's Blowpipe Candle and Stand, extremely handy and compact, for travelling purposes. See "Pyrology," No. 4534, and Fig. 4249*a*. Price of the Candle Stand, 2s. 6d.; price of the Candles, 4s. per dozen.

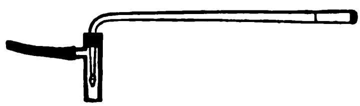
GAS BLOWPIPES AND GAS BURNERS.

4250. Mouth Blowpipe attached to a Gas Burner, form of Fig. 4250, brass, with caoutchouc blowing tube, 4s. 6d.

a, Fig. 4250, is the jet; *b* is the supply pipe for the coal gas; *c* is the flexible blowpipe, the end of which is placed in the operator's mouth; *d* is a cork, by which the blowpipe is held in the fingers. The brass tube connected with the blowing tube *c*, can be moved backwards and forwards, in the jet pipe *a*, to regulate the size of the flame and adapt it either for oxidising or reducing. Of course, the force of the jet of coal gas which feeds *b* must be regulated by a stopcock.



4250.



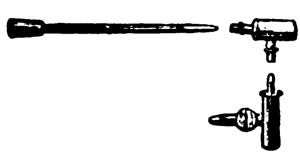
4251.

4251a. Mouth Blowpipe, attached to a Gas Burner, another form, Fig. 4251, 3s.

The long tube is placed in the mouth. The coal gas arrives by the short tube represented on the left hand.

4251b. Ditto, with regulating stopcock and moisture chamber, form of Fig. 4251*b*, 8s.

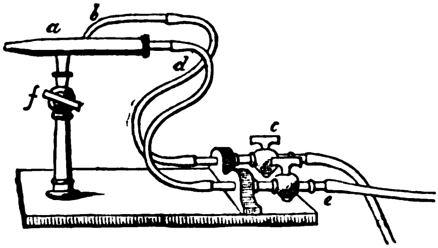
4252. Griffin's Blast Gas Blowpipe, for Analytical Experiments on Chemicals and Minerals; consisting of a Brass Blowpipe and Stand, with two fine stopcocks, mounted on a japanned iron base, as represented by Fig. 4252, 21s.



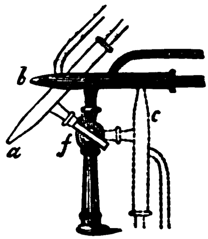
4251*b*.

4253. This Blowpipe gives a clear and steady blue flame for any length of time, when used with an effective blowing apparatus; and the flame can be made at will, either large or small, oxidating or reducing, by a proper regulation of the supplies of gas and atmospheric air. It is, therefore, suitable for the performance of the various qualitative and quantitative blowpipe experiments that have been described by Berzelius, Plattner, and others,—leaving the operator's mouth and both his hands perfectly at liberty.

4254. The blowpipe *a*, Fig. 4252, is supplied with coal gas by the tube *b c*, and with air by the tube *d e*, which has a slight motion *towards* and *from* the point of the jet, by means of which the proper mixture of the air and gas is made, which is necessary to produce either oxidation or reduction, as may be required. The supply of coal gas is regulated by the stopcock *c*, and that of air by the stopcock *e*; the former being, of course, connected with the gas main, and the latter with the blowing machine. An excellent blowing machine for this purpose is that described at No. 1166. Another, still more powerful and regular, but also somewhat higher in price, is No. 1168. A much cheaper, and quite efficient for many purposes, though not so convenient a blowing apparatus, is described at No. 4221. Whichever of these machines is used, it must be put into complete working order before the commencement of any blowpipe experiment that is to last for some minutes, in order that no interruption of the experiment may take place. No blowing machine will answer that does not, like those referred to, give a perfectly steady blast.



4252.



4255.

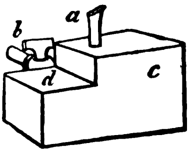
4255. The blowpipe can be fixed by the screw *f*, Fig. 4252, in any required position, as exhibited by Fig. 4255. Thus, if the flame is to be blown *downwards* upon an object to be heated on charcoal, as in many blowpipe operations, the position *a* is adopted. If the flame is to be forced *horizontally*, as is required for many experiments on coloured flames, or as it is used by Plattner in the roasting of metallic ores in his charcoal furnace, No. 4330, the position *b* is chosen. If an upright flame is required for the ignition or fusion of substances in a spoon or a crucible, or for certain experiments on bodies that produce coloured flames, then the position *c* is to be arranged. In moving the blowpipe from one to another of these positions, care must be taken that no *kink* is made in the caoutchouc tubes *b* and *d*, so as to cut off the supply of gas or of air. This blowpipe readily melts metallic silver in a small crucible, and also a few grains of copper. Any crucible of less than an inch in height can be brought over it to a bright red heat. It answers well for the roasting of metallic ores, or for the decomposition of siliceous minerals in small quantities for qualitative analysis, or even for quantitative analysis after Plattner's methods.

GAS BLOWPIPES OF A LARGER SIZE. See 1176 and following Nos. of this work, and the section on Blast Gas Furnaces commencing at No. 1100.

4256. Gas Burner for the supply of Coal Gas for Blowpipe Experiments, mounted on a solid heavy block of wood, upon which the fingers may be steadied while holding the blowpipe and the assay to the flame, form of Fig. 4256, with a stopcock for regulating the flame, 4s.

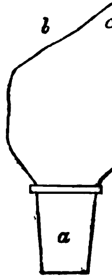
4257. Ditto, the same apparatus without the stopcock, 2s. 6d.

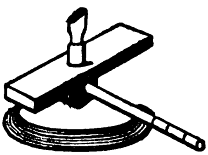
4258. Gas Burner for the supply of Coal Gas for Blowpipe Operations, with heavy iron foot, and wooden platform upon which to rest the fingers while holding the blowpipe and the assay to the flame, Fig. 4258, 2s.

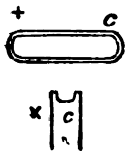


4256.


4260.




4258.



4261.

4259. The same Arrangement, with the addition of a stopcock, 3s. 6d.
4260. Bunsen's Blowpipe Burner, Fig. 4260, 4d.

This acts when dropped into a Bunsen's jet so as to cut off the supply of atmospheric air and give a luminous gas flame. See page 90.

4261. Massive Gas Burner for Blowpipe use, the lower part ground to fit an ordinary gas nozzle, Fig. 4261, 1s. 6d.

SUPPORTS FOR OBJECTS IN THE BLOWPIPE FLAME.

There are four kinds of Supports, namely:—1, Metallic; 2, Charcoal; 3, Clay; 4, Glass.

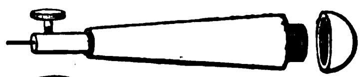
I. METALLIC SUPPORTS.

4270. PLATINUM WIRE of the proper thickness for Blowpipe Experiments, in pieces 2 inches long, Fig. 4270, each 2d.
4271. Platinum Wire, rather thicker than the sort commonly used for Blowpipe Experiments, in pieces 2 inches long, 2d.

4270.

4272. Platinum Wire, extremely fine, for holding very minute quantities, in experiments on the colours of flames, in pieces 12 inches long, 6d.
4274. Support for mounting short pieces of wire, Fig. 4270*a*, serving also as a box in which to store the wires, Fig. 4274, 2s. 6d.

4274.



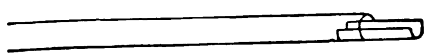
4275.

4270*a*.

4275. Handle for Mounting Platinum Wires, but without a box for storing the wires, Fig. 4275, 1s.
4276. Copper Wire, for determining the presence of chlorine, iodine, and bromine, Fig. 4276, per yard, 2d.

Coil up the end of the fine Copper Wire, in the form shown by Fig. 4276; and melt a little microcosmic salt in this grate, using only a gentle heat. When the bead has done effervescing, and has acquired a pale green colour, add to it a very small portion of the salt to be tried, and expose the bead to the point of the blue flame. If chlorine is present, a bright blue flame will appear; if iodine, an emerald green flame; if bromine, a blue flame with green edges.

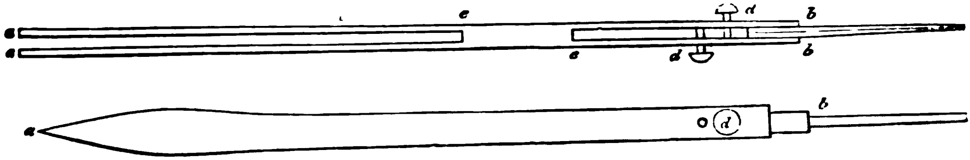
4276.



4280.

4277. PLATINUM FOIL of a proper thickness for blowpipe experiments, slip 2 inches long by ½ inch wide, 6d.
4278. Ditto, 2 inches long by 1 inch wide, 1s.
4279. Ditto, any length in slips of 2 inches wide, at per square inch, 6d.

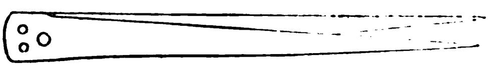
Fig. 4280 represents a small slip of platinum foil, mounted in a Bohemian glass tube, for determining the presence of fluorine. The fluoride is added to a fused bead of microcosmic salt, which is placed on the bit of platinum. The flame is then to be so applied as to drive the disengaged gas into the glass tube, into the other end of which a piece of wetted Brazil wood paper is inserted. Hydrofluoric acid corrodes glass, and gives a yellow colour to Brazil paper.



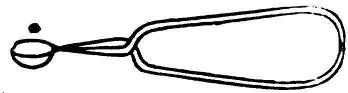
4281.

4281. Platinum Blowpipe Tongs, best construction, size and form of Fig. 4281, consisting of flat steel blades, with hardened points, *a a*, and Platinum Points at the other end, *b c*, 7s. 6d.

4281A. Platinum Blowpipe Tongs, very stoutly made, like Fig. 4281*a*; length, 6 inches; width, ½ inch, and having a file cut on one side, and strong Platinum Points 1 inch long, 20s.

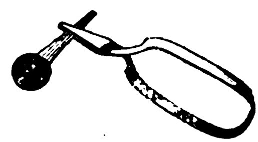


4281*a*.



4283*a*.

4282.



4283*b*.

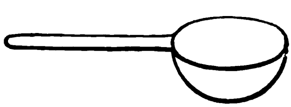
4282. Steel Spring Tongs, with Platinum Points, form of Fig. 4282, but nearly twice the size of that figure, the steel flattened as shown by Fig. 4283*b*, 3s. 6d.

4283. Steel Spring Tongs, for holding small capsules before the blowpipe, or in the flame of the spirit lamp, Fig. 4283*a*, which shows a platinum capsule, No. 4284; Fig. 4283*b*, which shows an iron spoon, No. 4291, 6d.

Platinum Spoons:—

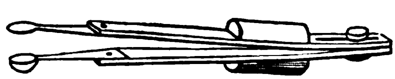
4284. Platinum Spoons, or cups with short handles, form of Fig. 4284. These have been fully described at pages 183 and 184.

Fig. 4283*a* represents the method of holding such cups in the flame, by which arrangement they are made to serve the purpose of spoons.

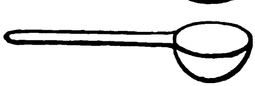


a.

4284.



4287.



b.

4285.

4286.

4285. Plattner's Platinum Blowpipe Spoons, with very deep bowls and long handles, as represented by Figs. 4285 *a* and *b*, both as to form and size.

4285A. Price of the large spoon, 5s.

4285B. Price of the small spoon, 3s.

4285C. Price of a smaller spoon, one-third the capacity of B, 2s. 6d.

4286. Plattner's Support for Blowpipe Spoons with long handles, brass mount on turned hard wood handles, Fig. 4286, 2s.

4287. Spoon and Cover for exposing to heat substances that decrepitate; spoon and cover both of platinum, mounted on brass, Fig. 4287, 8s.

4288. Double Cups for the same purpose, Fig. 4284, ⅜ inch, *per pair*, 2s.

When in use, the pair of cups, placed mouth to mouth, is to be held by the tongs, No. 4283.

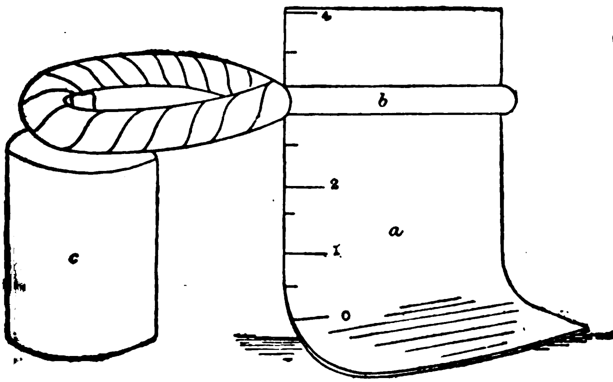
4289. Plattner's Platinum Capsule, 1¼ inch diameter, ½ inch deep, *about* 14s.

See pages 183 and 184 for other sizes.

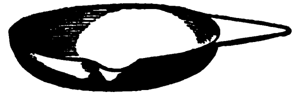
4290. Cover for the Platinum Capsule, consisting of a 1½ inch square of platinum foil, 2s.

This capsule is used when filters that contain small precipitates are to be burnt, and for decomposing Fluorides in sulphuric acid.

4290A. Major Ross's Aluminium Plate Support, for operations before the Blowpipe, Fig. 4290*a*. *The high conduction power of this metal for heat, enables it to be used with great advantage.* See Ross's "Pyrology," No. 4534. Price of the Aluminium Plate, 4s. Price of the Steel Tongs, 1s. 8d.

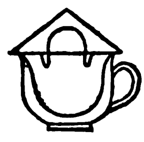


4290*a*.



4289.

4291.



4292.

4291. Iron Spoon, 1 inch bowl, short handle, Fig. 4291, for trying the combustibility of bodies, 2d.

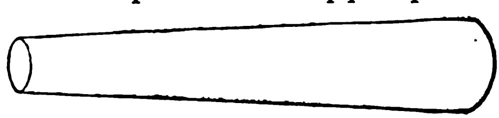
When in use it is held by spring steel tongs, as shown by Fig. 4283*b*.

4292. Cup and Cover of Berlin porcelain, with handle, for the ignition of decrepitating substances, ½ inch diameter, Fig. 4292, 3d.

II. CHARCOAL SUPPORTS.

4299. Sticks of Charcoal for use as Supports before the Blowpipe, per lb., 3d.

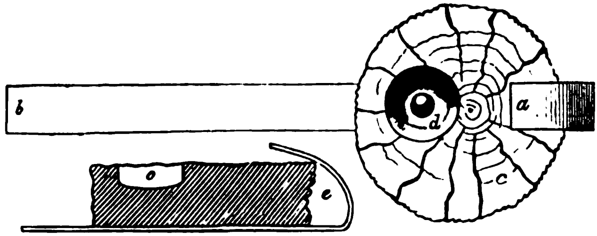
4300. Saw for Cutting Sticks of Charcoal into pieces fit for Blowpipe Experiments, such as the disc marked *c* in Fig. 4302, or into square prisms of any desired size, 1s. 6d.



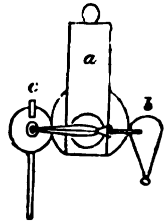
4301.

4301. Charcoal Borer, to scoop cavities in charcoal for supporting Assays before the Blowpipe, form and size of Fig. 4301, japanned tinplate, 4d.

4302. Charcoal Holders, tinplate slips, *a*, *b*, Fig. 4302, *per pair*, 1d.

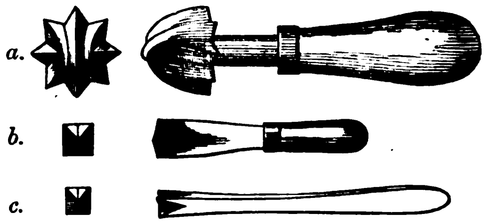


4302.



4303.

4303. Fig. 4302 represents a disc of charcoal mounted for use with the blowpipe. *c* is the disc of charcoal, cut from a stick by the saw, No. 4300. *d* is a hole scooped out by the charcoal borer, No. 4301. In the middle of the hole is the figure of an assay fused into a bead. *a*, *b* is the tinplate charcoal holder, No. 4302. The lower figure, *o*, *e*, represents a section of the charcoal disc, and of the tin holder, both represented the full size. Fig. 4303 represents the arrangement proper for an experiment. *a* is the blowpipe lamp, No. 4226; *b* the blowpipe, No. 4200; and *c* the charcoal disc, and its tin holder, No. 4302.



4304.

4304. Plattner's Charcoal Borers, for making in Charcoal Sticks, or in Charcoal Pastilles, holes of various dimensions; the steel borers all made of hardened steel; three forms and sizes, Fig. 4304, *a*, *b* *c*. The kinds *a* and *b* with cocoa handles, *c* with spatula end.

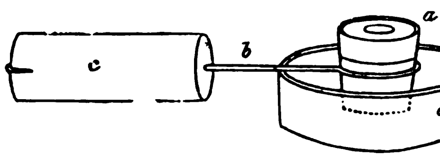
4304 *a*. Borer for holes of $\frac{7}{10}$ inch in diameter, 5s.

4304 *b*. Borer for holes of $\frac{3}{10}$ inch in diameter, 2s.

4304 *c*. Borer for holes of $\frac{1}{4}$ inch in diameter, with spatula end, 2s.

Description of PASTILLE CHARCOAL SUPPORTS for Blowpipe Experiments. By John J. Griffin. *Reprinted from the "Proceedings of the Philosophical Society of Glasgow,"* 26th April, 1843.

4305. Several of the most important experiments performed with the Blowpipe require the assistance of charcoal, upon which the object submitted to examination is supported in the flame. The charcoal employed for this purpose should be of soft wood, well burnt, compact, and free from crevices. Such charcoal is difficult to obtain. I have several times examined a sackful of charcoal, without finding above half-a-dozen sticks adapted for these experiments. This circumstance induced me to seek for a substitute, and having found one which seems likely to prove serviceable, I think it possible that other persons accustomed to operate with the Blowpipe, and accustomed also to feel the want of suitable charcoal, may be willing to learn in what manner they can easily replace it by an efficient substitute. For this reason I have drawn up the following notice.



4306.

4306. The Blowpipe experiments that require the assistance of charcoal may be divided into two classes:—In the first class may be named the formation of beads with microcosmic salt, the trial of fusibility *per se*, and the roasting of the metallic compounds that contain such volatile elements as sulphur and arsenic. The second class of experiments is restricted to the fusion of minerals or metallic compounds with carbonate of soda, or with soda and borax, for the purpose of effecting particular combinations or of procuring their metals in the state of regulus.

For these two classes of experiments, I make use of two different composition supports, the first of which I shall call *Supports for Fusions*, and the second *Supports for Reductions*. These are alike in appearance—the form and size of both being shown by Fig. 4306 *a*. Each consists of two parts, an upper or combustible portion, and a base or incombustible portion. The former is the proper substitute for the ordinary charcoal, the under portion only acting as a crucible in which the combustible portion is contained. I shall first describe the composition and formation of the supports, and afterwards show the way to use them.

4307. The incombustible portion of both supports is made of fine pipeclay and charcoal powder, mixed in equal parts by weight, with as much water, slightly thickened by rice paste, as is sufficient to form a stiff plastic mass.

The combustible portion of the *Support for Fusions* consists of—

Charcoal in fine Powder, ...	12	Parts.
Rice Four, ...	¼	,,
Water, ... about	8	,,

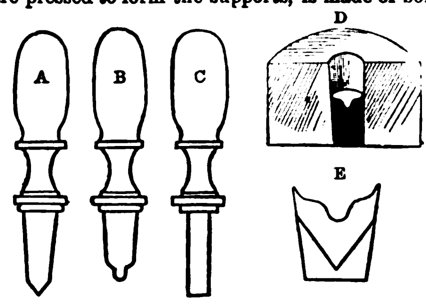
The rice is boiled in the water to form a paste, with which the charcoal is afterwards mixed into a mass of the consistence of dough.

4307 *a*. The upper part of the *Support for Reductious* consists of the following mixture:—

Charcoal in fine Powder, ...	9	Parts.
Carbonate of Soda, crystallised, ...	2	,,
Borax, crystallised, ...	1	,,
Rice Flour, ...	¼	,,
Water, ... about	8	,,

The water is boiled, the soda and borax are dissolved in it, and the rice is then added to form a paste, with which the charcoal is finally incorporated, and the whole well kneaded into a stiff mass.

4308. The mould in which these compositions are pressed to form the supports, is made of boxwood, and consists of four pieces, represented by Fig. 4308, A, B, C, D.



4308.

D is a cylindrical block, having a conical hole through the centre; A, B, C, are pestles or stampers fitted to this hole. The mould D, when in use, is set upon a clean surface of iron, such as a Blowpipe anvil. A round ball of the clay composition, ¼ inch in diameter, is put into it, and pressed to the bottom by means of the pestle A. This forms a conical cup or crucible similar to the under portion of Fig. E, which represents a vertical section of a support. A round ball of the combustible composition, of either kind, ⅓ inch in diameter, is next put into the mould, and pressed firmly down with the pestle B, and the pestle before being withdrawn is gently turned round to smooth the surface of the support. The mould is now lifted from the anvil, and the pestle C is applied below to push the support out of the hole.

The principal points which require attention, to ensure success in this process, are, to have the materials in the state of very fine powder, and the moist compositions of a proper degree of consistency. If they are too soft, the support will not quit the mould without losing its form. If too dry, the particles of the support will not cohere. The proper state is found after a few trials. It is most convenient to begin by making the mixture too soft, and then drying it slowly till found to be hard enough to work easily. The composition is rolled into little balls, of the size before mentioned, by means of the fingers. The moulds should be kept clean, and the forming parts of the pestle B and the ring D should be oiled. The best way to clean the hole in the mould D is by means of a long conical cork, rasped to a rough surface and oiled. The point of the pestle A must not be oiled, because grease prevents the adhesion of the combustible portion of the support to its clay base.

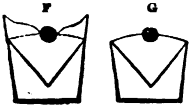
When the support is taken from the mould it is put on a hot plate or sand bath to dry, after which the rough edges are taken off by a rasp. It is then ready for use. The bottoms of the supports for reductions are painted with red ochre mixed with rice paste, to distinguish them from the other kind. The size I have fixed upon is as follows:—Height ½ inch, diameter at the top ½ inch, at the bottom ⅜ inch. The weight is about 16 grains, consisting of 10 grains of clay crucible, and 6 grains of combustible matter. I have tried several other sizes, but find this to be the most generally convenient. Nevertheless, a higher temperature can be produced upon a smaller support, and I find that large masses of charcoal are not essential, since many blowpipe experiments can be finished during the combustion of only 2 grains of charcoal.

4309. Before I proceed to explain the mode of using these supports, I must describe the handle by means of which they are to be held in the blowpipe flame. This handle consists of an iron wire, $3\frac{1}{2}$ inches long and $\frac{1}{30}$ inch in diameter, one end of which is bent into a ring about $\frac{3}{8}$ inch in diameter, while an inch of the other end is forced through a round cork 1 inch long and $\frac{1}{3}$ inch in diameter, as represented by *b*, *c*, Fig. 4306. The operator fixes the support in the ring of this wire, and holds it by the cork handle, which is intended, not so much to protect the fingers from heat, as to provide the power of varying the position of the support in the flame, as the progress of an ignition may require.

4310. I shall now describe one or two experiments which show the method of using these supports.

(1.) The surface of one of the *Supports for Fusions* is heated before the blowpipe till it is red hot. If then removed from the blowpipe flame, the support continues to burn, like an ordinary pastille, till it is consumed down to the clay. In this respect the support has a superiority over ordinary charcoal, which soon ceases to burn when removed from the fire. The ignited support is to be rested on a porcelain capsule in the manner represented by Fig. 4306 *d*, and a quantity of microcosmic salt, sufficient to form a bead, is placed upon its red-hot surface. The salt instantly melts and sinks into the central cavity, so as to form a bead, Fig. 4310 F; the heat, the form, and the smoothness of the surface of the support, facilitating this part of the process. The salt is then heated before the blowpipe till it is melted into a transparent colourless bead. The support is again placed on the porcelain capsule, and the metallic substance intended to be incorporated in the bead is added to it. The support continuing to be red hot, and the bead consequently continuing soft, the substance so added is immediately absorbed, and its loss by dispersion prevented. Whereas, upon common charcoal, the fused salt solidifies soon after it is removed from the flame, and the substance added for examination, not adhering to it, is often blown away by the first blast from the blowpipe jet. The bead is now again fused till the substance added to it is decomposed, and the resulting glass is observed to fuse quietly. It is then ready for examination, but it is sunk in the bottom of the hollow in the support (see Fig. F), and cannot be seen by transmitted light, unless the projecting sides of the support be removed. This is effected as follows: the support is placed, as before, upon the porcelain capsule, and the operator blows with his mouth, without using the blowpipe, strongly down upon its surface. The pastille then burns away rapidly, and the force of the blast of air disperses the ashes, until the whole rim of the support is consumed, down to the part marked, in Fig F, with dotted lines. The bead then appears situated on the summit of a cone, as shown in Fig. G, and can be examined either by reflected or transmitted light. It is also in a position adapted for exposure to the different action of the oxidating and reducing flames, so as to have the character of the included metal fully developed. If, finally, the charcoal is allowed to burn wholly away, the coloured bead can be lifted from the ashes and preserved in a closed glass tube for subsequent examination and comparison.

F G



4310.

(2.) If the surface of one of the *Supports for Reductions* is heated before the blowpipe, it burns at first like the simple charcoal support, but in proportion as the charcoal is consumed, the fluxes which were mixed with it, and which are not volatile, concentrate and fuse upon the surface of the residue. If, therefore, a reducible metallic compound is heated upon such a support, it becomes exposed at once to the reducing action of the high temperature of the nascent oxide of carbon, and of the carbonate of soda, whilst any earthy matter that it may contain is vitrified by the attendant borax. It is easy, therefore, to conceive that these supports should possess a powerful reducing action, and so in fact they do. For example, a crystal of sulphate of copper, as large as the surface of a support, can be decomposed upon it, and all its elements be driven off except the copper, which is finally obtained in a single metallic bead. A globule of metallic tin, an eighth of an inch in diameter, can be kept boiling upon a support without being converted into oxide. A crystal of quartz can be fused into soda glass. Flint glass can be melted with metallic oxides, in such quantities as to form beads of enamel or coloured glass the sixth of an inch in diameter. And these effects are producible upon a support of the weight of only 16 grains, and during the combustion of perhaps not more than 3 or 4 grains of charcoal. Indeed, many striking results are produced by a combustion of only 2 grains of charcoal, but then this combustion is effected under very favourable circumstances, where very little more charcoal is heated than is intended to be burnt, and where no more is burnt than is required to produce the intended effect.

This power of restricting the consumption of charcoal in such experiments, is a merit which will render these composition supports acceptable to travelling mineralogists. Berzelius laments the difficulty of procuring good charcoal when travelling, even in the well-wooded regions of the north, and this difficulty, and the consequent necessity of carrying about a quantity of charcoal, all travelling analysts must find an annoyance. But as the supports which I have described require for each only a cube of $\frac{1}{2}$ of an inch of charcoal, it follows that a sufficiency of either mixture for no less than 500 experiments, may be carried in a square tin box measuring only two inches on each side. Moreover, the incombustible portion of the supports can be pounded down and remoulded any number of times, so that only a very small quantity of clay is requisite.

(3.) The last blowpipe experiment to which I shall now allude is cupellation, the performance of which, before the blowpipe, is considerably facilitated by the apparatus described in this notice. When a cupellation is to be effected, a clay crucible is made in the mould D, by means of the pestle A, in the manner already described, and into this crucible a quantity of moistened bone ashes is pressed by the pestle B, so as to make a cupel similar in form to a charcoal support, Fig. E, but consisting of bone ashes. This cupel being mounted upon the wire handle, shown by Figs. *b*, *c*, is ready for use. A much higher temperature can be raised upon such a cupel than upon the same quantity of bone ashes placed, as usual, in a hole cut in a large piece of common charcoal.

I have now only to state my reasons for choosing rice as an ingredient of these pastille supports. They are, that rice paste is a strong, cheap, and convenient agglutinant; that when heated before the blowpipe it melts and binds the charcoal powder well together; that when decomposed, its charcoal is very difficult of incineration; and that its ashes are neither more abundant nor more troublesome than those of the wood charcoal that forms the mass of the support. These properties enable us to give to charcoal powder any desirable form, and to bind it firmly together, without the intermixture of any impurity. Other agglutinants do not possess the same combination of good properties. Thus, gum-arabic is sixteen times as dear, it intumesces under ignition so much as often to disrupt the charcoal pastille, and its ashes shine at a high temperature with such intense brilliancy, as to dazzle the eyes of the operator, and make analytical observations impossible.

It is probable that Rice would form an excellent ingredient in the mixture for Charcoal Galvanic Batteries.

Prices of Moulds and Materials for Griffin's Pastille Supports.

4311. Griffin's Mould for making charcoal pastille supports for blowpipe experiments, consisting of a ring and three pestles or stampers, all of polished boxwood, in a box, Fig. 4308, A B C D, 2s. 6d.

4312. Griffin's Charcoal Pastille Supports for blowpipe experiments, for use instead of ordinary charcoal, *two sorts*:—

4313. Supports for fusions, roastings, and for beads of microcosmic salt, size and form of Fig. 4308 E, *per box of two dozen*, 6d.

4314. Supports for Reducing Operations, on which reguline metals can be extracted from their salts without the use of additional fluxes, *per box of two dozen*, 6d.

4315. Handles for mounting the support, Fig. 4306 *b c*, four for 4d.

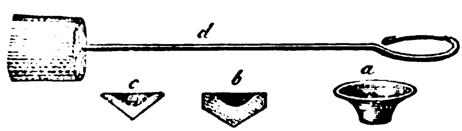
4316. Porcelain capsules, for use with the supports, Fig. 4306, *d*, four for 6d.

4317. Japanned Tin Box containing prepared clay, prepared charcoal, and prepared reducing mixture, sufficient for 1000 supports, 8 cubic inches of each, 3s.

4318. Box containing the set of Moulds, 4 dozen of Supports, 4 Handles, 4 Capsules, Box of Prepared Materials for 1000 Supports, with printed instructions for making and using the supports, complete, 8s.

More Portable Form of Griffin's Pastilles.

4319. After the publication of the paper of April, 1843, quoted above, I prepared a still smaller form of charcoal support, which I found to answer very well, and which is extremely portable, and consequently useful to the travelling mineralogist. These are represented in Fig. 4319, where *c* and *b* are sections of pastilles, differing in thickness, but made in the same mould; *a* is a Berlin porcelain crucible, represented in full size, by which the pastilles are supported in the blowpipe flame, and *d* is a wire support for the crucible, resembling that described at Nos. 4306 and 4315. These small charcoal crucibles, *b* and *c*, are quite sufficient for most qualitative blowpipe experiments.



4319.

4320. Berlin Porcelain Crucible, for supporting pastilles before the blowpipe, form and size of Fig. 4349 *a*, 3d.

4321. Pastilles of the size and form of Fig. 4319 *b c*, containing charcoal and rice, but no fluxes, *three dozen in a box*, 6d.

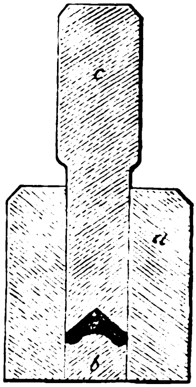
4321 *a*. Wire support for the pastille crucible, Fig. 4319 *d*, same as No. 4315, four for 4d.

4322. Iron Mould for preparing the Pastilles, Fig. 4321 *b c*, form and size of Fig. 4322, in three pieces, polished metal, price 2s. 6d.

The mould consists of three pieces; a cylinder *a*, a piece to form the surface of the pastille *b*, the pestle which forms the under side of the pastille *c*. The pastille is formed in the cavity *d*, and the thickness of it (producing the difference shown by *b* and *c*, Fig. 4319), depends upon the size of the ball of plastic charcoal that is put into the mould. The plastic charcoal is prepared by the method described at 4307. Plattner's improvements, as described in 4323, can be adopted when it is considered advisable.

4322*a*. Use of Fluxes with the Small Pastilles.—It is easy to saturate the small pastilles heated in the porcelain crucible, 4319 *a*, with soda, borax, cyanide of potassium, or any other flux to the action of which it is desirable to submit an assay; and after the fusion, the crucible can, when requisite, be transferred to a test tube, or a capsule, to be treated with acids.

4322*b*. Charcoal Blocks for Sublimations.—As the small charcoal pastilles, Nos. 4310 and 4319, become red hot all over, they afford no cold surface for the deposition of sublimates. For that reason, Plattner prepares with a mould prismatic blocks of charcoal, measuring 3 inches long, $\frac{4}{8}$ inch wide and $\frac{3}{8}$ to $\frac{4}{8}$ inch thick. I find, however, that it is much more convenient, and necessarily much more economical, to collect sublimates upon the clay support, No. 4349.



4322.

Plattner's Adoption and Modification of the Pastille Charcoal Supports.

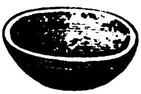
4323. In the third edition of his work on the Blowpipe, published in Leipzic in 1853, Plattner referred to the above proposal to replace thick charcoal by pastilles, and adopted it with the following modifications:—

1. He uses starch instead of ground rice, chiefly because he could more easily procure it. 2. He purifies the charcoal powder from metals by digestion in hydrochloric acid, and subsequently washing with water and drying it. 3. He makes the pastilles in various forms, in capsules, crucibles, square blocks, &c., according to the uses to which he intends to apply them. His moulds for these purposes will be described in this work. 4. He puts the dried pastilles into a covered crucible, and ignites them before use, to deprive them of the power of burning with flame.

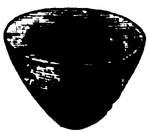
4324. Plattner's Mould for making charcoal capsules, to be used for the roasting of metallic ores in blowpipe assays, consisting of a pestle, Fig. 4324, and a mould similar to No. 4340, made of polished boxwood, *the pair*, 2s.

4325. Plattner's Charcoal Capsules, form and size of Fig. 4325, per dozen, 1s.

For an account of the use of the various capsules and crucibles, formed of charcoal or clay, as recommended by Plattner, I must refer the reader to the last edition of his work, *Die Probirkunst mit dem Löthrohre*. Diritte Auflage. Leipzic, 1853. The English translation of this work is much abridged in what relates to this matter.


4325.


4324.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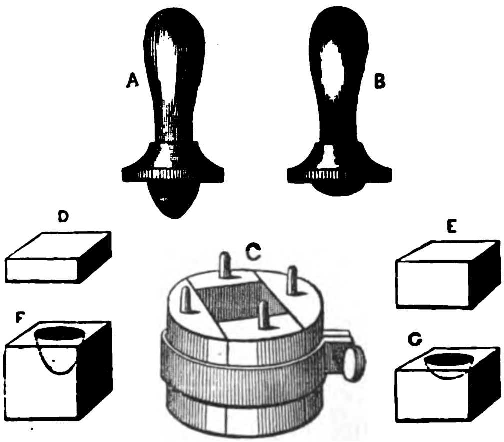


4327.

4326. Plattner's Charcoal Crucibles for quantitative blowpipe assays, form and size of Fig. 4326, per dozen, 1s.

Plattner's Mould for making these charcoal crucibles consists of the mould for making fireclay crucibles with an additional pestle. See No. 4343.

4327. Plattner's Mould for preparing square blocks of charcoal, for use in roasting metallic ores, and in various fusions of mixtures in the quantitative analysis of metallic ores before the blowpipe; the mould is made of boxwood, Fig. 4327, A, B, C, D, E. The set of 5 pieces complete, with brass binding, 10s. 6d.

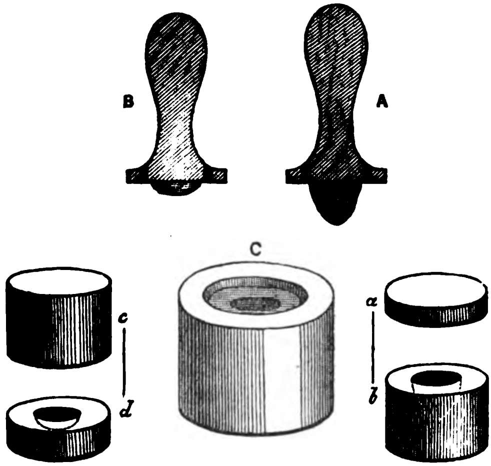
Letter C represents the mould which is to form the square block of charcoal. The blocks D and E serve to regulate the thickness of the square block. The pestle A is used to form the hollow of the crucible F. The pestle B forms the hollow of the crucible cover G. The four pegs in the mould C serve to guide the pestle exactly into the middle of the block.

The screwing up and unscrewing of the mould C, Fig. 4327, in the making of every pastille, takes up much time. For which reason, I have made a mould which makes round instead of square blocks for the same purposes.

4328. Mould for making Cylindrical Blocks of Charcoal with crucible cavity in them, consisting of the five pieces represented by Fig. 4328, A, B, C, *a*, *c*, which are to be used in the manner described by Plattner, *price of the set*, 7s.

The figures *b* and *d* represent a crucible and its cover, corresponding with F and G in Fig. 4327.

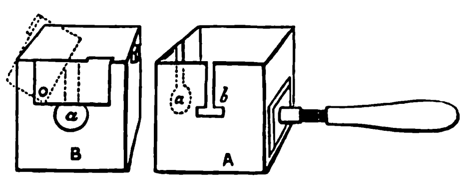
4329. Plattner's Square Charcoal Blocks with cavity of crucible shape, and corresponding charcoal covers, as made with the mould, No. 4327. Per dozen pair, 4s.



4328.

4329A. Japanned Metal Case, square form, size $5\frac{1}{2}$ inches by $1\frac{3}{8}$ inch, with pull-off cover, for holding 3 pairs of the square charcoals, No. 4329, 1s 6d.

4330. Plattner's Roasting Furnace, for holding and exposing to the blowpipe flame the charcoal crucibles, No. 4329, as described in Plattner's Instructions for the Quantitative Analysis of Metallic Ores before the Blowpipe, Fig. 4330, 6s.



4330.

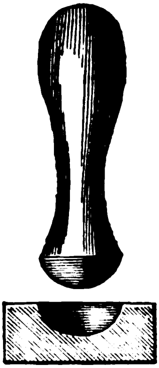
4331. Round Form of Plattner's Roasting Furnace, used for exposing to the Blowpipe flame the round blocks of charcoal made by the apparatus, No. 4328, with a support for holding it steadily against the blast-gas blowpipe, No. 4252, when the flame is blown horizontally, 6s.

4333. Platinum Wire and Foil, as used with the charcoal holder, No. 4330 or 4331, when an ore is to be roasted, *the pair*, 2s.

4334. Charcoal, in fine powder, for preparing charcoal pastilles, with the moulds described above, per lb., 6d.

III. CLAY SUPPORTS.

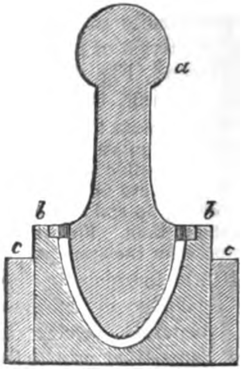
4340. Plattner's Mould for making capsules of porcelain clay, consisting of a mould and a pestle, Fig. 4340, of polished boxwood, *the pair*, 2s.



4340.

4342.

4343a.



4343.

4341. Ditto, with the addition of a boxwood pestle, Fig. 4324, for use with the mould in making capsules of charcoal, as explained at 4324, *the three pieces*, 3s.

Fig. 4342 represents the full size of the clay capsule formed in this mould, and Fig. 4325 shows the charcoal capsule which it produces.

4342. Plattner's Capsules of porcelain clay, burnt ready for use, form and size of Fig. 4342, per dozen, 1s.

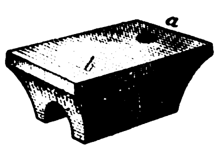
4343. Plattner's Mould for making small crucibles of porcelain clay, No. 4344, and of charcoal, Fig. 4326, which figure is of the actual size. The mould for making the clay crucibles is represented by Fig. 4343. It is made of gun-metal, in four pieces. The stamper for forming the middle part of the charcoal crucible, Fig. 4326, is represented of a reduced size by Fig. 4343*a*. It is made of boxwood. *Price of the Set*, 10s.

Full instructions for making these clay capsules and crucibles are given in Plattner's work. The clay being made of a proper consistence, is rolled into small balls, and put into the moulds, which are previously cleaned and oiled. They are then pressed into shape by the pestles, carefully removed from the moulds, dried, and afterwards heated to redness in a closed crucible.

4344. Plattner's Crucibles of porcelain clay, the form and size shown by the white space in the figure of the mould, No. 4343, burnt, ready for use, *per dozen*, 1s.

4345. Japanned Metal Cylindrical Case for holding a supply of the crucibles, No. 4344, and the capsules, No. 4342, size 3½ inches by 1 inch, 1s.

4348. Prepared Porcelain Clay, for making the crucibles, No. 4344, and the capsules, No. 4342, the mass requiring only to be mixed up and well kneaded with water to be ready for use, *per lb.*, 6d.



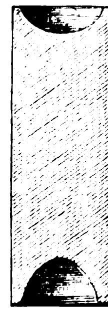
4349.

4349. Support for Griffin's Blowpipe Pastilles, to be used when Sublimates are to be Observed, made of smooth pottery, not glazed, form of Fig. 4349, size 3 inches long and 2 inches wide, price 1s.

4350. The charcoal pastilles, Nos. 4310 and 4319, when once ignited, exhibit a red heat over their whole surface, and afford no cool place upon which a volatilised powder or sublimate can be deposited. But since, in many blowpipe operations, it is requisite to note the colour, volatility, and other properties of sublimates, it is necessary to provide for their deposition upon some other surface than that of the red-hot pastilles. Plattner uses a sufficiently large block of charcoal, or a very large pastille, as I have noticed at No. 4322*b*. But I prefer for this purpose a smooth surface of fireclay, of the form and size just described. I invert this mass of fireclay over and into a smoky flame, until it is covered evenly with a coat of charcoal. I then cool the fireclay, and I put a charcoal pastille, Fig. 4319 *b* or *c*, into the hole *a* at one end of the support, Fig. 4349, and I perform the necessary blowpipe ignition, taking care to direct the blast of air upon the assay placed in the hole *a* in the direction *a* to *b*, Fig. 4349. The sublimate that is produced by the heat is thereby made to fall on the blackened surface of the support, and whether it is white, blue, red, or brown, it is distinctly visible; and as, moreover, there is plenty of room for the sublimate to deposit itself fully, the form, size, and range of the sublimate, and its gradations of colour, are much better seen than it ever is on a small and rough surface of either stick or pastille charcoal.

After each operation the surface of the support is rubbed clean with rough paper, or with sand paper, to be ready for a fresh experiment.

If the charcoal pastille does not fit well in the hole *a*, it can be kept in place by a little stiff rice paste rubbed between the hole and the pastille.



4351.

4351. Fireclay Support for holding $\frac{3}{4}$ inch capsules and crucibles, either of charcoal or fireclay, before the Blowpipe, consisting of a cylinder of fireclay, form of Fig. 4351, 3 inches long, 1 inch diameter, bored to hold a capsule (No. 4325 or 4342) at one end, and a crucible (No. 4326 or 4344) at the other end, 6d.

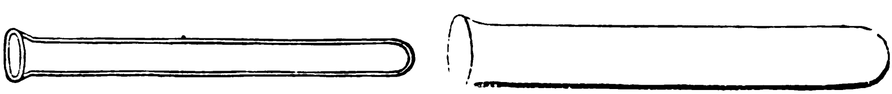
This support can also be used for cupellation with bone ash pressed into one of the holes, by the pestle of the agate mortar.

IV. GLASS SUPPORTS.

4360. Narrow Tubes of hard Bohemian glass, free from reducible metals, used for heating or subliming substances in a current of atmospheric air, from $\frac{2}{10}$ to $\frac{3}{10}$ inch in diameter, cut into pieces of 6 inches in length, *per dozen*, 6d.

4362. Narrow Tubes of hard Bohemian glass, about $\frac{1}{4}$ inch or $\frac{1}{3}$ inch in diameter, made extremely thin in the glass, in order that sublimates within them may be brought into the focus of lenses of high magnifying power, to make it possible to determine the crystalline forms of the sublimates. Cut into 6-inch lengths, *per dozen*, 9d.

4363. Plain Tubes of Hard White German Glass, closed at one end, Fig. 4363.



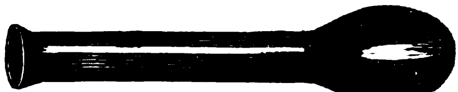
4363.

Prices per Dozen:—

Length in Inches.	Diameter across the middle in Inches.			
	$\frac{1}{8}$	$\frac{1}{6}$	$\frac{1}{4}$	$\frac{3}{8}$
1 inch	3d.	3d.	4d.	4d.
$1\frac{1}{2}$ „	3d.	3d.	4d.	4d.
2 „	3d.	3d.	4d.	4d.
$2\frac{1}{2}$ „	4d.	4d.	4d.	5d.
3 „	4d.	4d.	4d.	5d.
4 „	4d.	4d.	5d.	6d.

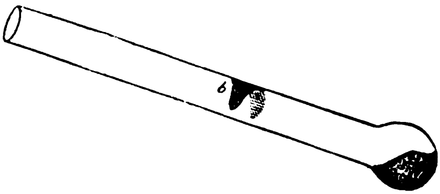
For the price of **Large Test Tubes** for use with liquids, in boiling, testing, &c. see article on **Testing**, page 275.

4364. Brush for cleaning narrow Test Tubes, Fig. 158, 2d.
4365. Berzelius's Bulb Tube for trying the hydration of minerals before the blowpipe, oval bulb, $\frac{5}{8}$ by $\frac{3}{4}$ inch, tube $1\frac{1}{2}$ by $\frac{1}{4}$ inch, hard Bohemian glass, Fig. 4365, per dozen, 1s. 3d.
4366. Support for Bulb Tubes when hot, Fig. 387, 6d.

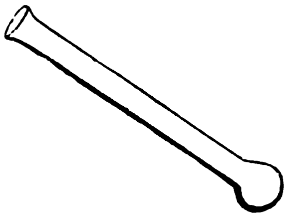


4365.

Arsenic Tubes, *for the reduction of Arsenical Compounds and sublimation of Arsenic; all made of hard German or Bohemian Glass, free from reducible metals.*



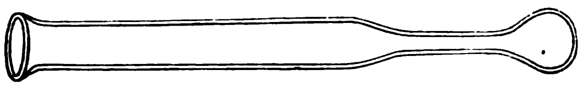
4370.



4367.

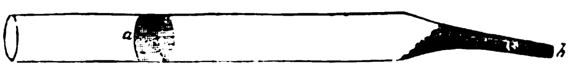
4367. Bulb Tubes, for subliming Arsenic, Figs. 4367 *a* and *b*, 1, $1\frac{1}{2}$, and 2 inches long, by $\frac{1}{6}$ or $\frac{1}{8}$ inch wide in the tube, bulb $\frac{1}{4}$ inch, *per dozen*, 4d.
4368. Bulb Tubes, bulb $\frac{3}{8}$ to $\frac{1}{2}$ inch, tube $2\frac{1}{2}$ inches long, $\frac{1}{8}$ inch wide, *per dozen*, 8d.
4369. Ditto, bulb $\frac{3}{8}$ to $\frac{1}{2}$ inch, tube $2\frac{3}{4}$ inches long, $\frac{1}{4}$ inch wide, *per dozen*, 10d.
4370. Berzelius's Bulb Tube, for use when the mixture to be heated is bulky, size of Fig. 4370, hard Bohemian glass, *per dozen*, 1s.
4371. Berzelius's Arsenic Tube, size of Fig. 4371, 3 inch, *per dozen*, 1s.
4372. Ditto, 6 inches long, *per dozen*, 3s.
4373. Rose's Arsenic Tube, size of Fig. 4373, 3 inch, *per dozen*, 1s.
4374. Ditto, 6 inches long, *per dozen*, 3s.
4375. Liebig's Arsenic Tube, 3 inch, size of Fig. 4375, *per dozen*, 1s.

4376. Box containing an assortment of 15 Arsenic Tubes of different kinds, 1s. 6d



4371.

4373.



4375.

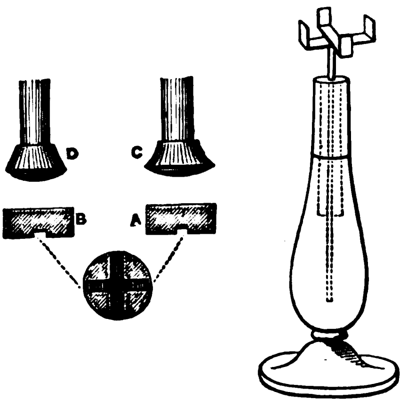
CUPELLATION BEFORE THE BLOWPIPE.

4380. Plattner's Apparatus for Cupellation before the Blowpipe, represented by Fig. 4380, consisting of two cupel moulds, A and B, with corresponding dies or pestles C and D, and a support E. The moulds A B differ in size. The cupels are exposed to the flame upon the moulds.

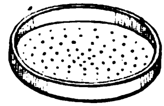
4380 *a*. Price when the moulds and pestles are made of hardened polished steel, 10s. 6d.

4380 *b*. Price when they are made of iron, 7s.

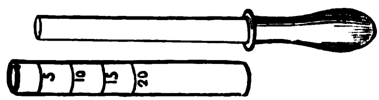
Plattner's work contains minute instructions for performing the operation of cupellation before the Blowpipe. Cupellation can be performed on cupels made in the manner described at No. 4310, 3. Also upon a cupel made in the mould, No. 4322, or upon a cupel pressed in the cavity of the fireclay cylinder, No. 4351.



4380. E.



4384.



4385.

4381. Bone Ash for preparing cupels, *per lb.*, 6d., finest 1s. *per lb.*

4382. Lead, finely granulated, for cupellation, *per lb.*, 2s.

4384. Plattner's Brass Sieve, to prepare fine-grained lead, for cupellations before the blowpipe, 1s. 9d.

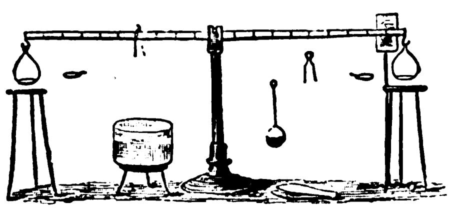
4385. Plattner's Measure for lead, for use in cupellation, consisting of a graduated glass tube, and a pestle of boxwood, which slides in the tube, and can be adjusted to any required measure, 2s.

4386. Plattner's Balance and Weights, for weighing small quantities of materials for quantitative analysis before the Blowpipe, or for weighing small beads of gold, silver, copper, and other metals, £4.

See description at No. 435.

4386A. Assay Balance and Weights, simple form, same as described No. 420B, in box, &c., price £2, 2s.

4387. Plattner's Balance, very highly finished, electro-gilt, with various additions to the weighing apparatus, £6.



4386*a*.

4388. Folding Glass Case, to contain the balance, No. 4387, when in use, and folding up into a small space for travelling, polished mahogany, 40s.

4389. Plattner's Ivory Scale, for measuring the very small beads of gold and silver, obtained by cupellation before the Blowpipe, 15s.

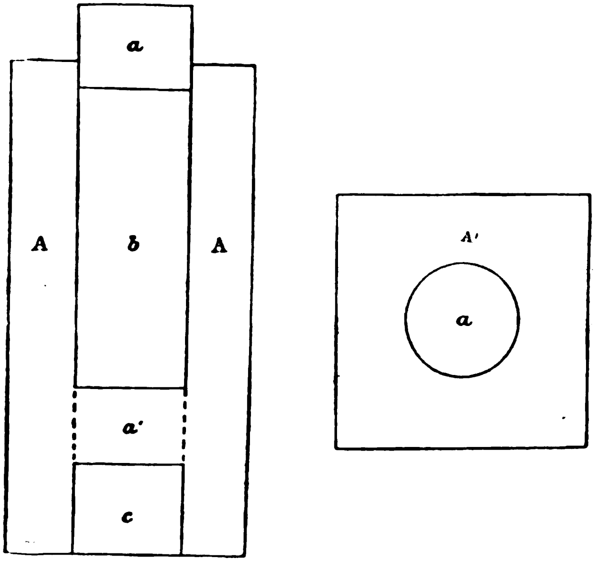
TOOLS AND MISCELLANEOUS INSTRUMENTS FOR USE IN BLOWPIPE EXPERIMENTS.

4395. HAMMER for Blowpipe Experiments, square face, and one cutting edge, hard steel, with handle, see page 1, 1s. 9d,

4397. ANVIL for Blowpipe Experiments, square block of hardened steel, 1½ inches square, block ⅝ inch thick, polished on one face, 2s.

For other sizes of Anvils, see page 2.

4398. ANVIL and MORTAR in one piece, Fig. 4398, as described in "Pyrology" by Major Ross, see No. 4532, 11s.



4398.

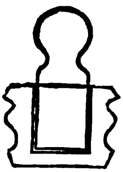
4399. Steel Mortar for Crushing hard Minerals, small size, 4399, 6s.

For several other varieties, see page 4.

4397.

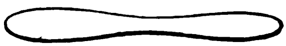
4409.

4402.

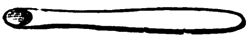


4399.

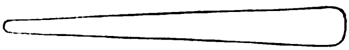
4400.



4404.



4406.



4407.

4408.

4400. Agate Mortar and Pestle, for Experiments of Reduction before the Blowpipe, *a*, $1\frac{3}{4}$ inch diameter, 5s.; *b*, 2 inch, 7s.; *c*, $2\frac{1}{4}$ inch, 8s.

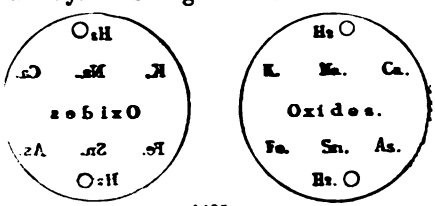
For particulars and Prices of other Sizes, see page 5.

4401. Glazed Porcelain Mortar for Blowpipe operations. See No. 56, page 5, 6d.

Intended as a substitute for an agate mortar in experiments of Reduction. It can be used for many experiments, but is by no means so useful as the agate mortar.

4401A. Major Ross's Oxide Plates, with the symbols engraved on them. See "Pyrology," No. 4534, and Fig. 4401*a*, the pair, 1s. 6d.

4402. Plattner's Mixing Capsule, Fig. 4402, for mixing powders, and transferring the mixture to a paper crucible, No. 4440, size $2\frac{1}{2}$ inch by 1 inch, made of thin polished brass, 6d.

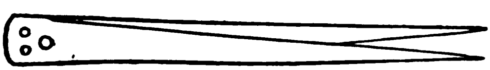


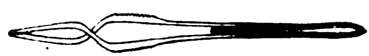
4401*a*.

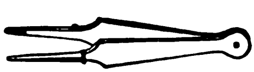
4403. Ditto, ditto, polished horn, 1s.
4404. Spatula, 4 inches long, $\frac{1}{3}$ inch wide, form of Fig. 4404, burnished steel, 1s.
4405. Camel-hair Brush, to assist in transferring fine powders from vessel to vessel, that no part be lost, 2d.
4406. Ivory Spoon, Fig. 4406, with spatula handle, 3 inches long, bowl $\frac{1}{4}$ inch diameter, 1s.
4407. Platinum Spatula, Fig. 4407. *See page* 9 *for varieties of size and price.*
4408. Steel Spatula, with cocoa handle, Fig. 4408. *For prices and sizes see page* 9.
4409. Test Spoon of Polished German silver, with a bowl $\frac{1}{2}$ inch diameter, for lifting small quantities of powder, the handle fashioned into a spatula for mixing powders, &c., in blowpipe and other experiments, $3\frac{1}{2}$ inches long, 3d.

Tongs for Use in Blowpipe Operations.

4410. Brass Tongs, for trimming the blowpipe lamp, Fig. 4410, *a*, *b*, *c*, each 3d.
4411. Iron Tongs, $4\frac{1}{2}$ inch, Fig. 4411, 2s.
4412. Fine Brass Tongs, Fig. 4412, highly polished, 3s.
4413. Fine Spring Steel Tongs, Fig. 4413, 4s.

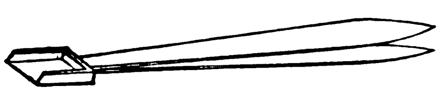

4410*a*.


4413.

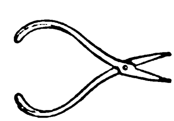

4412.


4411.


4410*c*.


4414.


4410*b*.


4416.

4414. Iron Tongs, with spoon handle for fluxes, Fig. 4414, 1s.
4415. The same, without the spoon, 9d.
4416. Steel Plyers, form of Fig. 4416, black, size 4 inches long, 2s.
4418. Cutting Plyers, to detach pieces of a mineral for examination, 3s. 6d.
4419. Strong Scissors, for cutting sheet metals, per pair, 1s. 9d.
4420. Folding Pocket Knife, 2-inch blade, 1s.

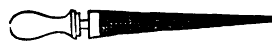
4421.

Files.

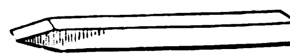
4421. Flat File, smooth cut, for trying the hardness of minerals, 4 inches long, $\frac{1}{3}$ inch wide, Fig. 4421, 1s.
4422. Triangular File, for cutting glass tubes, with handle, 8d.
4423. Rat's Tail File, for piercing corks, with handle, 4 inch, 8d.
4423A. Flat Rasp, for shaping corks, 4 inch, with handle, 8d.
4424. Steel Chisel, 4 inches long and $\frac{1}{4}$ inch wide, polished, and strongly magnetised, Fig. 4424, 9d.

4422.

4423.



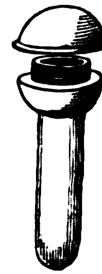
4423*a*.



4424.

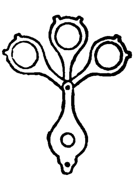
4425. Streak or Colour of Minerals, a slab of pure white biscuit Dresden porcelain, for trying this property, size 4 by 3 inches, 1s.
4426. Ditto, of white biscuit Thuringian porcelain, size 3 by 2 inches, 6d.
4427. Magnetic Needle and Electric Needle, each $1\frac{1}{2}$ inches long, both adapted to the same stand, and fitted into a turned wooden case, Fig. 4427, 7s. 6d.
4428. Ditto, larger; the needles each 3 inches long, and mounted with agate cups, but without case, 8s.
4429. Ditto, the large size, but without agate cups, 5s.
4430. Pair of Small Bar Magnets, 3 inch, with two keepers, in a leather case, with pull-off top, 1s. 6d.
4431. Horse Shoe Magnets, with keeper:—

2 inch, 6d.	4 inch, 1s.	6 inch, 2s.

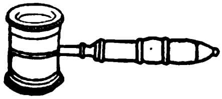


4427.

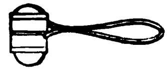
4432. Brush for cleaning beads of metal, strong bristles, 1s. 6d.
4433. Tin Foil, in small rolls, for assisting the operation of Reduction in beads before the Blowpipe, *per dozen rolls*, 4d.
4434. Tripple Lens, for examining small crystals, or the products of Blowpipe operations, the lenses $\frac{7}{8}$, $\frac{3}{4}$, $\frac{5}{8}$ inch diameter, in horn mounting, Fig. 4434, 3s.
4435. Magnifying Lens, Fig. 4439, in horn case, 1s.
4436. Magnifier, in tortoise-shell mounting, having at one end two plano-convex lenses, $\frac{5}{8}$ inch diameter, separated by a diaphragm, and at the other end a Coddington Lens, 12s.
4437. Coddington Lens, Fig. 4436, mounted in ivory, 4s.



4434.



4436.



4437.

4439.

4438. Coddington Lens, mounted in silver, for the pocket, with self-adjusting shades to protect the lenses.

A. $\frac{5}{8}$ inch diameter, 18s. | B. $\frac{3}{8}$ inch diameter, 15s.

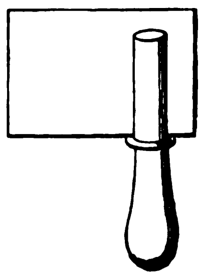
4439. Stanhope Lens, Fig. 4437, mounted in ivory, 4s.

MICRO-CHEMICAL APPARATUS FOR EXPERIMENTS IN THE WET WAY, TO SUPPLEMENT BLOW-PIPE OPERATIONS.

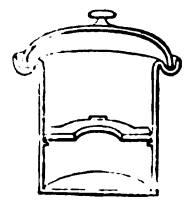
Apparatus for Decomposing Minerals.

4440. Plattner's Soda Paper, for preparing cartridges, or cases in which mixed powders are to be ignited before the blowpipe, prepared of pure filtering paper and pure carbonate of soda, in pieces measuring 1 inch by $1\frac{2}{5}$ inch, *Box containing* 50 *pieces*, 4d.

4441. Boxwood Mould, form of Fig. 4441, to assist in rolling the paper into a case, 6d.



4441.



4443.

4442. This is used in preparing siliceous minerals or metallic ores for solution in acids. The cartridge is prepared by rolling the prepared paper, No. 4440, by means of the pestle, No. 4441, into a cylinder, the end of which is to be closed by folding down the paper vith a spatula. Two grains of the mineral or the roasted ore are to be ground in a mortar with a mixture of borax and carbonate of soda. The ground mixture is transferred to the capsule, No. 4402, and is conveyed thence into the paper cartridge; this is then folded up and placed in the cavity of the charcoal crucible, No. 4326, which is placed in the clay support, No. 4351, and exposed to the blowpipe flame. The object of the soda paper is to prevent any of the powder being blown away by the mechanical action of the blowpipe jet. After the fusion of the assay is accomplished, the analysis of the residue is effected by the processes which Plattner's work gives in detail. The gas blowpipe, No. 4252, answers well for fusions of this description.

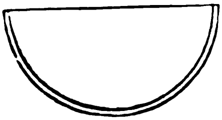
4443. Brunner's Apparatus for Decomposing Siliceous Minerals that contain Alkalies, by means of Hydrofluoric Acid gas. Made of lead, form of Fig. 4443. The cover dips into a lute of plaster of Paris; the crucible containing the mineral that is to be decomposed is fixed on the central perforated shelf; the mixture of fluor spar and oil of vitriol is put into the bottom of the apparatus. Size, 4 inches diameter, 4 inches high, 8s.

Vessels in which to prepare Solutions.

Preceding sections of this work contain abundant particulars of small vessels suitable for preparing solutions for micro-chemical operations. Among others may be cited, the smaller kinds of crucibles and capsules of platinum, pages 135 and 183; porcelain crucibles, page 136; porcelain cups, pages 191 and 192; porcelain basins, page 184; glass flasks, page 144; beakers, page 149; test tubes, page 275; and bulb tubes, page 147. The following kinds will be found useful:—

4444. Porcelain Hemispherical Cups, Fig. 4444.

a. 1 inch diameter, 3d. | *b.* 2 inch diameter, 5d.



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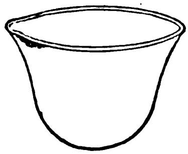

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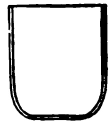

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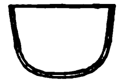
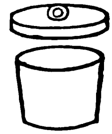


4447.



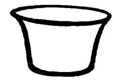
4448.

4445. Platinum Basin, Fig. 4445, price, according to weight, from 20s. to 30s.

See prices of platinum vessels at pages 135 and 183.

4446. Porcelain Beakers, Fig. 4446, 5 sizes. See No. 1491.
4447. Thin Porcelain Cups, various sizes, see p. 192, No. 1801, varieties 7, 8, 9.
4448. Plattner's Blowpipe Crucible, see No. 1333, with cover, 6d.
4449. Ditto, without cover, 4d.
4450. Plattner's Porcelain Digester, Fig. 4450.

a. 2¼ inch diameter, 1¼ ounce, 7d.
b. 1¾ „ ½ „ 6d.



4450.

Figures and particulars of other forms and sizes of porcelain vessels are given at pages 191, 192.

4451. German Glass Flask, with wide mouth, Fig. 1400, 1 ounce, 1½d.; 2 ounce, 2d.; 3 ounce, 2d.

For other varieties and sizes of flasks, see pp. 144-147.

4452. Beaker Glasses for Solutions, nest of four, holding from 1 to 5 ounces, Bohemian glass, No. 1461, 1s. 3d.
4453. Ditto, nest of three, holding from ½ to 1½ ounce, Bohemian glass, No. 1441, 7d.

For other sizes of Beakers, see pp. 149, 150.

4454. Watch Glasses, 2 inch, for use as covers to the Porcelain Capsules, &c., *per dozen*, 1s.
4456. Test Tubes, for boiling solutions, 6 inches long, ¾ inch wide, set of six, 5d.
4457. Folding Support for the six Test Tubes, 2s.
4458. Nests of German Glass Test Tubes, each nest in a paper box :—

a. Three Tubes, 4d.	*c.* Nine Tubes, 1s. 0d.
b. Six Tubes, 6d.	*d.* Twelve Tubes, 1s. 6d.

4459. Support for holding large Test Tubes over a spirit lamp, brass clip, 10d.

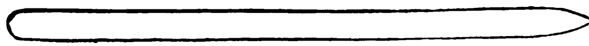
See No. 386 for other varieties of Supports for hot Test Tubes.

Testing Apparatus.

4460. Filtering Funnel, 1½ inch diameter, 1½d.
4461. Ditto, 2 „ 2d.
4462. 100 Circular Filters for each of the two funnels, 5d.
4463. Japanned tinplate box to hold the 200 filters, 7d.
4464. Funnel Holder, black wood, 1s.
4465. Porcelain Filter Ring, with two arms, for supporting the paper filter without funnel or funnel holder, 8d.
4466. Griffin's Quick Filter, see No. 2813, 3d.
4467. Conical Test Glasses, Fig. 2817, small size, 1 inch high, 1 inch wide, on feet, set of six, 8d.
4468. Decanting Tube, see No. 2814, three for 6d.

4469. Conical Precipitating Jar, 5 ounce size, Fig. 1487, 7d.

4470. Glass Stirrers, form of Fig. 4470.

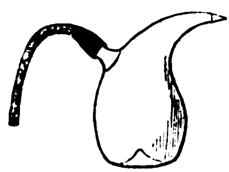


4470.

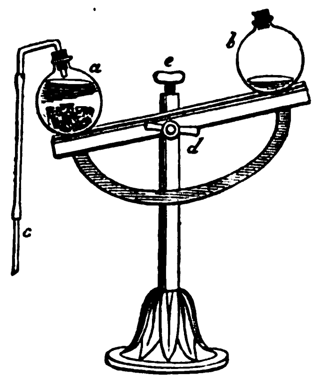
3 inch, per dozen, 2d.
6 „ „ 4d.

4471. Small Washing Bottle with two tubes, 8 ounce, see No. 1725, 1s. 6d.

4471A. Washing Bottle with one jet, see No. 1719, 1s.



4472.



4473.

4472. Schuster's Washing Bottle, fitted with a blowing tube, for supplying small quantities of water, or for washing precipitates on a filter, Fig. 4472, 1s.

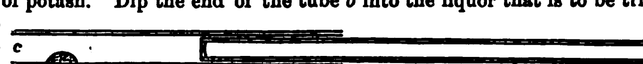
Apparatus for Sulphuretted Hydrogen Gas.

4473. Von Babo's Sulphuretted Hydrogen Gas Apparatus, for the prompt supply of that gas in small quantities, Fig. 4473, with support, 6s.
The Glass Tube only, 2s. 6d.

The bulb *a* is half filled with lumps of sulphide of iron; the bulb *b* is partly filled with diluted sulphuric acid. These two bulbs and the bar to which they are fixed, revolve on a centre at *d*, and can be fixed by the screw *e* in any required position. When the bulb *a* is placed higher than the bulb *b*, the acid runs into the latter bulb, and its action on the sulphide of iron ceases. When the bulb *a* is placed lower than the bulb *b*, the sulphuric acid flows upon the sulphide of iron in *a*, and a continuous current of sulphuretted hydrogen gas passes off by the bent flexible tube and the glass jet *c*. When the apparatus is not in use, the flexible tube *c* should be closed by a pinchcock, and the neck *b* by a cork.

4474. Apparatus for Testing with Sulphuretted Hydrogen Gas, where minute quantities of materials are employed, consisting of two glass tubes, size of Fig. 4474, *the pair*, 3d.

At *a* in the wide tube, put a small quantity of a mixture of one part of sulphide of calcium and three parts of bisulphate of potash. Dip the end of the tube *b* into the liquor that is to be tried for a metal that gives a coloured precipitate with sulphuretted hydrogen gas. Put the tube *b* into the wide tube as represented. Warm the wide tube at *a*, and then blow with the mouth gently into the open end *c*. Thereupon, sulphuretted hydrogen will be disengaged from the mixture *a*, and will produce a coloured precipitate at the inner end of the tube *b*.



4474.

A variety of other forms of Apparatus for use with sulphuretted hydrogen gas are described at pages 218–221.

Bottles to contain and apply Liquid Tests.

Bottles to contain solutions of re-agents, acids, &c., with pipettes, long stoppers, pierced stoppers, and other contrivances for delivering drops or small quantities of re-agents in qualitative analysis.

4475. Cobalt or Acid Bottle, of stout glass, with elongated stopper and ground cap, for applying drops of acid, or of solution of nitrate of cobalt, in Blowpipe experiments, Fig. 4475 :—

½ ounce to 1 ounce, 10d.; 2 ounces, 1s.; 3 ounces, 1s. 3d.

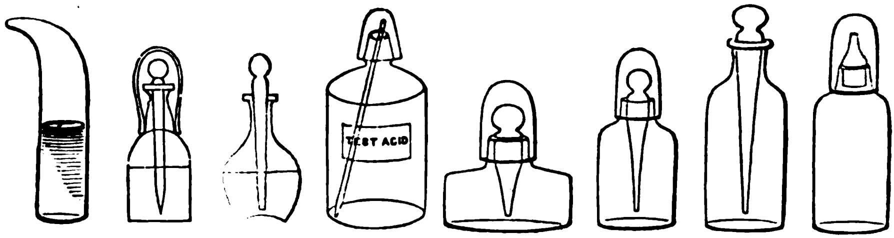
4476. Bottle blown before the lamp, with long stopper, Fig. 4476, 1 ounce size, 7d.

4477. Bottles with ground caps and pipettes, useful for acids and all re-agents. Many sizes. See No. 1556, page 159.

4478. Flat Acid Bottle, with long stopper and ground cap, for drops of acid, 10s. per dozen.

4479. Cylindrical Acid Bottle, about ½ ounce, with long stopper and ground cap, for delivering acid in drops, 10s. per dozen.

4480. The Acid Bottle, No. 4479, fitted into a stout gutta-percha or wood case, which opens stiffly, intended for the pocket of mineralogists in the field, being the safest form of acid bottle.



4484. 4475. 4476. 4477. 4478. 4479. 4481. 4483.

4481. Bottle with long glass stopper, without cap, contents about 1 ounce, 6d.

4481A. Acid Bottle, for the pocket, for mineralogists to use in the field; cut glass, with stopper and cap, ¼ ounce, 2s.

4482. Bottle with stoppered bulb pipette ground into it, by which larger or smaller quantities of test can be delivered as necessary, see Fig. 1651, 9d.

4483. Bottle about ½ ounce, with ground cap and stopper with fine perforation, by which very small drops of test can be delivered, 1s.

4484. Glass Tube Bottle, drawn off to a point, having a fine opening, *each* 3d.; *per dozen*, 2s. 6d.

To be filled by being warmed, and the point dipped into the liquid. The test is expelled in drops, when required, by the heat of the hand applied round the bottle.

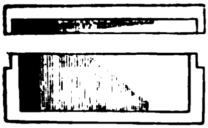
Other Bottles for Liquid Tests are described in the Sections that commence at pages 278 and 158. Pipettes of all kinds are described at page 175.

4485. Bottle for Atropia, form of 4481, but on foot and having the long stopper hollow, to act as a pipette, about ¾ ounce capacity, 8s. per dozen.

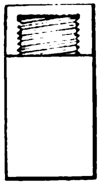
4486. Bottle for Atropia, &c., by Mr. William Oliver Chalk, same form as Fig. 4481, but having a pipette with a very fine bore, and an open upper end, closed by sheet caoutchouc; by pressing this covering a stream of equal drops can be obtained. 1s.

Boxes and Bottles to contain Dry Tests.

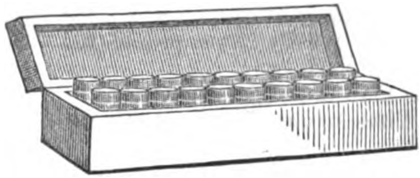
4490. Turned Wooden Boxes, Fig. 4490, with well-fitting slip-on tops, white wood, 1½ inch in diameter, for holding blowpipe re-agents, per dozen, 1s. 6d.



4490.

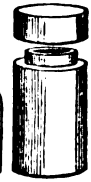


4491.



4493.

4496.



4497.

4491. Turned Wooden Boxes, for Fluxes, form of Fig. 4491, made of boxwood, size 1 inch by $\frac{3}{4}$ inch, with screw-on tops, per dozen, 3s.

4493. Polished Mahogany Cabinet of Stoppered Bottles, for Dry Re-agents, containing 20 wide-mouthed bottles, with ground glass flat-headed stoppers; form of bottles, Fig. 4496; form of box, Fig. 4493; size $11\frac{1}{4}$ by $2\frac{3}{4}$ by $2\frac{5}{8}$ inches, price 9s.

4494. The same Cabinet, containing 20 turned polished hard wood boxes, with pull-off tops, form of boxes, Fig. 4497, size $1\frac{3}{4}$ by $\frac{7}{8}$ inches, 9s.

4495. The same Cabinet, containing 10 of the bottles and 10 of the boxes, 9s.

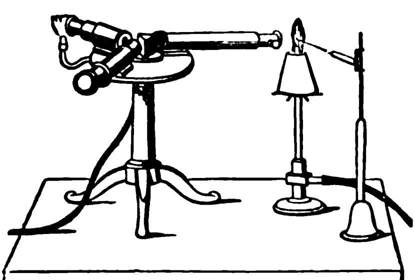
4496. Bottles alone, form of Fig. 4496, size $\frac{5}{8}$ ounce of water, 3d. each, 2s. 9d. per dozen.

4497. Boxes alone, polished hard wood, form of Fig. 4497; pull-off tops, fitting stiffly; size $1\frac{3}{4}$ inch by $\frac{7}{8}$ inch; per dozen, 3s.

APPARATUS FOR EXPERIMENTS ON COLOURED FLAMES.

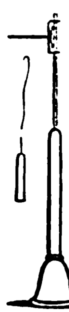
4500. Kirchhoff and Bunsen's Spectroscope, or Apparatus for examining the Coloured Spectra produced when the vapours of various chemicals are examined through a Prism. Compendious form of the Apparatus for use in Chemical Laboratories, including an arrangement for the examining of two different spectra at one time, represented by Fig. 4500.

Price of the Spectroscope, Fig. 4500, consisting of an Instrument, with three tubes, mounted on an iron support, brass box, as described below, with two gas burners like Fig. 4501; one support for objects in the flame, Fig. 4502; another support, Fig. 4503; 8 platinum wires, mounted in glass handle, as shown by Figs. 4500 and 4502; and 4 platinum wires not mounted in glass, for use with Fig. 4503; *the complete set*, £6, 6s.

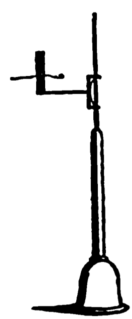


4500.

4501.



4502.



4503.

4501. Gas Burner, like Fig. 4501, 5s.

4502. Support for Platinum Wires, by which the salts put on the end of the wire can be placed exactly in the proper part of the flame produced by the gas burner, Fig. 4502, 2s.

4503. Support for Platinum wires, of the form of Fig. 4503, 2s. 6d.

4504. Platinum Wires mounted in glass handles, for use with the support, No. 4502, 6d.

4505. Platinum Wires, unmounted, for use with the support, No. 4503, 3 inches long, 3d.

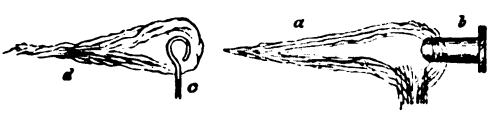
4506. *Description.*—The Spectroscope is represented by Fig. 4500, as arranged for use. The table is now replaced by a brass box revolving upon the pedestal. The prism which produces the spectra is fixed vertically upon the centre of the box by a spring, one end of which is screwed to the box, while the other presses upon the prism. The three tubes are firmly screwed to the box in proper positions, one towards the other. The tube in front is that by which observations are made. It is a telescope, having a six-fold magnifying power, and an objective of ⅘ inch diameter. The tube on the right hand carries a slit, through which the light from the coloured flame produced by the chemical placed in the gas flame is admitted. The tube has a screw to regulate the width of the slit, and one-half of the slit is covered with an additional movable prism, to enable the operator to observe two spectra at the same time. The tube on the left hand carries a photographic scale, marking 100 degrees on a straight line, visible bright upon a dark ground. When two spectra are observed at the same time, one is seen below this scale, and the other above it. The axes of the two tubes are directed at the same angle upon one plane of the prism, and the axis of the telescope tube is directed upon the other plane of the prism. The telescope and the prism are so placed that the deviation of the rays of the soda flame are at a minimum, and the red and violet lines of the potassium flame fall at equal distances from the middle of the field of view.

The gas lamp which illuminates the scale in the left hand tube is also attached to the iron table *a*, and revolves with it and the scale, so that in every position the scale is properly lighted.

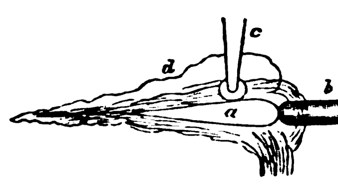
The vapours to be observed are produced as follows :—The heat is supplied by a Bunsen's gas-burner, Fig. 4501, which has a star support, and a short conical chimney to steady the flame. The salt to be tried is taken up on the end of the platinum wire, 4502, and the glass tube attached to that wire is put upon the projecting horizontal wire of the support 4502. This wire is attached to a spring, which slips up and down the rod of the support 4502, and thus makes it easy to put the substance in a proper part of the flame. Another method of supporting the platinum wire is shown by Fig. 4503, where the spring on the vertical rod carries a slight clip, between the jaws of which the platinum wire is stretched, so that one end of it which carries the salt to be tried can be put into the flame.

Blowpipe Experiments on Coloured Flames.

4507. Many salts and other chemicals, when heated in the Blowpipe flame, produce coloured flames, which serve to indicate the presence of particular elements, principally metals. A pretty full account of such coloured flames was given in my work on Chemical Manipulation, published in 1838. The method of operating is represented in Figs. 4507 and 4508.



4507.



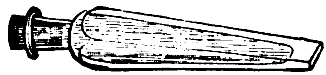
4508.

In Fig. 4507 the salt to be tried is held on a platinum wire at the point of the Blowpipe flame. In Fig. 4508 the salt, held in platinum tongs, is dipped into the upper part of the blowpipe flame. Soda gives a large and brilliant yellow flame when tried as 4507 ; potash gives a violet-coloured flame, but so much more feeble than the soda flame, that a mixture of 300 parts of potash and 1 part of soda shows only the yellow flame. Strontium chloride held as in 4508, and wetted with water, gives a brilliant crimson flame. In general soluble salts of the earths give their characteristic colours best when moistened with water or acid and tried as 4508, but insoluble salts are best treated as in 4507. These experiments require only the ordinary blowpipe supports, which, however, must be carefully washed in distilled water, and never be wetted in the mouth.

Apparatus for Changing the Colours of Blowpipe Flames.

4509. Square Plate of Blue Glass, through which to examine the Colours of Blowpipe flames, size 3 by 4 inches, 4d.

4510. Glass Prism to contain a solution of Sulphate of Indigo, through which to examine the colours of Blowpipe flames, size of the prism, 9 inches long, $1\frac{3}{4}$ inch wide, with glass stopper. Fig. 4510, 3s.



4510.

The appearances of coloured flames are so curiously changed when they are looked at through these blue diaphragms, that different elements can be discriminated when their salts are mixed together. The following are examples of the changes produced :—

a. The Yellow flame of Sodium becomes light blue when seen either through the blue glass or the blue liquid.

b. The Violet flame of Potassium is visible through the blue glass and the blue liquid. Consequently, the presence of potassium can be easily detected in the presence of a large excess of Sodium.

c. The Crimson flame of Lithium can be seen through the indigo prism, but not through the blue glass.

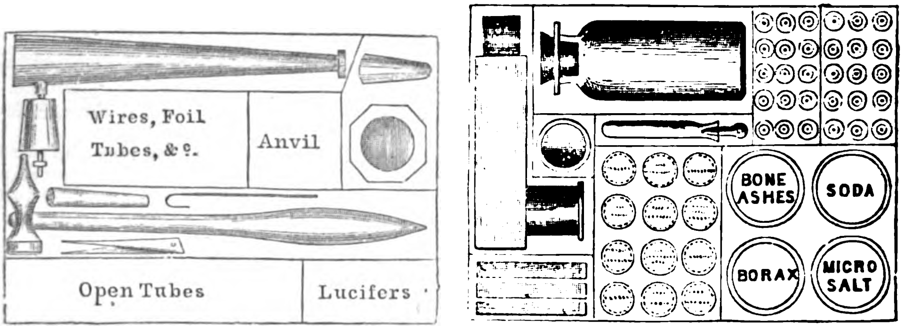
Consequently, potassium can be found in the presence of lithium by using the blue glass, and lithium can be found in the presence of sodium by using the prism. A mixture of the three metals gives an orange flame naturally ; but when this is seen through the blue glass, only the violet flame of potassium appears, and when seen through the indigo prism, only the crimson flame of lithium is apparent.

For further details consult Cartmell, *Philos. Mag.*, Nov. 1858 ; and Bunsen, *Annalen der Chemie*, Band cxi.

When coal gas is available, the observations on coloured flames can in many cases be very well made by using the apparatus represented by Figs. 4501, 4502, 4503, and dispensing with the blowpipe.

CABINETS OF BLOWPIPE APPARATUS SUITABLE FOR QUALITATIVE EXPERIMENTS.

4520. The Cabinets, Nos. 4521 to 4527, contain the Instruments and Tests necessary for Qualitative Analysis by the Blowpipe. The sets are prepared with apparatus of the newest and most approved patterns, and they are more or less complete according to their respective Prices. The Cases, Nos. 4522 to 4527 are made of Japanned tinplate, in a flat rectangular form, with divisions to keep the numerous small instruments in order ready for use; somewhat as represented by Fig. 4520. The pocket-case, No. 4521, has no divisions in it. None of these cabinets contain the articles necessary for Plattner's QUANTITATIVE operations, nor for experiments in the *wet way*.



4520.

The marginal numbers printed in the lists of contents refer to descriptions or figures of the articles given in the preceding pages.

4521. POCKET CABINET OF BLOWPIPE APPARATUS, contained in a Japanned tinplate case, oval form, with pull-off cover, size 5 inches high, and the oval 1½ by 3 inches, price 10s. 6d.

CONTENTS.

4211. Flexible Blowpipe.
4282. Tongs with Platinum points.
4277. Platinum Foil, two pieces.
4270. Platinum Wire, three pieces.
4284. Platinum Capsule, ¾ inch.
4276. Copper Wire, 12 inches.
4321. Charcoal Supports (eighteen).
4321*a*. Wires to hold ditto (two).
4320. Porcelain Crucible for ditto.
4409. Spatula and Spoon, albata.
4360. Open Glass Tubes, 4½ inch (six).
4363. Closed Glass Tubes, 2 inch (three).
4363. Closed Glass Tubes, 1½ inch (three).
4365. Glass Bulb Tube.
4367. Glass Bulb Tube.
Borax in a bottle.
Soda ditto.
Microcosmic Salt, ditto.
Cobalt Nitrate, ditto.
Japanned Tin case.

4251*a*. Pocket Blowpipe Lamp, cylindrical form, with screw cap to prevent the escape of oil. Price 2s.

4522. **CABINET OF BLOWPIPE APPARATUS**, containing the principal Instruments required in the Study of Blowpipe Analysis, and for the identification of most Mineral and Chemical substances, arranged in one flat divided case, of Japanned tinplate, size 11 inches long, 7½ inches wide, and 1½ inch deep. Price 21s. nett.

CONTENTS OF THIS COLLECTION :

Conical Blowpipe.
Drill to clear Blowpipe nozzle.
Blowpipe Lamp.
Cotton Wick for Lamp.
Brass Tongs.
Platinum Wires (2).
Platinum Foil.
Tongs with Platinum points.
Charcoal.
Porcelain Crucibles (2).
Blowpipe Hammer.
Blowpipe Anvil.
Agate Mortar and Pestle.
Test Paper.
Open Glass Tubes, 6 inch.
Bulb and Arsenic Tubes.
Closed Glass Tubes.
Glass Spirit Lamp.
Crushing and Cutting Plyers.
Small Aluminium Sublimate Plate.
Filter Paper.
Magnifying Glass.
Magnet.
Zinc Plate.
Pipette Bottle of Cobalt Solution.
Phosphoric Acid in a Bottle.
Bisulphate of Potash in a Bottle.
Boric Acid in a Bottle.
Boxes containing—
  Microcosmic Salt.
  Borax.
  Carbonate of Soda.
  Fluor Spar.
  Assay Lead.
  Sulphur.
  Copper Oxide.
  Rolls of Tin Foil.
  Thin Copper Wire, 12 inch.
Japanned Tin Case.

4523. COLLECTION OF BLOWPIPE APPARATUS arranged in TWO DIVIDED JAPANNED TIN CASES, measuring 10¾ inches in length, 6¾ inches in width, and respectively 1¾ inch and 1⅜ inch in depth. Price £3, 13s. 6d.

CONTENTS :—

4200. Conical Blowpipe.
4213. Extra Nozzle for ditto.
4218. Drill to clear Blowpipe nozzle.
4232. Blowpipe Lamp with screw-cap.
4241. Brass Lamp Support.
4249. Cotton Wick for Lamp, 1 yard.
4415. Iron Tongs to trim Lamp.
4281. Tongs with Platinum Points, best.
4270. Platinum Wires (6).
4277. Platinum Foil (3).
4276. Copper Wire, thin, 12 inches.
4321. Charcoal Supports (36).
4320. Porcelain Crucibles for ditto (2).
4321*a*. Wire Supports for ditto (2).
4322. Iron Mould for making Pastilles.
4307. Charcoal Mixture for ditto.
4349. Support for showing Sublimates.
4351. Clay Support for Cupels.
4414. Iron Tongs with Spoon.
4284. Platinum Capsules, ½ inch (2).
  Ditto, ¾ inch, with handle.
  Ditto, 1 inch, with handle.
4283. Steel Spring Tongs to hold ditto.
4399. Steel Crushing Mortar.
4400*b*. Agate Pestle and Mortar, 2 inch.
4395. Blowpipe Hammer.
4397. Blowpipe Anvil.
4404. Steel Spatula.
4409. Albata Spatula and Spoon.
4424. Magnetised Chisel.
4421. Flat File for testing Minerals.
4422. Triangular Cutting File.
115. Glass Stirrers, 3 and 6 inch.
4360. Open Glass Tubes, 6 inch (12).
4363. Closed Ditto, 3 inch (4).
4363. Ditto, 2 inch (4).
4363. Ditto, 1¼ inch (4).
4375. Arsenic Tubes, 3 sorts (6).
4367. Bulb Glass Tubes, 3 sorts (6).
4433. Tin Foil, 6 rolls.
2423. Test Papers, 5 books.

Potassium Bisulphate, Cobalt Nitrate, Potassium Cyanide } in stoppered glass bottles.

Borax, Soda, Microcosmic Salt, Bone Ashes } in large wooden boxes.

Gypsum, Nitre, Silica, Fluor spar, Lead, Iron Wire, Graphite, Starch, Rock Salt, Nickel Borate, Potassium Oxalate, Boracic Acid } In hardwood boxes, with screw tops.

Pair of Divided Japanned Tin Cases.

4524. COLLECTION OF BLOWPIPE APPARATUS, arranged in TWO DIVIDED JAPANNED TIN CASES. Price £3, 3s.

CONTENTS.—Precisely the same as the preceding collection, excepting that the ¾ inch and 1 inch Platinum Capsules are omitted.

4525. COLLECTION OF BLOWPIPE APPARATUS, arranged in **Two divided Japanned Tin Cases.** Price £2, 12s. 6d.

Contents.—The same Cabinets and the same articles as No. 4523, with the following alterations:—The Platinum Capsules of ¾ inch and 1 inch diameter are omitted; the Steel Crushing Mortar, No. 4399, is omitted; the Platinum-pointed tongs, No. 4281, are exchanged for No 4282; and the Agate Mortar, No. 4400*b* is exchanged for No. 4400*a*. The other articles are the same, both in number and quality, as in the collection at £3, 13s. 6d.

4526. Solid Mahogany Cabinets, French polished, with lock and key, of a size to hold the two japanned cases with the collections of apparatus Nos. 4523, 4524, or 4525, price 10s. 6d. *extra.*

4527. COLLECTION OF BLOWPIPE APPARATUS, very complete, for Qualitative Analysis, arranged in Three Divided Japanned Tin Cases, measuring 10¾ inches in length, 7¼ inches in width, and respectively 2 inches, 1½ inch, and 1¼ inch in depth. *The set,* price £5, 5s.

Contents of this Collection of Apparatus:—

4204. Conical Blowpipe, brass.
4213. Extra nozzle for ditto.
4232. Lamp with screw cap.
4241. Plattner's Brass Stand for lamp.
4218. Drill to clear Blowpipe nozzle.
4415. Iron Tongs to trim lamp.
4249. Cotton Wick for lamp, 2 yards.
4281. Tongs with Platinum points, best.
4270. Platinum Wires (12).
4274. Handle and box for Platinum Wires.
4277. Platinum Foil (8).
4276. Copper Wire, fine, 2 feet.
4285*b*. Platinum Spoon with handle.
4283. Spring Steel Tongs, to hold ditto.
4284. Platinum Capsules, ½ inch (2).
4284. Ditto, ¾ „
4284. Ditto, 1 „
4321. Charcoal Pastilles (72).
4320. Porcelain Crucibles for ditto (2).
4321*a*. Wire Supports for ditto (2).
4306*d*. Porcelain Capsules, 1 inch (3).
4322. Iron Mould for making Pastilles.
4307. Charcoal mixture for ditto.
4349. Support for showing Sublimates.
4351. Clay Support for Cupels.
4395. Blowpipe Hammer.
1333. Blowpipe Crucible and Cover.
1323. Porcelain Crucible and Cover.
1800. Porcelain Cup, Fig. 1.
1800. Ditto, Fig. 2.
1800. Ditto, Fig. 3.

Potassium Bisulphate, Potassium Cyanide, Cobalt Nitrate, — In stoppered glass bottles.

Borax, Soda, Mircrocosmic Salt, Bone Ashes, — In large wooden boxes.

14. Blowpipe Anvil, 1¾ inch.
4400*c*. Agate Mortar and Pestle, 2¼ inch.
4399. Steel Crushing Mortar.
4409. Spatula and Spoon, albata.
4404. Steel Spatula.
4414. Iron Tongs with Spoon.
Steel Tongs, fine bent points.
4422. Triangular Cutting File.
4421. Flat File for trying Minerals.
4424. Magnetised Chisel.
4418. Cutting Plyers.
4430. Pair of Bar Magnets in box.
4402. Brass Scoop for powders.
4425. Plate to try streak of minerals.
4360. Open Glass Tubes, 8 inch (12).
4363. Closed Glass Tubes, 3 inch (4).
4363. Ditto, 2 „ (4).
4363. Ditto, 1¼ „ (4).
4371,5. Arsenic Tubes, 3 sorts (6).
4370. Bulb Glass Tubes, 3 sorts (6).
4365. Ditto, ditto (6).
115. Glass Stirrers, 3 and 6 inch (4).
Glass Pipette for Cobalt drops (3).
4433. Tin Foil, 12 rolls.
2423. Test Paper, 6 books.
1800. Flat Porcelain Capsule, 1¼ inch.

Gypsum, Nitre, Silica, Fluor spar, Lead, Iron Wire, Graphite, Starch, Rock Salt, Nickel Borate, Potassium Oxalate, Boracic Acid, — In small boxes with screw top.

Three Japanned Tin Cases with divisions.

4528. Solid Mahogany Cabinet, French polished, with lock and key, of a size to hold the three japanned tin cases containing the foregoing collection of Blowpipe Apparatus, price 15s. *extra.*

CABINETS OF BLOWPIPE APPARATUS, AFTER THE METHOD OF PLATTNER, SUITABLE BOTH FOR QUALITATIVE AND QUANTITATIVE ANALYSIS.

4529. COMPLETE SET OF PLATTNER'S BLOWPIPE APPARATUS, made precisely after his patterns, and in the first style of workmanship, £30.

The apparatus and tools are arranged in a mahogany box, which measures 12 by 9 by 7 inches, and which contains several boxes and trays, lined with velvet, into which the instruments are sunk. There is a special box that contains the fine balance and weights, and all that concerns the operation of weighing. A mahogany box, measuring 12 by 9 by 4 inches, contains the bottles and boxes that are filled with reagents, solid and liquid. Several small boxes contain the various glass vessels for operations to be performed in the wet way. A box for the capsules and crucibles that are made of charcoal and clay, according to Plattner's directions. A folding mahogany glass case for the balance. These comprise in all 4 packages, which are inclosed for travelling in a strong divided leather case studded with brass knobs, and which measures 14 inches in length, 12 inches in width, and 12 inches in depth.

THE CONTENTS OF THIS COLLECTION ARE AS FOLLOWS:—

In most instances the figures referred to in the marginal numbers, agree with the articles in this cabinet; but in some cases, there are differences which are not exactly represented by the woodcuts in the preceding pages. These are either left without reference, or else reference is made to the nearest approximate figures. The contents of this cabinet are liable to variations.

4235. Brass Lamp.
4241. Brass Stand.
4243. Support for Basins.
4243. Support for Crucibles.
Lamp Chimney.
Support for do.
Double funnel ring.
4203. Blowpipe (Argentan).
4215. Platinum nozzles (3).
4380. Cupel support.
4396. Hammer, polished.
4398. Anvil, polished.
4416. Plyers, polished.
4418. Cutting Plyers, polished.
4281. Tongs with Platinum points.
4411. Tongs to trim lamp.
4412. Fine Brass Tongs.
4424. Magnetic Chisel.
4304a. Charcoal Borer.
4304b. ditto.
4304c. ditto.
4421. Flat File.
4422. Triangular File.
4423. Rat Tail File.
4245. Bottle for Oil.
4246. Bottle for Spirit.
4345. Box for Crucibles and Capsules.
4329a. Box for Square Charcoals.
Japanned Funnel for Oil.
4343. Mould for Clay Crucibles.
47. Steel Crushing Mortar.
4330. Charcoal Roasting Furnace.
4333. Platinum Wire and Foil for ditto.
4400c. Agate Mortar, 2¼ inch.
4274. Platinnm Wire Holder.
4270. Platinum Wires.
4285a. Platinum Spoon, $\frac{5}{8}$ inch.
4285b. ditto, $\frac{3}{8}$ inch.
4286. Handle for ditto.
4384. Sieve for fine Lead.
4402. Mixing Capsule, brass.
4403. ditto, horn.
4420. Penknife, folding.
4385. Measure for Lead.
4441. Cylinder for Soda papers.
4340. Mould for Clay Capsules.
4440. Soda papers in box.
4419. Strong Scissors, 4½ inch.
4389. Ivory Scale for Gold Beads.
4404. Iron Spatula, polished.
Spirit Lamp, brass top.
4434. Double Lens.
4432. Brush for Beads of Metal.
4406. Ivory Spoon.
4300. Charcoal Saw.
4249. Cotton Wick, 1 yard.
4387. Assay Balance, with weights, nippers, 2 pairs Gold capsules, 1 pair horn capsules, 2 gilt plates, 2 glasses, ivory spoon, &c., in a box, with a folding glass case.
4329. Charcoal Crucibles and Covers (6).
4322b. Rectangular Charcoal (2).
4344. Clay Crucibles (12).
4342. Clay Capsules (8).
4326. Charcoal Crucibles (12).
4325. Charcoal Capsules (12).

PLATTNER'S COMPLETE SET OF BLOWPIPE APPARATUS, *continued*—

The following for Experiments in the Wet Way, but including all the Reagents for both Wet and Dry Way.

Bottles ½ oz., with ground stoppers and engraved name (14), containing—

Sulphuric Acid.
Nitric Acid.
Hydrochloric Acid.
Acetic Acid.
Ammonia.
Potash.
Soda.
Ammonium Sulphide.
Cobalt Nitrate.
Alcohol.
Platinum Chloride.
Boracic Acid, *fused.*
Ammonia Carbonate.
Potash Bisulphate.

Bottles ¼ oz., glass stoppers, with labels (9), containing:—

Bone Ash, *sifted.*
Bone Ash, *washed.*
Borax Glass.
Ammonia Molybdate.
Iron Sulphate.
Plattner's Flux.
Potassium Cyanide.
,, Antimoniate.
,, Oxalate.

Turned Wooden Boxes with pull-off Tops, labelled (22), containing:—

Oxalic Acid.
Charcoal and Clay.
Microcosmic Salt.
Borax.
Soda Carbonate.
Assay Lead.
Nitre Cryst.
Graphite.
Sodium Chloride.
Starch.
Iron Wire.
Arsenic.
Fluor spar.
Silica.
Copper, Black Oxide.
,, Sulphate.
Potassium Ferrocyanide.
Lead Acetate.
Sal Ammoniac.
Nickel Oxalate.
Tartaric Acid.
Gypsum.

Porcelain:—

4450*b*. Deep Capsules, 1⅞ inch (2).
1800, 12. Flat Capsules, 1⅛ inch (2).
1800, 12. ,, 1½ ,,
1800, 12. ,, 1¾ ,,
1800, 12. ,, 2 ,,

Glass Apparatus:—

4472. Schuster's Bottle with tube.
4453. Beaker Glasses, 2¼ inch (2).
4460. Glass Funnels, 1½ inch (2).
4470. Glass Stirrers. 3 inch (2).
4454. Watch Glasses, 1¾ inch (2).
Bulb Pipette, small (2).
4373. Arsenic Tubes (4).
4371. ,, (2).
Potassium Sulphate, in paper.
Platinum flat Wires (5).
Slip of thin Silver.
Slip of thin Tin.
1725. Washing Bottle, 2 oz.
4365. Bulb Tubes (6).
4370. ,, (6).
4366. Holder for hot Tubes.
4360. Open Glass Tubes, 10 inch (6).
4457. Tube Frame for six Tubes.
4456. Test Tubes to fit it (6).
Boxes and Cases, as enumerated above.

Plattner's Work on the Blowpipe, English Translation, 36s.

4530. APPARATUS for QUANTITATIVE ANALYSES ONLY.

Those who already possess the ordinary blowpipe apparatus for QUALITATIVE experiments, and wish to add to their collection the instruments necessary for QUANTITATIVE experiments and CUPELLATION, can select them from the preceding lists, to suit their requirements.

4531. CABINETS of APPARATUS and TESTS for Analyses in the *Wet Way*, are described in a subsequent section of this work.

4532. Complete set of Blowpipe Apparatus, suitable for the new methods of Analysis described by MAJOR W. A. ROSS, in "*Pyrology, or Fire Chemistry,*" viz.:—Aluminium plate support and spoon, Pyrological Candles, apparatus for the Separation and Detection of Oxides and Elements in Boric and Phosphoric Acids, &c., &c., with the latest pattern of the hand blowing machine. The whole set is portable and packed in a divided tin case, and comprises the following instruments. Large set, £9, 9s.

		s.	d.
No. 92.	2 Agate Slabs, ...	4	6
93.	1 Aluminium Spoon, . . .	4	6
Fig. 22.	Combined Crushing Mortar and Anvil, . . .	11	0
24.	Water Bottle, . . .		9
23.	Wash Bottle, 2 tubes, . .		8
No. 96.	12 Small Cork Bottles, 1 inch flat bottom, . . .	2	6
Fig. 25.	Cobalt Bottle, 4483, C. H., .	1	0
Fol. 68.	Colour Box, 3 Brushes, . .	1	0
Figs. 28, 29.	2 Hard Tooth Brushes, .	1	0
62.	Brass Sieve, 4384, C. H., .	1	9
61.	Spirit Lamp, 1½ oz., . .	1	6
	Two Wick Holders, . .		2
7.	German Silver Blowpipes, G. P. Mouthpieces, 2 Platinum Nozzles, 4203*a*, C. H., .	15	0
7.	1 Candle Stand, . . .	2	6
7.	2 Candles, ...		8
Fol. 86.	24 Small Test Tubes in box, 1 inch to 1½ inch, . .		8
67.	Small Charcoal Borer, . .		10
No. 93.	Aluminium Plate, 4½ in. × 2½ in.,	4	0
Fig. 39.	Pair Scissors, flat points, .	3	0
Fol. 76.	Horse Shoe Magnet, 3 inch, .		6
	Platinum Tongs, 4282, C. H.,	3	6
Fig. 37.	Steel Tongs, ...	1	8
	2 pieces Platina foil, 2 inch × 1 inch, stout, . . .	3	0
52.	Platinum Crucible and Cover,	6	0
	12 inch Blowpipe Wire, . .	1	0
	2 Books Red Litmus, 3 books Blue Litmus, in case, .	1	0
43.	Ivory Spoon, 4406, C. H., .	1	0
40.	Lead Measure, 4385, C. H., .	2	0
42.	Pair Glass Plates, 5 inch, for Oxides with symbols, .	1	6
	Zinc Plate 5 inch × 4 inch, .		2
54.	Platinum Spatula, 3½ inch, .	12	0
53.	Platinum Spoon, C. H. 4285*b*,	3	0
31.	Horn Scoop, C. H. 4403,	1	0
30.	Platinum Lid to Cup, . .	5	0
	Glass Pipette, 3 inch, . .		1
44.	Ivory Bead Scale, . . .	5	3
36.	Pair straight Brass Tongs, with Steel points, . . .	2	6
35.	Pair bent Brass Tongs, Steel points, ...	2	6
	Drawing Pen, . . .		6
35.	6 D. P. basins, 1 in., 1801, 9, C. H.,	1	6
	Brass Stand, 4241, C. H., .	3	0
Fol. 74.	Blowpipe Hammer, C. H. 9, .	1	9

		s.	d.
	2 pieces Emery Cloth, 4 in. sq.,		1
Fig. 33.	Pair Cutting Plyers, . .	2	6
32.	Pair Nipper Plyers, . .	2	0
38.	Pair Ringing Plyers, not marked,	1	8
	Triangular File, 3 in. handle,		7
	Round File, 4 inch handle, .		7
	Flat File, 3 inch handle, .		6
11*c*.	Blowpipe Jet to fit Brass Stand,	3	6
11*d*, *e*.	Blowing Apparatus, 2 feet tubing, C. H. 4220 *c*, *d*, . .	12	0
	Piece of Sponge, . . .		1
	2 dozen Charcoal Mortars in 2 boxes, ...		8
41.	Glass Funnel, 1 inch, . .		2
	Lense (Watchmaker's) ½ in. focus,	4	6
	100 Cut Filters, No. 2, . .		2
	Aluminium Spoon, with handle, ⅝ inch diameter, . .	3	0
	Charcoal Saw, *fine*, . .	1	6
	Brass Clip and Block to hold Lens, ...	2	6
	,, ,, stronger,	3	0
	Mirror Mount and Block, .	4	6
	Wooden Pestle for mortar, .		3
	2 Distilling Tubes, fitted to wash Bottle Flask, . . .	1	3
	Note Book, ...	1	0
Fol. 69.	Ink Eraser, ...		1
	Small German Silver Tube Holder,	1	6
68.	Magnetic Compass, . .		6
	Tin Case for Chemicals, . .	2	0
	Tin Cabinet, lock and key, .	16	0
	Leather Strap for ditto, .	1	6
	16 W. M. Bottles, containing the following chemicals, .	8	0

REAGENTS—

1. Potassic Carbonate, in a ¼ oz. W.M. bottle.
2. Magnesic Sulphate, ¼ oz. ,,
3. Boric Acid, ⅛ oz. ,,
4. Phosphoric Acid, glacial, ⅛ oz. ,,
5. Sodic Carbonate, dry, ⅛ oz. ,,
6. Arsenicobalt Solution, ¼ oz. ,,
7. Alumina, ¼ oz. ,,
8. Cobalt Solution, ¼ oz. ,,
9. Cupric Oxide, ¼ oz. ,,
10. Cobalt Pyroxide, ¼ oz. ,,
11. Gold Metallic, ¼ oz. ,,
12. Lime Carbonate, ¼ oz. ,,
13. Manganese Solution, ¼ oz. ,,
14. Manganicobalt, ¼ oz. ,,
15. Silica, ¼ oz. ,,
16. Sulphur, ¼ oz. ,,

The Marginal Figures in above List refer to Major Ross's Work, and the letters C. H. to corresponding Nos. of this Catalogue.

4533. Small Set, Price £3, 13s. 6d.

		s.	d.
No. 92.	2 Agate Slabs,	4	6
Fig. 24.	1 Water Bottle,		9
No. 96.	12 Cork Bottles, 1 inch,	2	6
Fig. 61.	1 Spirit Lamp,	1	6
7.	1 Blowpipe (Tin),		8
7.	1 Candle Stand,	2	6
7.	2 Candles,		8
Fol. 86.	24 Test Tubes,		8
No. 93.	1 Aluminium Plate,	4	0
Fig. 39.	1 pair Scissors,	3	0
Fol. 76.	1 Horse Shoe Magnet, 3 inch,		6
	1 Wick Holder,		1
	1 pair Platinum Tongs, C. H. 4282,	3	6
Fig. 37.	1 pair Steel Tongs,	1	8
	2 pieces Platinum Foil,	3	0
	12 inches Platinum Wire,	1	0
	3 books Blue and 2 books Red Litmus paper in box,	1	0
	Zinc Plate, 5 inch × 4 inch,		2
36.	Straight Brass Tongs with Steel points,	2	6
	Drawing Pen,		6
	3 Crucibles, OO,	1	3
35.	3 D.P. Basins, 1801, 9,		9
32.	Nipper Plyers,	2	0

		s.	d.
Fig. 33.	Cutting Plyers,	2	6
38.	Ringing ,, not marked,	1	8
	Triangular File,		7
	Piece of Sponge,		1
	1 box Charcoal Mortars,		4
	1 piece Charcoal,		2
	Lense (Watchmaker's), ½ in. focus,	4	6
	2 Distilling Tubes,	1	3
42.	Pr oxides Plates,	1	6

Reagents—

1. Potassic Carbonate, ¼ oz. bottle.
2. Boric Acid, ⅛ oz. ,,
3. Phosphoric Acid, glacial, ⅛ oz. ,,
4. Sodic Carbonate, ⅛ oz. ,,
5. Cobalt Solution in dropping, ¼ oz. ,,
6. Cobalt Pyroxide, ¼ oz. ,,
7. Lime Carbonate, ¼ oz. ,,
8. Sulphur, ¼ oz. ,,
9. Copper Wire, } in box.
10. Lead Foil, }
11. Iodide Potash, dry, ¼ oz. ,,
12. Manganese Sulph, ¼ oz. ,,
13. Sol Soda Carbonate, in dropping ,,
14. Silver Nitre, dry, ¼ oz. ,,

	s.	d.
Price of above Bottles and Chemicals,	9	3
Tin Box,	13	0

4534. PYROLOGY; or, Fire Chemistry; an art of infinite importance to the Chemist, Mineralogist, Metallurgist, Geologist, Farmer, or Engineer, &c. By William Alexander Ross, lately Major in the Royal Artillery. Crown 4to, cloth, with Plates and Cuts, 36s.

"Major Ross is no 'paper-philosopher,' but an earnest, careful, persevering worker, possessed of a fruitful and suggestive mind; and his conclusions, therefore, however unexpected, cannot be without value. We strongly recommend his work to the attention of chemists and mineralogists, in the belief that they will find it both interesting and useful."—*Quarterly Journal of Science* for January, 1876.

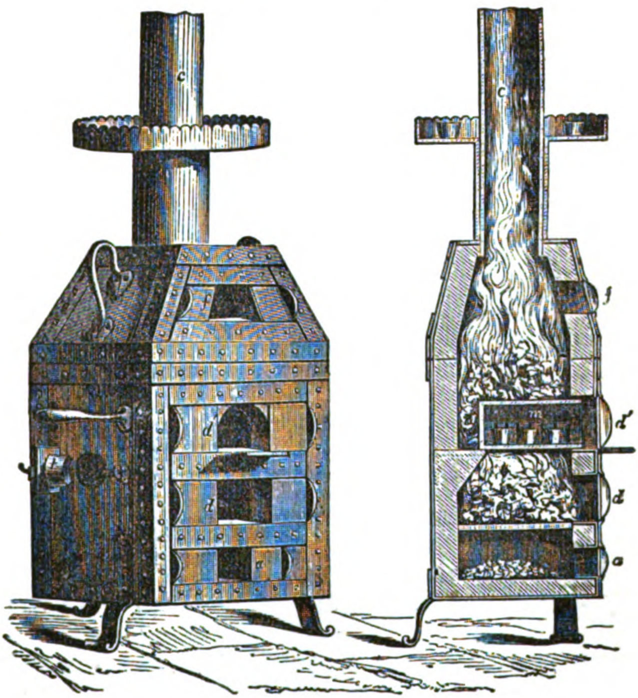
"We can imagine few courses of research more beneficial for a young chemist than to take up this work, and go carefully through the experiments laid down, and a few of the collateral issues which they evidently raise. We can strongly recommend this book to analysts, assayers, mineralogists, and to persons interested in mining and metallurgy; and we trust the author will feel encouraged to persevere in researches which must ultimately prove fruitful."—*Chemical News*, 1875.

"The work is an elaborate treatise on Blowpipe Analysis, and various cognate subjects, and contains many most curious and interesting statements. The mass of really valuable information given in the volume is enormous; and the manner in which it has been printed and illustrated shows that no expense has been spared in its production. It is a volume which will doubtless be quoted from hereafter, since it cannot be questioned that it contains the germ of many brilliant ideas and suggestions."—*Mining Journal*, 1875.

Apparatus for Assaying and for Metallurgic Operations in General.

In this section only those articles are noticed which especially belong to the subject of Metallurgy, and which have not come fully under notice in other sections. Thus Furnaces, Crucibles, Tools, Instruments for Assaying in the wet way, and other articles which belong to special sections, and are there fully described, are not repeated in this section, it being presumed that the index, or even the systematic plan of this work, will direct the inquirer to the desired information.

CUPELLATION.



4540.

4540. Cupelling Furnace, of wrought-iron plate, lined with fireclay, with two side openings for heating a tube, form of Fig. 4540. This size of furnace is suitable for a muffle measuring inside 9 inches long and 4½ inches wide. The fire-room is 10 inches long, and 9 inches wide, £5, 5s.

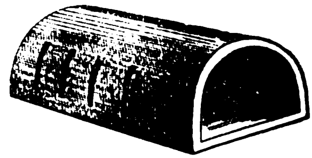
4541. Muffles for this furnace, each 3s. 6d.

4542. A Larger Cupelling Furnace, also of wrought-iron plates lined with fireclay, Berlin pattern; this furnace is in three pieces. The fire-room is 12 inches long, and 12 inches wide. The inside floor of the muffle is 9 inches long, and 5 inches wide, £7.

4543. Muffles for the Cupelling Furnace, No. 4542, each 4s.

4544. Fireclay, prepared, in powder, requisite for fixing the muffles in the door of the furnace, and for repairing cracks in the lining of the furnace, per cwt., 7s.

4545. Muffles, Fireclay, best London make, Fig. 4545. Orders for Muffles should state the external length, breadth, and height with precision. They can be supplied up to 12 inch long by 8 inch wide.



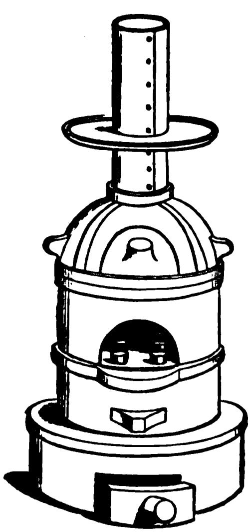
4545.

For Prices of Muffles, see Nos. 4546 and 4547.

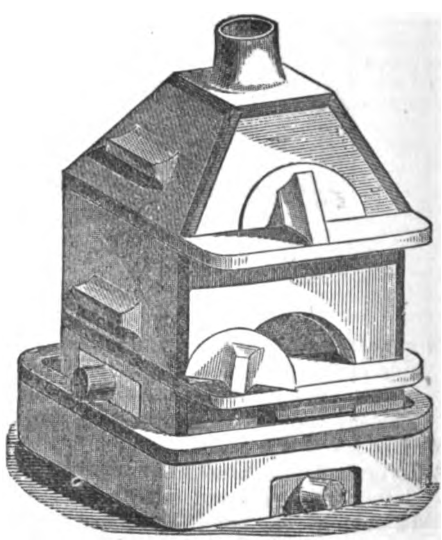
4546. Cupelling Furnaces, of fireclay, oval form, style of Fig. 4546, with separate base.

Approximate Measurements:

Inner Dimensions of the Furnaces.				Corresponding Muffles.			
No.	Length.	Width.	Price.	Width.	Height.	Length.	Price.
	Inches.	Inches.	£ s.	Inches.	Inches.	Inches.	s. d.
1	7	5	1 5	2¾	2	4	1 9
2	8	6	2 0	3¼	2¾	4¾	2 4
3	9	7	2 16	3¼	3	5	2 9
4	10	8	4 0	4¼	3½	6	3 0
5	11	9	5 5	5	4	7½	3 6



4546.



4547.

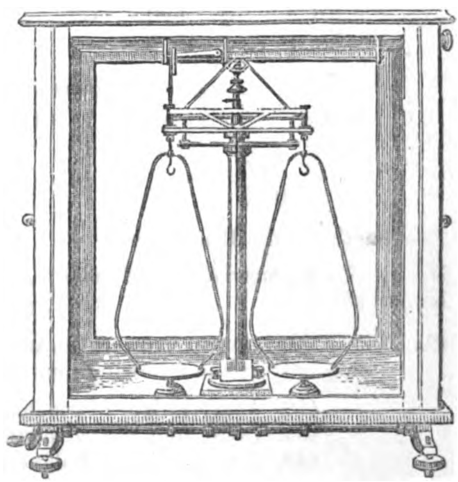
4547. **Cupelling Furnaces**, of Fireclay, square form, style of Fig. 4547.

Approximate Measurements of the Furnaces.				Corresponding Muffles.		
No.	Diameter Inside Square.	Height Outside, Not Including the Base.	Price.	Width.	Height.	Price.
	Inches.	Inches.	£ s.	Inches.	Inches.	s. D.
1	9½	19	2 16	3½	2½	2 6
2	10	20	3 3	4	2¾	3 3
3	10½	21	3 10	4½	3	3 6
4	11	22	4 4	5	3¼	4 0
5	12	24	5 0	5⅜	3⅜	4 6
6	13	26	5 15	6	3¾	5 0

BUNGE'S ASSAY BALANCE.

4548. The figure represents a short-beam analytical Balance, which has been introduced into this country with great success. In its present improved form it has decided advantages over any other balances in existence, and chiefly recommends itself by its quick action, which is a great saving of time to the scientific operator, and by its extreme sensitiveness and accuracy, while, owing to the lightness of its beam, the friction, and consequently the wear of the knife edges and their supports, are reduced to a minimum.

A short inquiry into the laws that govern the action of a balance will show that this form must be equal, and in some important respects vastly superior, to the most elaborate and costly long-beamed instrument.



4548.

The times of vibration are determined by three factors, viz.:—Length of beam, its weight, and the distance between the point of gravity from that of suspension. These times of vibration are inversely proportionate to the squares of the beam lengths, and vary on the other hand, with the square roots of distance between points of gravity and suspension, also in an indirect ratio. It is chiefly this distance on which the sensitiveness of the balance depends, and to lessen it as much as possible must be the first consideration of the balance maker. If, therefore, it is proposed to quicken the vibrations for the convenience of the operator, the lengthening of that distance cannot be resorted to. But the case is very different with the beam; here the number of vibrations in a given time augment in the ratio of the squares as the beam shortens, so that a beam one third the length of another would perform nine vibrations to one vibration of the longer, while the loss of sensitiveness on that score only amounts to one-third. We can, therefore, by using such short beams, afford to restore the requisite sensitiveness by lessening the distance between the points of gravity and suspension, and still retain to a great degree the advantage of quick action. Another consideration of importance in this respect is the extreme lightness of the beam as compared with the long one. The friction being much less, this would also cause a greater freedom of action, and tend to accelerate the vibrations.

The capabilities of this balance are such that it yields to the tenth part of a milligramme with the greatest precision, and has a working range up to two thousand grammes.

The appliance by which it is worked will be found extremely convenient. When not in use, all the knife edges are disengaged. By turning the handle, which is visible in the figure, all the acting parts come into play one after the other. The whole range of motion of the handle is about one-half of a turn. Beginning the operation, the pans are freed first; they are easily brought to rest by gently bringing their stoppers in contact with them, by carefully turning the handle back again once, or twice if necessary. When they are perfectly quiescent, the further turning of the handle engages the suspension pieces by gently and simultaneously bringing their knife edges in contact with their supports; the end of the handle motion suspends the beam, and the balance is ready for use. After use the handle is turned back again, by which everything is set out of action. This arrangement, besides the great convenience it affords, prevents all unnecessary wear of the acting parts.

In order to enable the final operation to be performed in the perfectly closed case, a parallel action and sliding rod serves to lift the rider and place it in the required position with the greatest ease. The rider can be used the whole length of the beam.

To ensure greater strength the whole is fixed to a stout glass plate, which is supplied with two spirit levels. The balance is so arranged that it can easily be taken to pieces and put together again. The pieces, when apart, fit in a box, and can be carried about without any fear of injury in the transport. The knife edges and their supports are made of agate, and most carefully finished.

The form adapted for the smaller weights, from 0·5 downwards, will be found very convenient. They are made of wire, turned up into a flat spiral, the inner end projecting and forming a little upright, by which it can easily be taken hold of. The number of coils indicates the number of units in each decimal, and the decimals themselves are distinguished by different thicknesses of the wire.

PRICES.

Balance.

No. 1.	To carry	20	grammes in each pan,	14 Guineas nett.
No. 2.	,,	200	,,	15 ,,
No. 3.	,,	500	,,	17 ,,
No. 4.	,,	2000	,,	26 ,,

Gramme Weights (in Mahogany Boxes.)

From	10	grammes to	1	milligramme,	1½	Guineas nett.
,,	100	,,	1	,,	2	,, ,,
,,	200	,,	1	,,	2½	,, ,,
,,	1000	,,	1	,,	£3, 15s.	,,

The lengths of the Beams are—

No. 1.	7 centimetres, or 2¾ inches.	No. 3.	17 centimetres, or 6¼ inches.
No. 2.	13 ,, 5 ,,	No. 4.	25 ,, 9¾ ,,

4548a. Assay Balances. Consult the article on Balances, commencing at page 38, especially at the following numbers:—

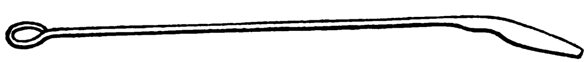
418. Assay Balance in mahogany glass case, £3, 10s.
434. Ditto, in a box without glass case, £2, 10s.
419. Another Assay Balance, in glass case, £8, 8s.

Tools used with the Cupelling Furnace.

4549. Iron Rod, or Poker, for arranging the fuel in the furnace, Fig. 4549, 3 feet long, ⅝ inch diameter, 2s. 6d.

4550. Ditto, larger, 3½ feet long, ⅝ inch diameter, 3s.

4549.


4551.


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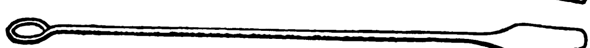


4551. **Bar Scraper, for clearing the grate, detaching slags, and causing the fuel to descend in the furnace, Fig. 4551, 3 feet long, $\frac{5}{8}$ inch rod, 3s.**

4552. **Long Iron Rod, flattened (chisel form) at one end, and a ring at the other, 3 feet long, $\frac{5}{8}$ inch rod, Fig. 4552, 3s.**

4553. **Cupel Tongs, or Long Iron Tongs, for removing Cupels into or out of the Muffle, elastic iron, 30 inches long, form of Fig. 4553, 3s. 6d.**

4553A. Ditto, of Steel, being lighter and stronger, 5s. 6d.

4554. Cupel Tongs, for removing Cupels into and from the Muffle, form of Fig. 4554, made of elastic iron, 30 inches long, 5s. 6d.

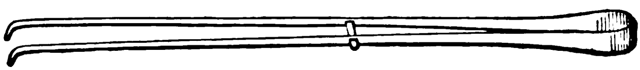
4554A. Ditto, of Steel, being lighter and stronger, 8s.

4554B. Ditto, of Steel, with sliding shield to protect the hands from the heat, Fig. 4554B, 10s.

4554C. Ditto, of Iron, with shields, 7s.

4555. Scorifier Tongs for lifting Scorifiers or Cupels, Fig. 4555. Elastic iron, length 25 inches, two sizes, with jaws 1 or $1\frac{3}{4}$ inch wide, *each* 2s. 6d.

4553.



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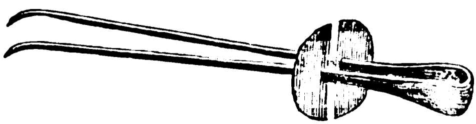
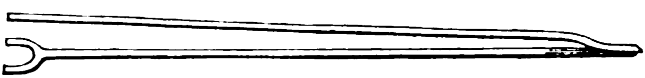


4554B.



4555:

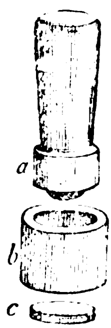
4556. Cupel Moulds, form of Fig. 4556. The parts *a*, *b*, *c*, of polished iron. The handle of boxwood.

No. 1. For Cupels of 1 inch diameter, 7s.
„ 2. For Cupels of $1\frac{1}{4}$ inch diameter, 9s.
„ 3. For Cupels of $1\frac{1}{2}$ inch diameter, 12s.
„ 4. For Cupels of 2 inch diameter, 14s.

4557. Cupel Moulds, form of Fig. 4556, but made entirely of boxwood or other tough wood that will bear blows and pressure.

No. 1. For 1 inch Cupels, 3s.
„ 2. For $1\frac{1}{4}$ „ Cupels, 3s. 6d.
„ 3. For $1\frac{1}{2}$ „ Cupels, 4s.
„ 4. For 2 „ Cupels, 5s.

4558. Wooden Mallet for driving the Die into the Ring of the Cupel Mould, Fig. 4558, 2s.



4556.

4558.

4559. Cupels, best French, of finest white ash, *per dozen*, 1 inch, 2s. 6d.; $1\frac{1}{2}$ inch, 5s. 6d.; 2 inch, 12s.; $2\frac{1}{2}$ inch, 18s.

4560. Cupel Trays with square divisions, $\frac{1}{2}$ inch deep, the holes of any size and of any number. *Prepared to order.*

4561. Flatting Mill, a pair of Steel Rollers, mounted in an iron frame, for rolling metal into sheets; used especially for flattening alloys of gold and silver, in preparation for the operation of parting, £7 to £10.

4562. Hammer for flattening Buttons of Metal in Silver Assaying, small size, 3s. 6d.

4563. Ditto, large size, 4s.

4564. Hammer for flattening Buttons of Gold, weight about six pounds, bright face, 9s.

4565. Assay Pots, for melting Gold (Cornet Pots), Fig. 4565.

A.	$1\frac{1}{8} \times 1\frac{1}{8}$	inch,	per dozen,	3s. 0d.
B.	$1\frac{1}{4} \times 1\frac{1}{4}$	„	„	3s. 0d.
C.	$1\frac{1}{2} \times 1\frac{1}{2}$	„	„	3s. 0d.
D.	$1\frac{3}{4} \times 2$	„	„	3s. 6d.
E.	$2 \times 2\frac{1}{2}$	„	„	4s. 0d.

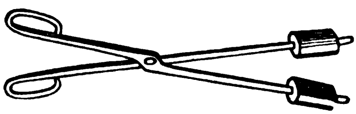
GLASS PARTING FLASKS, for assaying alloys of gold and silver.

4570. Conical form of flask, flat bottom, with welt round the neck, Fig. 4570, 2 to 4 ounce size, *per dozen*, 3s. 6d.

4571. French form of flask, with long neck, Fig. 4571, of 1, 2, 3, 4, or 5 ounces in capacity, *per dozen*, 2s. 6d.

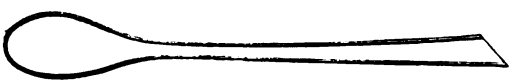
4572. Pear Shaped form of flask, round bottom, Fig. 4572, 3 ounce size, *per dozen*, 2s. 6d.

4565.



4574.

4570.



4571.

4572.

4573. Iron Tongs, for lifting Hot Parting Flasks, Fig. 4570, 1s. 9d.

4574. Iron Tongs, mounted with cork, for lifting hot flasks, Fig. 4574, 1s. 6d.

ASSAY OF SILVER BY THE WET WAY,
According to Gay Lussac.

4580. This process is described in detail in Roret's *Manuel complet de l'Essayeur*. An abstract is given in English, in Mitchell's *Manual of Assaying*. In both these works the measurements are given in Grammes and Centimetre Cubes. In Miller's *Elements of Chemistry*, 1856, vol. ii., p. 1035, the process is described with reference to English grains. The graduation of the apparatus can be made to suit either of these methods of reckoning. In the following List the apparatus is supposed to be divided into Centimetre Cubes. It is particularly requested that in any order given for this apparatus, it will be stated whether French or English graduation is desired.

4581. Large Stoneware Jar, for graduated salt test; containing 90 litres, with three necks, and gauge tube, graduated to show spaces of 5 litres, 42s.

4582. Safety Tube, to supply air to this jar, 1s. 3d.

4583. Glass Stopcock, 3s. 6d.

4584. Woulff's Bottle, with Three Necks, size 5 litres, to be mounted in a water bath, by which the temperature can be adjusted for the supply of salt solution, for use in very cold weather, 6s. 6d.

4585. Standard Thermometer, 100° C. enclosed in glass tube, with cork, 10s. 6d.

4586. Double air-way Stopcock and connector, for pipette, with Mohr's pinchcock (on the plan recommended by Varrentrap. See *Handwörterbuch der Chemie*, VII., 921); the object of which plan is to supply the salt solution without its coming into contact with any metal, 31s. 6d.

4587. Pipette, to measure 100 CC. of salt solution, with male screw to fix it, and a space on the neck of the tube of 2 CC. divided into $\frac{1}{10}$ CC., to increase or diminish the measure delivered by one or more thousandth parts, according to the temperature of the liquor at the time; with a brass spring clip, to direct the eye upon the proper line of graduation that is to be observed, 8s.

4588. Mahogany Support for the Pipette, of the form of Fig. 2730, 5s.

4589. Pipette mounted with a Silver Stopcock, with double air-way, on the original plan of Gay Lussac. (This is for use instead of No. 4586.) 45s.

4590. Bottle Holder on Wheels, with small railway for bringing the bottle exactly under the delivery pipette for salt, with wiper for the pipette, 14s.

4591. Bottles, 10-ounce size, narrow mouth, with stoppers ground to a cone inside, and numbers engraved on bottle and stopper, 1 to 10, the set, 8s. 6d.

4592. Gay Lussac's Hot Water Bath, for 10 bottles, 20s.

4593. Small Bellows, with bent glass nozzle, for blowing nitrous acid out of the bottles, 4s. 6d.

4594. Caoutchouc Ball, with glass, Fig. 1733, for the same use as the Bellows, 6-ounce size, 3s.

4595. Circular Shaking Apparatus, for 10 Bottles, of zinc japanned green, 35s.

4596. Japanned Tin Case, for Shaking a Single Bottle by hand, 2s.

4597. Five Mohr's Burettes, each containing 25 CC. divided into $\frac{1}{10}$ CC., provided with small pinchcocks and regulating screws, as represented by Fig. 2721, the object of which is to secure delivery of the decimal salt solution in very small drops of perfectly equal size, provided also with Erdmann's floats, Fig. 2728, and numbered in rotation 1 to 5:—the set of five complete, 35s.

4598. Elegant Mahogany Frame to support this set of Burettes, form of Fig. 2710, but for five Burettes, provided on the base with a contrivance for bringing each numbered bottle exactly under its proper jet, the positions of the Burettes being all numbered in rotation 1 to 5, price 21s.

4599. Mahogany Stand for a Single Mohr's Burette, form of Fig. 2697, 5s. 6d.
4600. Burette for this Stand, similar to those described at No. 4597, 7s.

This Burette is for decimal standard silver solution. The five Burettes, No. 4597, are for the decimal salt solution.

4601. Mohr's Burette, containing 50 CC., each divided into $\frac{1}{10}$ CC., with float, 6s.

The support, No. 4600, or any of those described at No. 2697, serves for this burette.

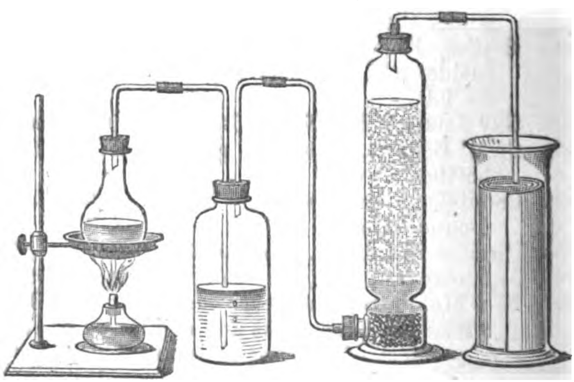
4602. Bottle with Cap, size 15 fluid ounces, marked "NITRIC ACID," with Pipette graduated to deliver 12 single CC. 4s. 6d.
4603. Bottle with Cap, size 15 fluid ounces, marked "SALT $\frac{1}{10}$," with Pipette graduated to deliver 1 CC. 3s. 6d.
4604. Bottle Stoppered, 1 pint size, marked "SALT $\frac{1}{10}$." 2s. 6d.
4605. Bottle with Cap, size 15 fluid ounces, marked "SILVER $\frac{1}{10}$," with Pipette to deliver 1 CC. 3s. 6d.
4606. Bottle Stoppered, 1 pint size, marked "SILVER $\frac{1}{10}$." 2s. 6d.

The Bottles 4602 *to* 4606 *are empty at these prices.*

4607. Bottle Stoppered, size 4 litres, *labelled "Saturated Solution of Salt."* 3s.
4608. Pipette to deliver 10 CC., 7d.
4609. Pipette to deliver 100 CC., 1s. 6d.
4610. Flask to contain 5 Litres, without stopper, used to prepare normal solution of salt, 7s.
4611. Stoppered Flask, to contain 1 Litre, 3s. 6d.
4612. Test Mixer, tall form, similar to Fig. 2790, contents 1 Litre, graduated into 100°, 8s.
4613. Chloride of Sodium, pure, per lb., 1s. 6d.
4614. Rock salt, colourless and transparent, per lb., 1s.
4615. Nitric Acid, pure, spec. gravity, 1·18, per lb., 1s.
4616. Nitric Acid, pure, spec. gravity, 1·38, per lb., 1s.

Plattner's Apparatus for estimating in the Wet Way the Percentage of Gold contained in Crushed Quartz.

4625. *Outline of the process for the extraction of Gold:*—The rock quartz must be reduced to very fine powder. If that has not been done in the large way, it must be done by means of a pestle and mortar. A quantity is then to be weighed for testing. The apparatus described below serves to operate upon 2 lbs. or 2½ lbs. avoirdupois of the ore. The powder must be thoroughly roasted at a red heat, to expel sulphur, arsenic, and other volatile substances. The roasted ore is then mixed with water, and is put wet into the glass cylinder C of Fig. 4625. Materials for producing chlorine gas are put into the flask A; the gas is washed in the bottle B, passed slowly and continuously through the cylinder C, and finally into the jar D, where the superfluous chlorine is absorbed by alcohol placed on several folds of blotting paper. The gold contained in the cylinder C becomes converted into chloride of gold. The apparatus, Fig. 4625, is then dismounted. The chloride of gold is washed out of the cylinder C with water, and the gold contained in the solution is precipitated by a solution of ferrous sulphate. The gold is collected, washed, and weighed.



A B C D

4625.

4626. APPARATUS FOR THIS PROCESS :—

a. Translation of Plattner's detailed Instructions for this process, 1s.
b. APPARATUS FOR PULVERISING THE QUARTZ. See Steel Crushing Mortars, page 4, especially No. 49, and Agate Mortars, page 5, especially No. 52.
c. APPARATUS FOR WEIGHING THE ORE FOR TESTING. See Balance, No. 441; and Weights, No. 459.
d. FOR WEIGHING THE GOLD EXTRACTED FROM THE ORE. The gold being obtained in but minute quantities a fine balance and delicate weights are required to weigh it. See Nos. 434, 445, 435, and others in the Section on Weighing, page 38.

4627. APPARATUS for ROASTING the ORE.

a. Fireclay Chauffer, Fig. 803, 8½ inch, 10s.
b. Blower for ditto, to raise the heat, Fig. 797, 2s.
c. Cast-iron triangle, to support the tray on the Chauffer, 1s.
d. Iron Tray, in which to roast the ore over the Chauffer, 6 inches square, 1s. 6d.
e. Iron Spatula, to stir the hot ore, 9d.
f. Pair of crucible Tongs, to hold the Tray, 1s. 6d.
g. Iron Mortar and Pestle, to grind the ore after roasting, Fig. 44, 5 inch, 2s.
h. Horse-shoe Magnet to extract particles of Iron from the roasted ore, 5 inch, 1s. 6d.
i. China Tray, in which the roasted ore is mixed with water, 1s. 6d.

4628. APPARATUS for SATURATING the ORE with CHLORINE, *as represented by* Fig. 4625. Consisting of Iron retort stand, tinned iron sand bath, spirit lamp, flask to prepare chlorine gas, wash bottle, cylinder to contain the pounded ore, condensing jar for excess of gas; with glass tubes and caoutchouc fittings; size to operate upon 2 or 2½ lbs. of ore, price 16s.

If supplied with extra glass bottle and set of extra tubes, 18s.

4629. APPARATUS for EXTRACTING the CHLORIDE of GOLD and PRECIPITATING the GOLD.

a. Set of Four Beaked Tumblers, 2s. 4d.
b. Glass Funnel, 2½ inch, 3d.
c. 100 Circular Filters for ditto, 4d.
The ring of the Stand in Fig. 4625 serves to support the funnel.
d. Washing Bottle to wash the gold on the filter, 1s. 6d.
e. Two flasks for preparing solution of ferrous sulphate, 6d.
f. Porcelain Basin in which to dry the filter and precipitate, 2¾ inch wide, 4d.

4630. CHEMICALS REQUIRED for this PROCESS :—

a. Manganese peroxide, per lb., 3d.
b. Sulphuric Acid, commercial, per lb., 2d.
c. Hydrochloric Acid, commercial, per lb., 2d.
d. Ferrous Sulphate (Iron Protosulphate), pure, per lb., 6d.

APPARATUS FOR METALLURGIC OPERATIONS.

4640. FURNACES for METALLURGIC OPERATIONS.

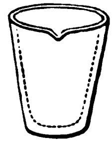
Consult the Section on the various methods of producing and applying Heat, commencing at p. 70; see in particular, the blast furnaces of Deville, No. 770, Sefstroem, No. 762, Griffin, No. 1090, and Griffin, No. 1100.

4641. CRUCIBLES REQUIRED by METALLURGISTS.

Consult the Section on Crucibles, commencing at page 135.

4642. Crucibles, conical form, Fig. 4642, with spout, wrought iron, without covers, 4 inches deep outside, 3½ inches deep inside, 2⅞ inches across the mouth, thickness of metal, ⅛ inch, holds 8 ounces of water, 4s. 6d.

4643. Crucibles, wrought iron, very stout, Fig. 4643, without cover, no spout, 4 inches high outside, 3½ inches deep inside, 2¼ inches wide inside, thickness of metal ¼ inch, holds 6 ounces of water, 6s. 6d.



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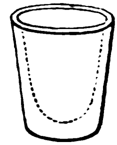


4643.

4644. Mould for making Small Crucibles for the Assay of Iron Ores, and other Metallurgic Experiments. Accompanied by a second Mould for making Covers for the Crucibles. See *Percy's Metallurgy*, I., 228–230.

The Crucibles made by this mould are about 2 inches high by 1¼ inch wide. The use of the mould is fully described by Dr. Percy. The Crucibles serve for the assay of iron ores when only 10 grains of ore are operated upon.

4644A. Best make, solid Boxwood and Gun Metal, finely finished, *the pair of moulds*, 33s.

4644B. Second Quality, made of Mahogany, and less finely finished, *the pair of moulds*, 16s. 6d.

4645. Apparatus for Boring Cavities in the small crucibles when lined with charcoal. Preparation of *creusets brasqués*. Consisting of a pair of borers, see *Percy's Metallurgy*, I., 230, price 7s.

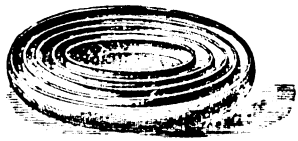
The Crucible is made by means of the apparatus No. 4644. It is filled with charcoal powder, mixed with a little starch paste or treacle, and rammed in close. The hole is first cut with a borer having cutting edges, and it is then pressed with a round smooth borer, to give it an even surface.

4646. Roasting Dishes, fireclay, English, Fig. 4646, price per dozen :—

2½ inch, 1s. 9d.; 3 inch, 2s. 3d.; 4 inch, 2s. 6d.; 5 inch, 3s.

4647. The Set of Four Dishes, 2½ to 5 inches, Fig. 4647, 1s.

4646.



4647.

4648.

4648. Scorifiers, fireclay, English, Fig. 4648, price per dozen :—

1 inch to 1⅞ inch, 1s. 9d.	3 inch to 3½ inch, 3s. 3d.
2 ,, 2¼ ,, 2s. 3d.	3¾ ,, 4 ,, 3s. 6d.
2½ ,, 2⅞ ,, 3s. 0d.	4½ inch, 4s. 6d.; 5 inch, 6s. 6d.

Crucible Tongs used by Metallurgists.

4649. Consult the Section on Tongs at page 11; also those mentioned in the Section on Cupellation, page 401. The following are also useful :—

4650. Crucible Tongs of the form of Fig. 4650, which either clip the crucible by the edge, or grasp it round the middle, the handles and as far as the bow made of German silver, the prongs and bow of platinum, 8 inches long, price £5, 5s.

4650A. The same, with the prongs only made of platinum, price £2, 2s.

4650B. The same, with the prongs and bow *lined* with platinum, £1, 5s.

4650c. The same, with the prongs only *lined* with platinum, 12s. 6d.
4651. The same form in German Silver, 3s. 6d.

For other varieties of small Tongs, see page 11.

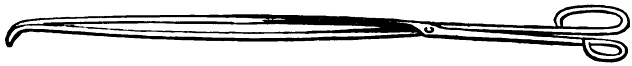
4650.

4652. Crucible Tongs for lifting Crucibles of 4 inch size into and out of a Furnace, 26 inches long, elastic iron, Fig. 4652, of iron, 6s.; of steel, 7s. 6d.

For other sizes, see page 11.

4653. Crucible Tongs for lifting Crucibles vertically, and pouring the metal from them, basket form, Fig. 4653; the basket 3 inches, length 24 inches, 4s. 6d.

For other sizes, see No. 128, page 12.

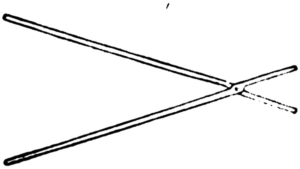


4652.

4653.

4654. Crucible Tongs for lifting Iron Crucibles, made with straight points, form of Fig. 4654, 25 inches long, 3s. 6d.
4655. Ditto with bent points, form of Fig. 4655, 25 inches long, 3s.

Larger and stronger Tongs are quoted at page 11.



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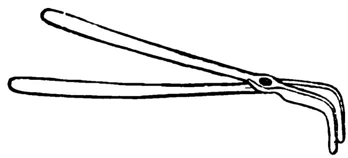


4655.

4656. Mortars and Pestles, the varieties chiefly used by Metallurgists :—

Mortars, Iron, Bell-shaped, see page 4, No. 44.
Sizes required, 5 to 12 inches diameter.
Mortars, Iron, Hemispherical, see page 4, No. 45.
Size required, 5 or 6 inches diameter.
Mortars, Porcelain, see pages 5 to 7.
Sizes required, between 4 and 6 inches diameter.
Mortars, Steel, for Crushing Minerals, see page 4, No. 49.
Mortars, Agate, see page 5, No. 52.

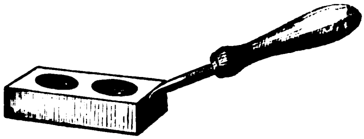
4657. Iron Moulds for Casting Ingots.

When used the Moulds should be made hot, slightly greased inside, and sifted over with fine charcoal dust. This prevents the adhesion of the fused metal to the mould.

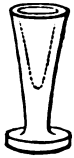
4658. Ingot Mould, form of Fig. 4658, with two hemispherical holes, each $1\frac{3}{4}$ inch diameter and 1 inch deep, turned smooth, 3s.
4659. Ingot Mould, with long arm and wood handle, Fig. 4659, 4s.
4660. Ingot Mould, form of Fig. 4659, with long metal handle and wood top, two holes, each $2\frac{1}{8}$ inch diameter and $\frac{7}{10}$ inch deep, turned smooth, 5s.

4661. Ingot Mould, Conical form, Fig. 4661, depth inside $3\frac{1}{2}$ inches, diameter at mouth $1\frac{3}{4}$ inch, at bottom $\frac{3}{4}$ inch, 4s.

4658.



4659.



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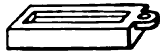
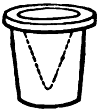


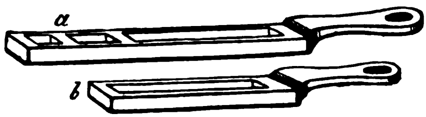
4663.

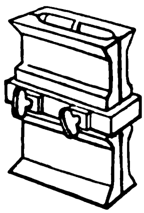
4662. Ingot Mould, form of Fig. 4662, for producing small cones, size of cavity 2 inches diameter, 2 inches deep, 3s.
4663. Ingot Mould for Small Bars, Fig. 4663, size of cavity $4\frac{1}{4}$ inch long, $1\frac{1}{2}$ inch wide, $\frac{1}{2}$ inch deep, 9d.
4664. Long Ingot Mould, in Three Divisions, 1 by $\frac{3}{4}$ inch, $1\frac{1}{2}$ by $\frac{3}{4}$ inch, $5\frac{1}{4}$ by $\frac{3}{4}$ inch, all $\frac{1}{2}$ inch deep, with handle, Fig. 4664, 1s. 6d.
4665. Long Tin Assay Mould, for producing a Slab of Tin, of semi-cylindrical form, measuring $6\frac{1}{4}$ inches long, $\frac{3}{4}$ inch wide, $\frac{3}{8}$ inch thick, Fig. 4665, 1s. 6d.



4662.

4664.
4665.





4666.

4667.

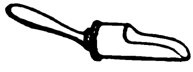
4666. Ingot Mould for producing flat slabs of metal, mould of the form of Fig. 4666, two pieces, secured together by a collar and screw, the inside filed smooth, Two sizes :—
4666A. For Slabs of metal measuring 4 inches long, $1\frac{1}{4}$ inch wide, $\frac{3}{16}$ inch thick, 8s.
4666B. For Slabs of metal measuring 5 inches long, $1\frac{3}{8}$ inch wide, $\frac{1}{4}$ inch thick, 9s.
4667. Iron Moulds for casting narrow rods of caustic potash, pure zinc for Marsh's Apparatus, &c. The cavities measuring $\frac{3}{16}$ inch in width; the mould in two pieces, connected by a collar with screws, as represented by Fig. 4667, or the larger sizes by Fig. 4666, the metal filed smooth inside, rough outside.

a. For 3 Rods of 3 inches, 6s. 6d.
b. For 6 Rods of 3 inches, 8s. 0d.
c. For 12 Rods of 3 inches, 10s. 0d.
d. For 18 Rods of $3\frac{1}{2}$ inches, 14s.
e. For 24 Rods of $3\frac{3}{4}$ inches, 18s.

4668. Gun Metal Mould of the same description, filed smooth both within and without, to produce 3 rods, 12s.

4669. Miscellaneous Instruments and Tools.

4670. Iron Slab, 12 inches square, $1\frac{1}{2}$ inch thick, smooth top, planed, 28s.
4671. Plumber's Scraper, for cleaning the surface of metals, with handle, 1s. 6d.
4672. File, with float cut, for rasping metals without becoming choked, 1s. 6d.
4673. Scratch Brush, for cleaning buttons of metal, 1s. 6d.
4674. Copper Assay Scoops, length 10 inches, greatest width 4 inches, width at mouth $1\frac{1}{4}$ inch, 5s. 6d.



4675.

4675. Copper Flux Spoon, Fig. 4675, $1\frac{1}{2}$ inch long, 1 inch wide, ebony handle, 2s.
2 „ 1 „ „ 2s.

4676. Sieves: see page 7.

4677. Sieves, a set of six, wooden sides, copper bottoms, diameters from 6 to 12 inches, apertures 6, 13, 25, 40, 60, and 80 to the inch, *the set*, 24s.

4678. Box Sieve, 8 inches in diameter, with three divisions, size of gauze bottoms 100, 50, and 30 meshes to the lineal inch, with cover, see Fig. 71, 4s.

4679. Magnifying Lens, of three powers (for the pocket), for examining Crystals, Minerals, &c. See Nos. 4434, 3s., and 4435, 12s.

4680. Shears for cutting Lead, &c. See No. 142.

4681. Steel Anvils (Stakes) for crushing Minerals and flattening Beads of Silver, see page 2.

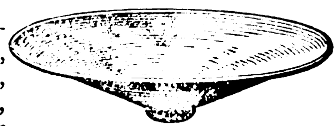
4682. Massive Anvil, weight 28 lbs., 20s.

4683. Hammer, square face, for breaking Crucibles after a fusion, 2s. 6d.

4684. Steel Slice, for cutting the fused assay out of an iron crucible, 30 inches long, 4s.

4685. Gold-washing Basin, of stout Zinc, form of Fig. 4685, 26 inches in diameter, 15s.

4686. APPARATUS FOR GENERAL USE IN ANALYSIS:—Spirit Lamps, Furnaces, Flasks, Beakers, Test Glasses, Baths, Filtering Apparatus, Evaporating Basins, Retorts and Receivers, Hydrometers, Stills, Gas Bottles, and other analytical apparatus, will be found under their respective heads in this work.



4685.

4687. APPARATUS AND TEST SOLUTIONS FOR VOLUMETRIC ANALYSIS. See page 286.

4688. BLOWPIPE APPARATUS. See page 360.

4689. CHEMICALS REQUIRED FOR ASSAYING. The prices of the chemicals cannot be stated, as they change daily, and depend not only on the market price, but on the quantity demanded:—

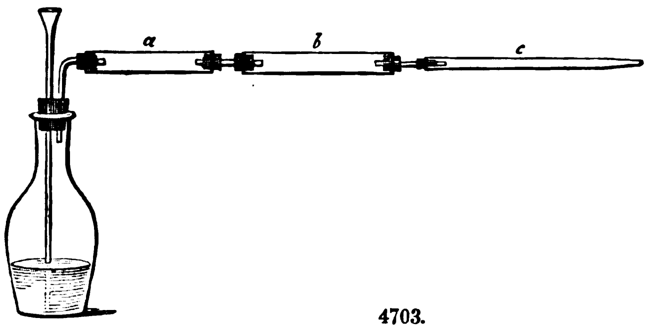
Bone Ashes.	Cream of Tartar.
Pure Lead.	Red Argol.
Carbonate of Soda.	Sal Ammoniac.
Refined Nitre.	Carbonate of Ammonia.
Borax.	Chlorate of Potash.
Litharge.	Fluor spar.
Lead in foil.	Black flux.
Fireclay for Luting.	White flux.

Marsh's Arsenic Test.

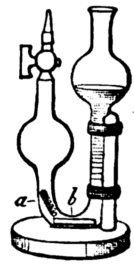
4700. Marsh's Arsenic Apparatus, for the detection of Arsenic contained in solutions of organic matter; consisting of a tube with two bulbs, fitted upon a mahogany stand, with brass stopcock and jet complete, Fig. 4700, 6s.

4701. The Two-bulb Glass Tube, without fittings, 9d.

4702. White Biscuit Porcelain plate, for receiving the deposit of metallic Arsenic, when arseniuretted hydrogen gas is burnt at Marsh's jet.
a, 3 inches by 2 inches, 6d.; *b*, 4 inches by 3 inches, 1s.



4703.



4700.

4703. Berzelius's Apparatus for the decomposition of sulphide of arsenic by heating it with carbonate of soda in a current of dry hydrogen gas. Size of flask about 30 ounces, length of tubes *a*, *b*, *c*, about 30 inches, 5s.

The mixture of sulphide of arsenic with dry carbonate of soda, is loosely fitted into a slight glass tube, and that is pushed into the tube *c*. The tubes *a* and *b* are to contain substances to dry and purify the hydrogen gas.

4704. Fresenius's Apparatus for reducing Sulphide of Arsenic, comprising a gas bottle for hydrogen gas, a chloride of calcium tube, and a hard glass jet, arranged as represented by Fig. 4704, 4s.

The stand is prioed at page 32.

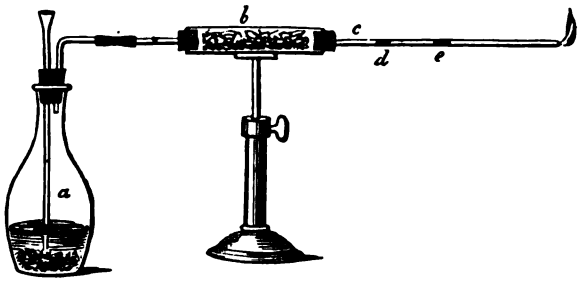
a is a gas flask, *b*, a tube containing chloride of calcium, *c*, a hard glass tube in which, at the point *d*, is placed a glass splinter containing a mixture of sulphide of arsenic and carbonate of soda. The apparatus is filled with pure hydrogen gas, the point *d* is gently heated to expel moisture, and then suddenly a very strong heat, such as that of a blowpipe, is applied to *d*, whereupon a metallic mirror of arsenic is produced at *e*.

4705. Regnault's Modification of Marsh's Arsenic Apparatus, Fig. 4705. Price of the Gas Bottle, with the tubes *a*, *b*, *c*, *d*, *f*, and the iron screen *e*, 5s.

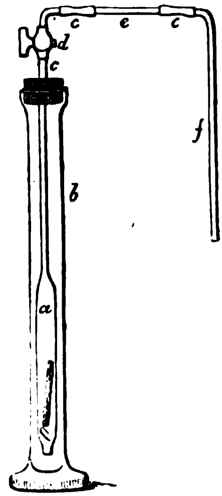
4706. Mitscherlich's Modification of Marsh's Apparatus, Fig. 4706, with 6 copies of the tube *e*, 8s.

4707. Extra copies of the Pipette *a* (wide branch 10 by ¾ inches), Fig. 4706, 1s.

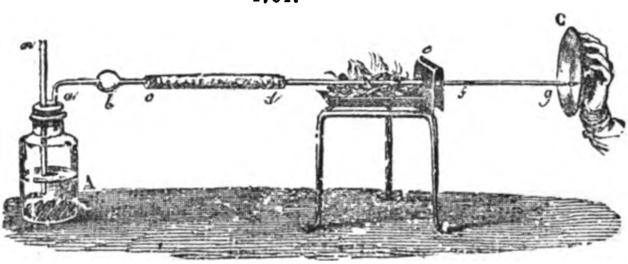
The pipette *a* contains a rod of pure zinc, retained in its place by a spiral of copper wire; *b*, a cylinder that contains the solution to be tested, filled up to the neck of the pipette; *c*, *c*, *c*, three caoutchouc connectors; *d*, a brass stopcock with an elbow piece; this is secured to the tubes *a* and *e* by caoutchouc connectors, to admit of separation for cleaning for each operation; *e*, a hard glass tube of 12 inches in length, in which the gas is decomposed by the application of external heat; *f*, a tube which dips into water, to cut off atmospheric air. The arsenic should be collected in several copies of the tube *e*.



4704.



4706.



4705.

4708. Fresenius and Von Babo's Arsenic Apparatus, for decomposing arsenious acid or sulphide of arsenic, by heating it with a mixture of cyanide of potassium and carbonate of soda, in a current of dry carbonic acid gas, Fig. 4708, page 412, price 5s.

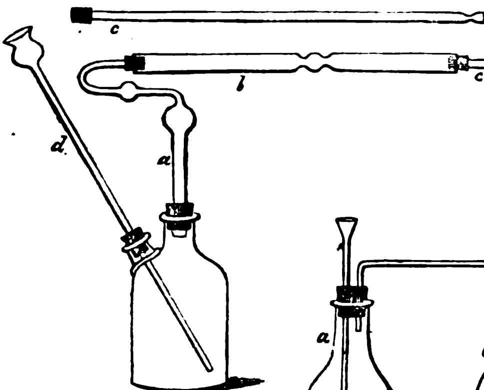
a is a large flask to prepare the gas; *b*, wash bottle containing oil of vitriol to dry the gas; *c*, a tube containing the arsenical mixture. See Fresenius on Qualitative Chemical Analysis, page 119.

4709. Otto's Modification of Marsh's Arsenic Apparatus, Fig. 4709, page 412, size of flask about 1 pint, each horizontal tube about 12 inches long, *the set*, 10s.

The use of this apparatus is described in Fresenius's Qualitative Analysis, page 116. It serves like No. 4704, to reduce sulphide of arsenic, but with the additional advantage of preventing the mistaking of antimony for arsenic.

4710. CLARK'S ARSENIC APPARATUS, consisting of a gas bottle, pint size, 3 bent tubes and connectors, fitted complete, Fig. 4710, page 412, 6s. 6d.

When Arsenic is sought for by Marsh's process in mixtures containing organic matter, an excessive frothing often spoils the experiment. To prevent this, Professor Clark separates the arsenic by this Apparatus. A is a bottle for preparing hydrogen gas; B, C, D, three bent glass receivers connected by bent glass tubes and corks. A contains pure zinc and pure hydrochloric acid, not stronger than 12° (=sp. gr. 1·03). B contains a solution of caustic potash; C, a solution of acetate of lead; D, a solution of nitrate of silver. When it is proved that hydrogen gas passes through the V-tubes without action, the arsenical liquor is poured into the bottle A by the funnel *b*. The great size of this bottle permits the frothing to occur without damage. The arseniuretted hydrogen gas passes through the receivers. In B it deposits sulphuretted hydrogen, and other impurities. In C it produces no action, if the washing in B is sufficient; that is, if the hydrochloric acid is not too strong, so as to force the operation too rapidly. In D it throws down metallic silver, and the arsenic remains in solution. When the current of gas ceases, the liquor in D is mixed with hydrochloric acid to throw down the excess of silver, and the liquor is filtered and evaporated to dryness. The product is *pure arsenic acid*, which can be submitted to its appropriate tests.



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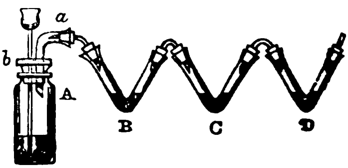
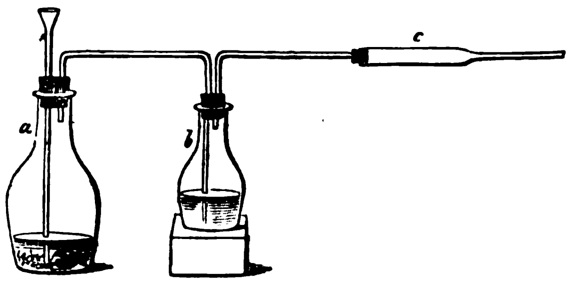


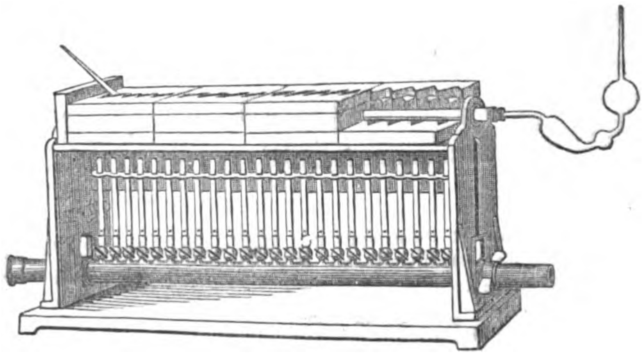
4710.



4708.

Organic Analysis.

4720. **GRIFFIN'S GAS COMBUSTION FURNACE,** Fig. 4720. The details of this Furnace are given at page 100. The furnace represented by Fig. 4720 is of the size commonly used for nitrogen analyses. It measures 17 inches in length within the upright ends, and has 24 Bunsen's burners. Price £4.

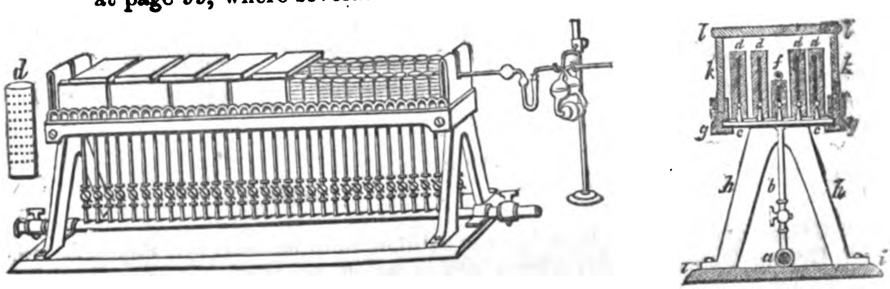


4720.

4721. Furnaces of this construction of the following sizes are usually kept in stock. See page 102.

No.	Inside Length.	No. of Burners.	Price.
1078.	35 inches,	50 burners,	£7, 7s. 0d.
1079.	30 "	42 "	£6, 6s. 0d.
1080.	25 "	36 "	£5, 5s. 0d.
1081.	21 "	30 "	£4, 14s. 6d.
1082.	17 "	24 "	£4, 0s. 0d.
1083.	13 "	18 "	£3, 3s. 0d.

4722. **HOFMANN'S GAS COMBUSTION FURNACE.** Consult the section at page 99, where several sizes of this furnace are described.



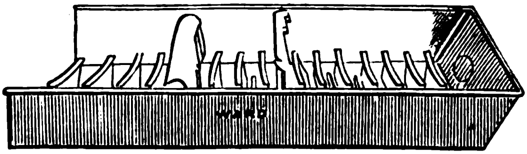
4722.

4723. Hofmann's Gas Combustion Furnace for use when oxygen gas is required to complete the combustion. See page 100, £3, 10s.

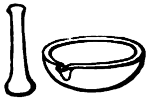
4724. Combustion Furnace, for use with Charcoal. This furnace, in the form originally used by Liebig, is represented by Figs. 4743 and 4743*a*. The improvements of Stenhouse are in some measure represented in Fig. 4724. They consisted partly in turning over the tops of the slips of metal that form the tube supports, and increasing their number, and partly in regulating the draught of the grate by increasing the number of openings and diminishing their size. *Price of the improved furnace,* 24 *inches long, made of stout sheet iron,* 4s.

4725. Charcoal Tongs, see No. 120. A handy sort is the 16 inch, price 2s. 6d.

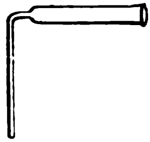
4726. Fireclay Chauffer for bringing charcoal to a red heat, to feed the combustion furnace, No. 805, 6½ inches diameter, 6s.



4724.



4728.



4735.

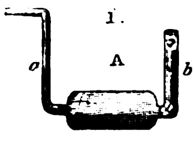
4727. Chimney or Blower, to raise the heat of the chauffer, No. 797, 2s.

4728. Mortars and Pestles, broad and shallow form, with spouts, glazed inside, with glazed pestle. Fig. 4728.

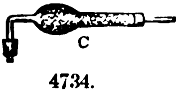
No. 64.	Semi-Porcelain, 4¼ inches diameter,		2s. 0d.
,,	,, ,, 5 ,, ,,		2s. 3d.
No. 65.	Dresden Porcelain, 5 inches diameter,		3s. 6d.
,,	,, ,, 4 ,, ,,		2s. 9d.

They may be had *unglazed* at the same prices.

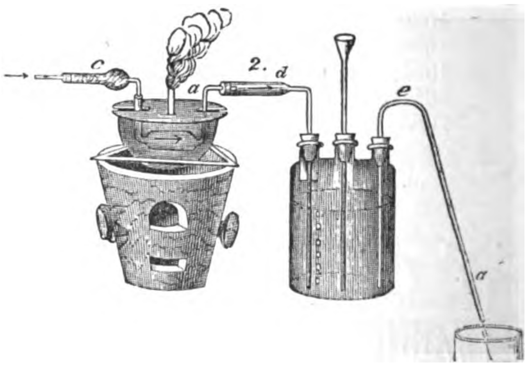
4729.



4730.



4734.



4731.

4729. Glass Tube in which to weigh the substances to be analysed, Fig. 4729, 1d.

4730. Drying Tube, namely, a bent tube in which organic bodies may be dried, by placing the tube in a hot-bath of oil or water, and passing dry air through the tube, form of Fig. 4730, and *a*, Fig. 4731, 8d.

4731. Bath for the Drying Tube, Fig. 4731. This consists of the following articles:—

4732. Iron Bath, such as No. 1227, 9 inch wide, 4½ inch deep, price 1s. 6d., or No. 1226, 8 inch or ¾ gallon, price 1s.

4733. Chauffer for charcoal, No. 806, 10s., or a Gas Furnace, No. 982, 10s.

4734. Bent Chloride of Calcium Tube of large size, for drying air, Fig. 4734, and *c*, Fig. 4731, 6d.

4735. Bent Chloride of Calcium and connecting tube, form of Fig. 4735, and *d*, Fig. 4731, 6d.

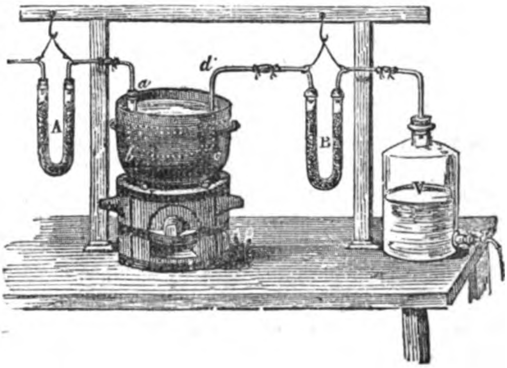
4736. Plain Syphon, *e a*, Fig. 4731, 8d.

4737. Long Funnel, 18 inch, Fig. 4731, 4d.

4738. Woulff's Bottle, 3 necks. See prices at page 148. Instead of a Woulff's Bottle any other form of Aspirator may be used. See page 20.

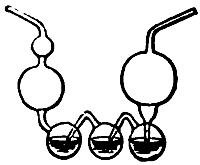
4739. Regnault's Apparatus for drying Organic Substances previous to Analysis, as represented by Fig. 4739, consisting of one aspirator, two chloride of calcium tubes, and a bent tube, containing the organic body immersed in an iron water-bath, placed on a trivet over a furnace, the whole connected by glass and caoutchouc tubes, with two mahogany crook supports, 21s.

The prices of the articles separately, and of various sizes, may be found at the following places:—The Chloride of Calcium Tubes, No. 2048; the Support, No. 398; the Aspirator, No. 250; the Drying Tube, No. 4730; the Chauffer and Bath, as referred to in the preceding article, Nos. 4732, 4733; D, Fig. 4755, represents another form of drying bath, which is heated by a spirit lamp.



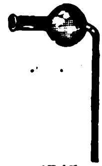
4739.

4743*a*.

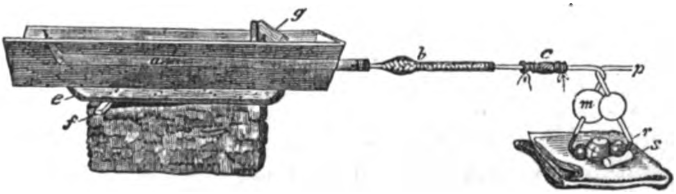


4744.

4740.



4745.



4743.

4740. **Combustion Tube**, being that part of the apparatus in which the organic substance is ignited with oxide of copper, or other oxidating substances, form of Fig. 4740, white Bohemian glass, of the most infusible quality, prepared for use, per dozen :—

12 inch, 4s. ; 16 inch, 7s. ; 20 inch, 8s. ; 30 inch, 10s.

4741. Combustion Tube in lengths of from 3 to 4 feet, and of ½ inch, ⅝ inch, and ¾ inch bore. 1 lb. at 1s. 2d., 20 lbs. at 1s.

4741a. Best Corks for the Combustion Tubes, per gross, 4s.

Purchasers are requested to state on their orders which Bore of tube they wish to have. See pages 19, 20.

4742. Brass Wire Gauze to wrap round the tube to prevent its flexure at a high temperature, per square foot, 2s.

4743. Liebig's Potash Apparatus, with 5 bulbs, used to contain a solution of caustic potash, to absorb the carbonic acid produced during the combustion of an organic body. See Fig. 2213, and *m*, *r*, Fig. 4743, *packed in a paper box*, 1s. 3d.

4743a. In Fig. 4743, the apparatus for organic analysis is arranged in order for a combustion. It embraces the Furnace, No. 4724, a Combustion Tube, No. 4740, a Chloride of Calcium Tube, No. 4747, a Caoutchouc Connector, No. 4751, and the Potash Bulbs, No. 4743.

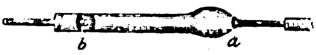
4744. Potash Apparatus, Geissler's form, Fig. 4744, which stands steadily on three bulbs, so connected together as to ensure the effectual absorption of the gas, without danger of the liquor running back into the combustion tube, 2s. Like 2214 2s–3d

For other forms of Potash Bulbs, see articles on the Absorption of Gases, commencing at No. 2186, page 243.

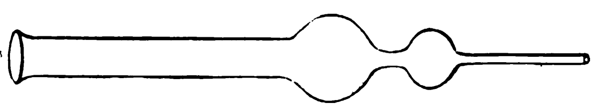
4745. Suction Tube, for filling the Bulb Apparatus with solution of caustic potash, Fig. 4745, 3d.

4747. Chloride of Calcium Tube, for absorbing the water produced during a combustion, form of Fig. 4747, and *b*, Fig. 4743, of light German glass tube, the wide tube measuring 4 inches by ⅜ inch, 2d.

4748. Ditto, larger size, the wide tube measuring 5½ inches by ½ inch, 2d.



4747.



4749.

4749. Chloride of Calcium Tube, with an extra bulb to condense part of the water produced before it reaches the chloride of calcium, form of Fig. 4749, 4d.

4750. Marchand's Chloride of Calcium Tube, form represented by Fig. 4750, 10d.

For other forms of chloride of calcium tubes, see Nos. 2048 to 2059, pages 224–226.

4751. Caoutchouc Tubes for connecting together the various pieces of glass apparatus. The proper sort is the narrow vulcanised tubes, described at No. 1953.

In Figs. 4743, 4739, &c., these tubes are represented as being tied with strings. The reason is that the woodcuts of those figures were engraved before the invention of vulcanised caoutchouc. When the latter is properly chosen, tying is unnecessary.

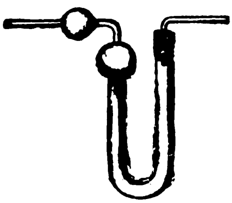
4752. Corks for closing the Combustion Tube. See No. 168.

4753. Caoutchouc Stoppers. See No. 193.

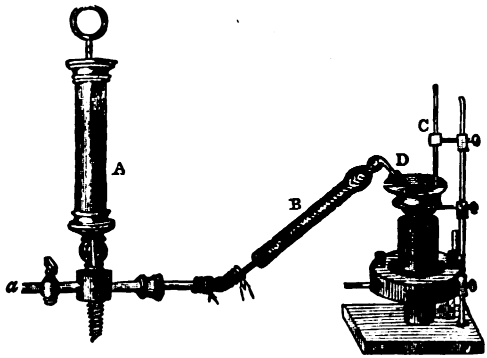
4754. Apparatus for heating Oxide of Copper to redness, to render it perfectly dry. The Gas Furnace, No. 994, answers this purpose perfectly. In less than half an hour a $4\frac{3}{4}$ inch clay crucible, filled with oxide of copper, can be heated by it to full redness.

4755. Air Pump or Syringe for exhausting air from glass tubes, as represented by A, Fig. 4755. See No. 736 in this list.

4756. Large Bulb Tube, in which ignited oxide of copper may be cooled, and from which it can be transferred to the combustion tube, Fig. 4756, 3d.



4750.



4755.

4756.

4757. Boat-shaped Trays of Porcelain or Platinum, for use when organic substances are burnt in a current of gaseous oxygen. See No. 1380.

4758. Apparatus for determining the relative volumes of Nitrogen and Carbonic Acid gas produced by the combustion of an organic body; consisting of a Combustion Furnace, No. 4724, a Combustion Tube, No. 4740, the Pneumatic Mercury Trough, No. 2089, and a Graduated Glass Tube. The latter should be about 12 inches long and $\frac{1}{4}$ inch in width, graduated to cubic centimetres or cubic inches, as may be desired. See Nos. 2331 and 2326. Six or eight such tubes are required for an analysis of this description.

4759. Apparatus for discriminating Nitrogen from Carbonic Acid in a gaseous mixture, by absorbing the latter with solution of Caustic Potash. See Fig. 4759. A, Fig. 4759, is a tall glass mercury trough, No. 2099. B is one of the Tubes described under No. 4758. β is a pipette by which the solution of potash is passed through the mercury trough into the mixed gases. This pipette is shown at large by Fig. 4760.

4760. Potash Pipette, Fig. 4760, 4d.

4761. Three-limbed or T-shaped Tube, used in the direct determination of Nitrogen, namely, for connecting the Combustion Tube at the same time to the air syringe and by a gas-leading tube to the pneumatic trough. Fig. 4761, 4d.

4762. Apparatus for determining Nitrogen quantitatively, Fig. 4762.

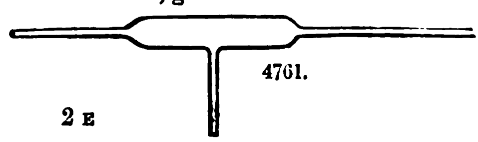
4763. Graduated Gas Tube, B, Fig. 4762, about 18 inches long, and 1 inch or $1\frac{1}{8}$ inch bore, the glass $\frac{1}{10}$ inch in substance, graduated to show about 280 centimetre cubes, 6s.

4764. The same, capacity about 16 or 17 cubic inches, graduated to show $\frac{1}{20}$ cubic inch, 6s.

4759.

4760.

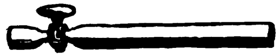
4765. Gas-leading Tube, U form, C, Fig. 4762, for use with the above apparatus, 39 inches long, 6d.



4761.

4766. **Will and Varrentrapp's Apparatus for the determination of Nitrogen, by converting it into Ammonia, and collecting the Ammonia in Hydrochloric Acid, form of the Apparatus, Fig. 4766, thin hard German glass,** 7s. per dozen.

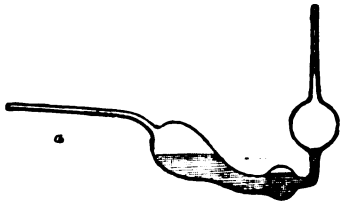
4766a. **Crumm's Nitrogen Tube, with glass Stopcock,** of small bore, so as to be closed by the thumb, Fig. 4766*a*, 3s. 6d.



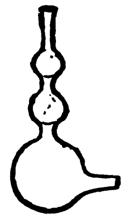
4766*a*.

4767. **Apparatus for the Collection of Nitrogen disengaged during the combustion** of organic bodies, after the method of Simpson; glass receiver of the form of Fig. 4767, 1s.

The use of this apparatus is described by Dr. Simpson, in the *Quarterly Journal of the Chemical Society*, 1854, vol. vi., p. 289.



4766.



4767.

4768. **Specific Gravity of Vapours,** determination after the method of Dumas. Very light Flasks of thin German glass, suitable for this experiment; the bulb from 2½ to 4 inches diameter, with a long narrow bent neck, 8s. to 12s. per dozen, according to size.

4769. **Cloez's Apparatus for Combustions in Organic Analysis.**

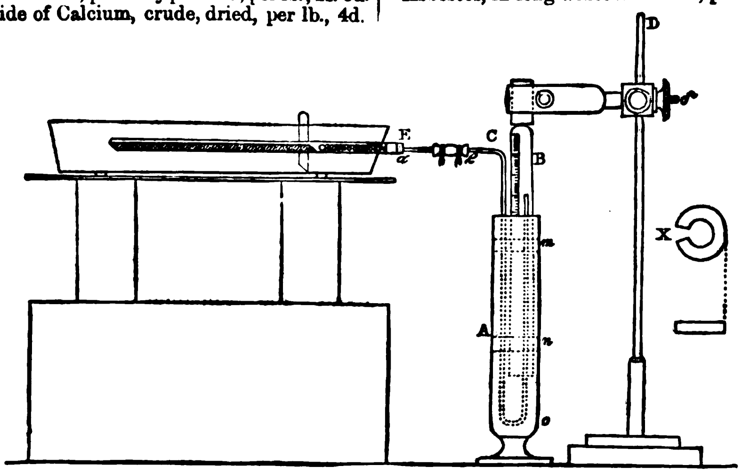
In this apparatus the combustion is effected in a wrought iron tube, which is 45 inches long and about ⅝ inch in bore. When heated, about 8 inches of it is allowed to project from each end of the furnace. That leaves 29 inches in the furnace.

The description of Tube is that described at page 143 of this work, and a suitable Furnace for heating it is that described at No. 1079.

A description of the mode of conducting an Organic Analysis with this apparatus is given in the *Annal. de Chim. et de Phys.*, sér. III., 68, 394. Also in Fresenius's *Anleitung zur Quantitativen Chemischen Analyse*, 1862, page 619.

4770. **Pure Chemicals used in Organic Analysis:—**

Oxide of Copper, per lb., 6s.
Ditto, *dense*, per lb., 8s.
Chromate of Lead, pure, fused, per lb., 6s.
Soda-Lime, per lb., 3s.
Bichromate of Potash, cryst., per lb., 2s. 6d.
Caustic Potash, partially purified, per lb., 2s. 6d.
Chloride of Calcium, crude, dried, per lb., 4d.
Chloride of Calcium, fused, per lb., 6d.
Chlorate of Potash, cryst., per lb., 2s. 6d.
Copper, in fine filaments, per lb., 10s.
Copper Turnings, per lb., 3s.
Copper Foil, per lb., 4s. 6d.
Asbestos, in long white filaments, per lb., 2s.



4762.

Collections and Cabinets of Chemical Apparatus.

In order to facilitate the comparison of the numerous details given in the following specifications, the collections of Instruments have been arranged in GROUPS, according to the purposes for which they have been prepared. The numbers prefixed to the names of the Instruments refer to those numbers in CHEMICAL HANDICRAFT, in which FIGURES or DESCRIPTIONS of the Instruments will be found.

GROUP I.—*Collections of Apparatus for Amateurs, or for those beginning the study of Chemistry, Nos.* 4780 *to* 4785.

4780. APPARATUS and PREPARATIONS for performing ELEMENTARY EXPERIMENTS in CHEMISTRY, arranged in Portable MAHOGANY CABINETS. THREE SIZES—at 16s., 31s. 6d., and 52s. 6d.

These CABINETS have been prepared to suit the wants of the student of Chemistry, who wishes to possess the means of performing the experiments he witnesses at lectures, or finds described in books. They have been arranged with a view to practical utility, and are not mere toys. The articles they contain are of the best materials and construction, and selected with due regard to their adaptation to one another, and to their general utility. Even the cheapest collection (at 16s.) affords the apparatus and materials for trying an extensive range of interesting experiments; while the more expensive collections, besides enabling the student to demonstrate the fundamental facts of Chemistry, provide him with the apparatus and tests necessary for an effective course of qualitative analysis. Every article contained in these Cabinets is fully described in Griffin's "Chemical Recreations," which also contains those instructions on Chemical Manipulation which are necessary to enable the beginner to perform his experiments with safety and certainty of success.

The following articles, required by the Experimental Chemist in large quantities, could not have been included in the Cabinets without greatly increasing their bulk and price. They have therefore been omitted:—Distilled Water, Sulphuric Acid, Hydrochloric Acid, Nitric Acid, Ammonia. These may be obtained of any Chemist and Druggist.

Separate Chests are prepared, containing Stoppered Bottles filled with Acids, Ammonia, &c., either commercial or pure, suitable to any of the Laboratories.

Also, Collections of Stoppered Bottles, containing Solutions of all the principal Reagents in a state of purity. See No. 4809.

4781. PORTABLE CHEMICAL CABINET, in MAHOGANY, *price* 16s.

CONTENTS.

289. Retort Stand, one ring.
62. Pestle and Mortar, No. 00, 2¼ inch.
851. Glass Spirit Lamp, 1 ounce.
1400. Glass Flask, 1 ounce.
1400. Glass Flask, 2 ounces.
2400. Test Tubes, 3 by 1, and 3 by ⅜ inch.
2400. Test Tubes, 4 by 1, and 5 by ⅝ inch.
4360. Open Glass Tubes, ⅛ and ¼ inch.
115. Glass Stirrers, 3 and 6 inch.
1690. Glass Pipette, 6 inch.
1743. Porcelain Basin, No. 00, 2¾ inch.
1323. Porcelain Crucible and Cover, No. 00.
1800. Porcelain Capsule, No. 5.
1626. Glass Funnel, 1¼ inch, No. 1.
1626. 100 Paper Filters to fit it, No. 1.
2410. Conical Test Glass, 1 ounce.
1785. Watch Glass, 1½ inch.
1790. Capsule with handle, 1¼ inch.
2423. Book of Litmus Paper.
2423. Book of Turmeric Paper.
92. Iron Spoon for Fusions.
1616. Two Slips of Glass, 4 by 1 inch.
2437. Test Metals, Fe, Cu, Zn.
864. Cotton Wick for Lamp.

Continued on page 420.

4781. **Portable Chemical Cabinet**, *continued*—

Chemical Preparations, contained in 9 Corked Bottles and 24 Paper Boxes:—

Alum.
Ammon. Carbonate.
Ammon. Oxalate.
Antimony, Sulphide.
Barium, Chloride.
Boracic Acid.
Bleaching Powder.
Cobalt, Chloride.
Copper, Nitrate.
Copper, Sulphate.
Fluor spar.
Galls, Tincture.
Iron, Sulphate.
Lead, Acetate.
Manganese, Peroxide.
Potass. Bichromate.
— Binoxalate.
— Carbonate.
— Chlorate.
— Ferrocyanide.
— Hydrate.
— Nitrate.
Potassium, Sulphate.
Silver, Nitrate, *solution*.
Sodium, Borate.
— Carbonate.
— Phosphate.
Strontium, Nitrate.
Sulphur.
Tartaric Acid.
Tin, granulated.
— Protochloride.
Zinc, granulated.

4782.

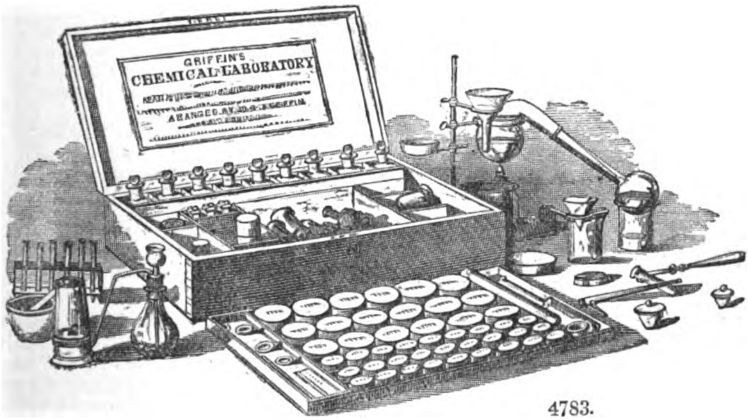
4782. PORTABLE CHEMICAL CABINET, in Mahogany, represented by Fig. 4782, *price* 31s. 6d.

Contents.

289. Retort Stand, one ring.
62. Porcelain Mortar and Pestle, No. 00.
851. Glass Spirit Lamp, 1 ounce.
864. Cotton Wick, 3 feet.
4201. Blowpipe.
4270. Platinum Blowpipe Wire.
4277. Platinum Foil.
92. Iron Spoon for Fusions.
98. Albata Test Spoon.
1442. Set of 3 Beaker Glasses.
1400. Glass Flask, 3 ounce.
1419. Bulb Tube, No. 3.
2400. Test Tubes, 3 by ½, 4 by ⅝ inch.
2400. Test Tubes, 4 by 1, 5 by ½ inch.
2400. Test Tubes, 2 by ¼ (3).
4365. Berzelius's Bulb Tube (2).
1785. Watch Glass, 2 inch.
1790. Porcelain Capsule and Handle (2).
1626. Funnel, No. 2, 1½ inch.
1626. Filters for ditto, 2¾ inch (100).
1626. Funnel, No. 1, 1¼ inch.
1626. Filters for ditto, 2¼ inch (100).
2410. Clark's Test Glass.
2423. Book of Litmus Paper.
2423. Book of Turmeric Paper.
2437. Test Metals, Fe, Cu, Zn.
115. Stirrers, one each 3 and 6 inch.
1610. Filtering Ring, 2 arms.
1690. Straight Pipette, 6 inch.
4360. Open Glass Tubes, ⅛ to ¼ inch (4).
387. Tube Holder with Handle.
1323. Porcelain Crucible, No. 0.
1743. Porcelain Basin, No. 0.
1800. Porcelain Cup, No. 1.
Ditto, No. 3.
Ditto, No. 6.

Fifty Chemical Preparations, contained in 4 stoppered ¼ ounce glass bottles, 10 corked ½ ounce bottles, 14 half-ounce wooden boxes, and 22 quarter ounce paper boxes, as follows:—

Alum.
Ammon., Carbonate.
Ammon., Chloride.
Ammon., Oxalate.
Antimony, Sulphide.
Barium, Chloride.
Boracic Acid.
Bleaching Powder.
Calcium, Chloride.
Cobalt, Chloride.
Cobalt, Nitrate.
Copper, Nitrate.
Copper, Sulphate.
Fluor spar.
Galena.
Galls, Tincture.
Iron Pyrites.
Iron, Sulphate.
Iron, Sulphide.
Lead, Acetate.
Lead, Carbonate.
Litharge.
Litmus.
Magnesium, Carbonate.
Magnesium, Sulphate.
Manganese, Peroxide.
Microcosmic Salt.
Oxalic Acid.
Phosphorus.
Potassium, Bichromate.
—— Binoxalate.
—— Cyanide.
—— Carbonate.
—— Chlorate.
Potassium Ferridcyanide.
—— Ferrocyanide.
—— Hydrate.
—— Iodide.
—— Nitrate.
—— Sulphate.
Silver Nitrate.
Sodium, Borate.
—— Carbonate.
—— Phosphate.
Strontium, Nitrate.
Sulphur.
Tartaric Acid.
Tin, Granulated.
Tin, Protochloride.
Zinc, Granulated.



4783.

4783. PORTABLE CHEMICAL CABINET, IN MAHOGANY, represented by Fig. 4783, *price* 52s. 6d.

CONTENTS.

288. Retort Stand, 3 rings.
62. Porcelain Mortar, No. 00.
851. Glass Spirit Lamp, 1 ounce.
864. Cotton Wick, 1 yard.
4201. Blowpipe.
4270. Platinum Blowpipe Wire.
4277. Platinum Blowpipe Foil.
98. Albata Test Spoon.
92. Iron Spoon for Fusions.
135. Iron Tongs with Spoon.
1442. Set of 3 Beaker Glasses.
1441. Set of 3 Beaker Glasses.
1400. Glass Flasks, 1, 2, and 3 ounces.
1419. Bulb Tube, large size (2).
1962. Gas Bottle, Funnel and Tube, small.
1721. Cork and Jet for ditto.
2400. Test Tubes, 3 by $\frac{3}{4}$ inch (2).
" " 4 by $\frac{3}{4}$ inch (3).
" " 6 by 1 inch (1).
" " 3 by $\frac{1}{2}$ inch (6).
366. Folding Frame for Six Tubes.
1626. Glass Funnel, No. 1, $1\frac{1}{4}$ inch.
1626. Glass Funnel, No. 2, $1\frac{1}{2}$ inch.
1626. Filters for No. 1 Funnel (100).
1626. Filters for No. 2 Funnel (100).
1610. Filter Ring, 2 arms.
2410. Clark's Test Glass.
2426. Box of Six Test Paper Books.
1800. Porcelain Test Plates, No. 8, 9 (2).
115. Stirrers, 2 each, 3 and 6 inches.
4360. Open Tubes, $\frac{1}{8}$ and $\frac{1}{4}$ inch (2).
2437. Test Metals, Cu, Fe, Zn.
387. Test Tube Holder.
1690. Straight Pipette, 6 inch.
158. Test Tube Brush.
1805. Glass Retort, 2 ounce
1405. Glass Receiver, 2 ounce.
1785. Watch Glasses, 2 inch (2)
1790. Capsule with Handle (2).
1743. Porcelain Basin, No. 00.
1743. Ditto, No. 1.
1800. Porcelain Cup, No. 12 (2).
1800. Ditto, No. 10.
1800. Ditto, No. 1.
1800. Ditto, No. 2.
1323. Porcelain Crucible, No. 000.
1323. Ditto, No. 00.
2071*a* Beehive Shelf, 4 inch.
477. Graduated Measure, 1 oz.

Continued on page 422.

4783. **Portable Chemical Cabinet**, *continued*—

Sixty Chemical Preparations, contained in 9 stoppered 2 ounce glass bottles, 6 stoppered ½ ounce glass bottles, 18 half-ounce wooden boxes, and 27 quarter ounce paper boxes :—

Alum.
Ammon., Caustic.
—— Carbonate.
—— Chloride.
—— Oxalate.
Antimony, Sulphide.
Arsenious Acid.
Barium, Chloride.
—— Chloride, *solution.*
—— Nitrate.
Boracic Acid.
Benzoic Acid.
Calcium, Chloride, *solution.*
Cobalt, Nitrate, *solution.*
Cobalt Ore.
Copper, Sulphate.
Copper Turnings.
Fluor spar.
Galena.
Iron Pyrites.
Iron, Sulphate.
Iron, Sulphide.
Lead, Acetate.
— Acetate, *solution.*
— Carbonate.
— Nitrate, *solution.*
Litharge.
Litmus.
Magnesium, Carbonate.
—— Sulphate.
Manganese, Peroxide.
Mercurous Chloride.
Microcosmic Salt.
Oxalic Acid.
Phosphorus.
Platinum, Bichloride, *solution.*
Potassium, Bichromate.
—— Binoxalate.
—— Bitartrate.
—— Chlorate.
Potassium, Cyanide.
—— Ferridcyanide.
—— Ferridcyanide, *sol.*
—— Ferrocyanide.
—— Hydrate
—— Iodide.
—— Nitrate.
—— Sulphate.
Realgar.
Silver, Nitrate, *solution.*
Sodium, Borate.
—— Carbonate.
—— Phosphate.
Strontium, Chloride.
—— Nitrate.
Sulphur.
Tartaric Acid.
Tin, Chloride.
Tin, Granulated.
Zinc, Granulated.

4784. **PORTABLE CHEMICAL CABINET**, in a divided **Deal Box**, *stained Red*, with lock and key. Price 42s.

The articles in this Cabinet are intended for the use of an Amateur who wishes to repeat Class Experiments, and also to commence Qualitative Analysis. It contains thirty chemicals in the solid state, and the principal instruments used in testing operations, and these are of larger sizes than the instruments contained in the cabinets described above. But the collection contains no Test Solutions, and the Experimenter must provide himself with a few stoppered bottles, and prepare solutions when he requires them. See also sets of Reagents, No. 4810.

Contents.

62. Porcelain Mortar, 2½ inches.
288. Retort Stand, 3 rings.
851. Spirit Lamp.
864. Cotton Wick, in a box.
1191. Stoneware Lamp Cylinder.
1194. Ring tops for ditto, a pair.
1195. Hot Plates for ditto, a pair.
1196. Trellis top for ditto.
1197. Tinplate Sand-Bath, 5-inch.
1201. Support for 7 Tubes, on sand.
4201. Blowpipe.
4321. Charcoal Pastilles (36).
4320. Porcelain Crucible for ditto.
4321*a*. Wire Pastille-holders (2).
92. Iron Spoon.
93. Spring Tongs, to hold spoon.
1800. Porcelain cups, 1, 2, 3.
4376. Arsenic Tubes, *six.*
1400. Flasks, 2, 4, 6 ounces.
1442. Set of 3 Beaker Glasses.
1815. Clark's Retort and Receiver.
1419. Bulb Tubes, *two.*
2400. Test Tubes, 6 by ⅝ inch 12.
Ditto. 6 by 1 inch, 3.
359. Test Tube Frame, 6 holes.
158. Test Tube Brush.
387. Holder for hot Test Tubes.
2410. Clark's Test Glass.
98. Albata Test Spoon.
2424. Book of Blue Litmus.
2424. Book of Red Litmus.
2437. Test Metals, Fe, Cu, Zn.
115. Stirrers, 6 inch, 2.
1626. Funnel, 2-inch.
1626. Cut Filters, 100, 3¼-inch.
1610. Filter Ring, 2 sizes.
1690. Straight Pipette, 6-inch.
1766. Porcelain Basin, 3½-inch.
1790. Capsule, with handle.
1800. Flat Capsule, No. 10.
1760. Semi-porcelain Basin, 4½ inch.
1785. Watch Glasses, 2-inch, 2.
1994. Gas Bottle.
2072. Beehive Shelf, 2 inch.
2124. Gas Tubes, 3 assorted.
2124. Ditto, large, 6 by 1 inch, 2.
477. Graduated Measure, 1-ounce.
Open Glass Tubes, ¼ lb.

Continued on page 423.

THIRTY CORKED BOTTLES 1-ounce size, containing the following solid CHEMICALS:—

Alum.
Ammon. Carbonate.
——— Chloride.
Barium Chloride.
Calcium Chloride.
Copper Sulphate.
Galls.
Galena.
Iron Sulphide.
—— Sulphate.
Lead Acetate.
Litmus.
Magnesia Sulphate.
Manganese Peroxide.
Microcosmic Salt.
Oxalic Acid.
Potass. Bichromate.
——— Bisulphate.
——— Chlorate.
——— Hydrate.
Potass. Ferrocyanide.
——— Nitrate.
Sodium Borate.
——— Carbonate.
——— Sulphate.
——— Phosphate.
Strontium Chloride.
Sulphur.
Turmeric.
Zinc Cuttings.

4785. STOCKHARDT'S SCHOOL of CHEMISTRY; a Collection of Apparatus suitable for the performance of the principal Experiments described in that work. Packed in a case. Price 16s.

CONTENTS.

1805.	Retort, 4-ounce size.
1405.	Receiver, 4-ounce size.
1404.	Flasks, 3, 4, 6, 8 oz.
1442.	Set of 3 Beaker Glasses.
1192.	Spirit Lamp, stoneware.
4201.	Blowpipe.
4270.	Platinum Blowpipe Wire.
4277.	Platinum Blowpipe Foil.
62.	Porcelain Mortar, No. 00.
864.	Lamp Wick, 3 feet.
1191.	Lamp Cylinder, 6-inch.
1196.	Trellis Top for it.
293.	Tube and Support, on stand.
92.	Iron Spoon.
1323.	Porcelain Crucible, No. 0.
2400.	6 Test Tubes, each 5 by $\frac{1}{2}$ in. & 6 by $\frac{5}{8}$ in.
359.	Test Tube Frame, for 6 Tubes.
2414.	Test Glass, 4 oz., conical.
1626.	Funnels, $1\frac{1}{2}$ and 2 inch.
1626.	Filters, 100 of each, 2 sizes.
1616.	Slips of glass (6).
2433.	Book of Blue Litmus.
	Bar of Pure Zinc.
115.	Glass Stirrers, 2 each, 3 and 6 inch.
1766.	Semi-porcelain Basin, $3\frac{1}{2}$ inch.
2014.	Oxygen Retort and Tube.
1963.	Hydrogen Gas Bottle.
2071.	Beehive Shelf, 4-inch.
231.	Glass Tubes, $\frac{1}{4}$ lb. mixed.
177.	Round File, in handle.

GROUP II.—*Collections of Apparatus for the use of Students in Classes where Practical Chemistry is taught, Nos.* 4786 *to* 4792.

4786. **COPY OF SCIENCE FORM No. 390 of the Science and Art Department of the Committee of Council on Education.**

CATALOGUE OF APPARATUS FOR TEACHING CHEMISTRY.

SUBJECT X. INORGANIC CHEMISTRY.—SUBJECT XI. ORGANIC CHEMISTRY.

APPARATUS for teaching the ELEMENTS of INORGANIC and ORGANIC CHEMISTRY, embracing the Student's Set of Apparatus as used in the School of Mines, and that named in the "*Introduction to Inorganic Chemistry*" by W. G. VALENTIN, F.C.S., Principal Demonstrator of Practical Chemistry in the Royal School of Mines and Science Training Schools, South Kensington.

The Apparatus required by Science Teachers in the Special Courses of training at South Kensington costs, in a box, £2.

The additional Apparatus required for Quantitative Analysis costs £2, 2s. 6d.

The additional Apparatus required for Organic Analysis costs 12s. 5d.

The above named sets are all included in the following complete list :—

	£	s.	d.
1. Conical brass blowpipe, with bone mouth-piece,		2	0
2. Platinum foil, 2 in. by 1 in.,			10
3. Platinum wire, 6 inches,			6
4. Platinum crucible,	1	5	0
5. Test tube stand, 24 holes,		2	0
6. Test tubes, 6 in. by $\frac{3}{4}$ in., 18,		1	5
7. Do., 5 in. by $\frac{1}{2}$ in., 12,			6
8. Basket for holding the test tubes,			6
9. Boiling tubes, 8 in. by $1\frac{1}{4}$, 2,			4
10. Test tube brushes, 2,			5
11. Funnel, $1\frac{1}{2}$ in., 1,			$2\frac{1}{2}$
12. Do. 2 in., 1,			$2\frac{1}{2}$
13. Do. $2\frac{1}{2}$ in., 3,			7
14. Do. 3 in., 1,			3
15. Black wood funnel holder,		1	4
16. Quire filter paper,		1	6
17. Set 4 tinplate filter cutters,			10
18. Iron tripod stand, 8 in. high, 5 in. triangle,			9
19. Iron gauze, 5 in. square, 2 pieces,			4
20. Sand-bath, 5 in. tinplate,			4
21. 6 watch glasses, 2 in.,			5
22. 5 doz. assorted corks,		2	0
23. 1 set cork borers, $\frac{3}{16}$, $\frac{1}{4}$, $\frac{3}{8}$ in., with iron rod,		1	2
24. Triangular file, with handle,			6
25. Round file, 5 in., with handle,			8
26. Do. 4 in. do.,			7
27. Square flat file, 1 side to file and 1 to rasp,			10
28. Pair of scissors,		2	0
29. Brass crucible tongs,		1	8
30. Porcelain mortar, 4 in. S.P.,		1	0
31. Aluminum leaf,		1	6
32. Copper wire, thin,			6
33. Steel wire, thin,			6
34. Magnesium wire and foil,		1	6
35. Steel spatula, balanced handle, 5 in.,			10
36. Porcelain spatula S. P.,			9
37. Box of test papers,			9
38. 2 Porcelain boats,			10
39. $\frac{1}{2}$ doz. assorted glass cylinders,		6	0
40. $\frac{1}{2}$ doz. „ ,, plates,			9
41. 1 large glass plate,			6
42. 1 iron retort stand, with 3 brass rings,		2	3
43. 1 iron retort stand, with clamp extra,		7	0
44. 2 iron tripod stands, with body,		2	6
45. $\frac{1}{2}$ doz. Woulff's bottles, assorted, 2 and 3 necks, 1 pt. to 1 qrt.,		9	0
46. 3 straight acid funnels,			8
47. 2 bent ditto,			9
48. 7 lbs. glass tubing,		8	2
49. $\frac{1}{2}$ doz. Berlin basins, 2 in. to 5 in.,		5	0
50. $\frac{1}{2}$ doz. flasks, assorted, 1 litre down to $\frac{1}{4}$ litre,		3	6
Carry forward,	5	3	11

	£	s.	d.
Brought forward,	5	3	11
51. 4 Bunsen's burners, assorted, 1-jet, (1s.), 2-jet (3s.), 3-jet (5s.), and 1 rose (1s. 6d.),		10	6
52. 2 tubulated retorts, $\frac{1}{2}$ pint and 1 pint,		1	9
53. 6 plain retorts, small,		1	6
54. 4 V-tubes, assorted, with india-rubber cocks,		2	6
55. 2 eprouvettes, 2 sizes,		1	0
56. 2 deflagrating spoons,			8
57. $\frac{1}{2}$ doz. bulb tubes,		1	6
58. 1 set of 5 beakers,		1	9
59. $\frac{1}{2}$ doz. screw taps,		2	6
60. 3 pipeclay triangles,			6
61. 1 triangle, with platinum,		2	0
62. 1 pair tongs, with platinum points,		3	6
63. Filter dryer,			8
64. 12 feet india-rubber tube, $\frac{3}{16}$ and $\frac{1}{4}$,		4	6
65. 2 lb. combustion tube,		2	8
66. 1 lb. glass rod,		1	2
67. 2 small iron spoons,			4
68. $\frac{1}{2}$ doz. assay flasks,		1	8
69. Glass Basin, 6 in. diameter, fig. 1,			10
70. Spoon for sodium, fig. 2,		1	0
71. Pneumatic trough, 14 in. by $9\frac{1}{2}$ in., fig. 3,		6	0
72. Gasholder, Pepys's, 4 gallons, fig. 4,	1	5	0
73. Taper holder, fig. 8,			2
74. Cedar splinters, a bundle of,			6
75. 2 crook supports, fig. 10,		4	0
76. 1 bell jar, $7\frac{1}{2}$ in. by 4 in., fig. 14,			9
77. Glass tube, 3 ft. long by 1 in. wide, fig. 11,		1	0
78. { Hoffman's combustion furnace, with 30 jets, takes a 10 inch tube, fig. 16, £3. Griffin's combustion furnace, with 18 jets, takes a 13 inch tube, fig. 16,	3	3	0
79. { Charcoal furnace, fig. 16,		4	0
Support for do. (2 bricks will support it equally well),		4	0
80. Wire frame, with tapers fixed at different heights, fig. 22,		1	6
81. Wide glass cylinder, fig. 22,		2	3
82. Capped gas jar, with bladder, 2 cocks, fig. 24,		14	0
83. India-rubber balloon,			6
84. Wooden frame for drying tubes, fig. 25,		3	0
85. French balloons,		3	0
86. Small magnet, 4 in. long,		1	0
87. 2 Bunsen's batteries, fig. 27, More powerful batteries are preferable, 8s. each.		6	0
88. Bottle fitted with platinum electrodes for decomposing water, fig. 28,		5	0
Carry forward,	14	11	1

		£	s.	d.
	Brought forward,	14	11	1
89.	Hofmann's eudiometer tubes, fitted with electrodes, gutta percha support, stand, and clamps, fig. 29, . . .		15	0
90.	Hofmann's apparatus for decomposing water, on stand, fig. 30,		17	6
	Cheaper form of decomposer, 10s. 6d.			
91.	Hydrometer jar, fig. 31, . .		1	2
92.	Eudiometer graduated into 300 m.m., fig. 31, ...		3	6
93.	Leyden jar, with metallic chain, fig. 31, ...		3	0
94.	Hofmann's apparatus for showing volumetrical composition of steam, on stand, fig. 33, . .		15	0
95.	Liebig's condenser, glass only, fig. 35, ...		3	0
96.	Stand for do., fig. 35, . .		7	0
97.	Pipette, fig. 36, . . .			2
98.	Litre flask, with cup and wire support for sulphur, fig. 39, .		1	2
99.	Table support, bottle and cork, fig. 42, ...		6	0
100.	Stand and test tubes, with india-rubber corks, fig. 44, . .		2	0
101.	Copper water bath, with rings, 5¼ inch, fig. 45, . . .		8	0
	Carry forward,	18	13	7

		£	s.	d.
	Brought forward,	18	13	7
102.	Furnace 18 in, by 10 in., iron, lined with fireclay, fig. 49, £5, 5s. Furnace, same shape, made of fireclay and iron bound, heating a tube 13 inch long, . Furnace, for use with gas, heating a tube 17 inch long, £4.	2	4	0
103.	Iron and porcelain tubes, fig. 49,		10	0
104.	Hofmann's apparatus for decomposing hydrochloric acid, on stand, fig. 52, . . .		16	0
105.	U-tube and stand, fig. 53, .		3	0
106.	Hofmann's apparatus for decomposing HCl. by sodium, on stand, fig. 54, . . .		9	0
107.	French receiver, mounted, showing combustion of oxygen and nitrogen by electric spark, fig. 61,		3	0
108.	Galvanic battery, 5 cells of Groves, (*Mem.*—A weaker battery is useless.)	2	2	0
109.	Ruhmkorff's coil, ...	2	2	0
110.	Cylinder, tubes, and corks, for preparation of sulphuric acid, fig. 64, ...		3	6
111.	Bell jar, fig. 68, ...		3	0
112.	Bunsen's blowpipe, fig. 77, .		15	0
		£28	4	1

The Travelling Set of Apparatus for Special Important Illustrations, contains 20 composite pieces of apparatus, and costs £43, 2s. 7d.

MEDICAL STUDENT'S SETS OF APPARATUS, arranged to suit the course of studies prescribed at all the principal MEDICAL SCHOOLS, always kept in stock, packed in cases, with or without lock and key. Such sets generally cost from 15s. to 40s. each.

4787. ROYAL NAVAL COLLEGE, GREENWICH.

This Student's set is arranged by Dr. Debus of Guy's Hospital, where it is also in use.

		S.	D.
851.	Glass Spirit Lamp, ...	1	0
864.	Cotton Wick in box, . .		2
306.	Pipeclay Triangle, ...		3
4200.	Black's Blowpipe, ...		8
4278.	Platinum Foil, 2 inch × ¾ inch, .		9
4270.	,, Wire, 6 inch, . .		6
1323.	Porcelain Crucible, 1 inch, .		3
,,	,, ,, 1½ inch, .		6
121.	Crucible Tongs, ...	1	6
99.	Steel Spatula, 4 inch, . .		8
62.	Porcelain Mortar, 2½ inch, .		7
1462.	Set of 3 Beakers, ...	1	9
1743.	2 B. P. Basins, 3½ inch, No. 1, .	1	6
,,	2 ,, 3¾ inch, No. 2, .	1	8
1400.	2 Flasks, 4 ounces, ...		5
1405.	1 ,, 12 ounces, ...		4
1723.	1 twenty oz. Washing Bottle, .	1	3
4360.	12 Glass Tubes, 12 inch × ⅜ inch,	1	4
1785.	3 Watch Glasses, 2 inch, . .		3
115.	2 Glass Stirrers, 6 inch, . .		1
2400.	24 Test Tubes, 6 inch × ⅝ inch, .	1	8
,,	12 ,, ,, 4 inch × ½ inch, .		6
371.	Test Tube Frame, ...	1	2
158.	,, Brush, . . .		3
2426.	Test Papers, in box, . . .	1	0
	Rubber Tube, 12 inch × ¼ inch, .		5
	Funnels, 1½ inch and 2½ inch, .		4
	Filters, 100 each, 2¾ in. and 4½ in.,		6
	Triangular File, ...		8
	Round File, 4 inch, . . .		8
	Box with sliding top, . .	2	0
		£1 4	7

The Set is supplied at 21s. nett.

4788. **Collection of Apparatus and Tests for the QUALITATIVE ANALYSIS of Salts that Dissolve in Water, according to the process for School Teaching described in Griffin's "*Chemical Recreations*," Part I., page 65.**

4789. Set A. For Indicating Tests. Every pupil requires this set. Price 16s.

62. Porcelain Mortar, No. 00.
91. Albata Test Spoon.
1400. Flask, 2 ounce.
2769. Pipette, 25 septems.
851. Glass Spirit Lamp.
864. Cotton Wick for lamp.
132. Brass Tongs to trim lamp.
1191. Furnace Cylinder.
1196. Trellis Top for Furnace.
1626. Box, with 100 Filters, $2\frac{3}{4}$ inch.
1610. Filter Ring.
254. Water Bottle.
1626. Glass Funnel, $1\frac{1}{2}$ inch.
342. Support for Funnel.
1690. Pipettes, 5 inch, *two.*
2410. Test Glasses, conical, 8.
115. Stirrers, 3 inch, 8.
2400. Boiling Tubes, 6 inch × 1 inch, 2.
386. Handle for Hot Tubes.
2423. Book of Red Litmus.
2423. Book of Blue Litmus.
4474. Tubes for SH Gas.
1556. Pipette Bottles, 1 oz. size, *nine.*
1576. Bottles with stoppers, 1 oz., *two.*

4790. Set B. For Confirming Tests. Each set suffices for four or five pupils. Price 23s.

1800. Porcelain Cup, 1 inch.
291. Retort Stand.
4201. Blowpipe.
4230. Blowpipe Lamp and Stand.
4270. Platinum Wires, *two.*
4277. Platinum Foils, *two.*
4282. Platinum Tongs.
4296. Thin Copper Wire.
4321. Charcoal Pastilles, 36.
4320. Crucible for ditto, *two.*
4321*a.* Wire Supports for ditto, *two.*
4395. Hammer.
4397. Anvil.
2400. Closed Tubes, 2 inch × $\frac{1}{4}$ inch, 3.
2426. Box of Test Papers.
4349. Support for Sublimates.
Borax, in a box.
Microcosmic Salt, in a box.
Soda, Carbonate, in a box.
2476. Cobalt Nitrate, 2 oz. bottle.
Stoppered Bottles, to contain Test Solutions, 2 ounce size, *labelled, but empty*, 8.
Corked Bottles, with wide mouths, to contain Dry Tests, 1 oz. size, *labelled, but empty*, 7.

4791. Set C. Provision of Tests to be made by the Teacher, from which to supply the Bottles of Sets A and B, when preparing for the Lesson. The solutions may be of the strengths described at page 280 in this work. The price is for Six Ounce Bottles, full of the Liquid Reagents in the following List (excepting the Gold and Platinum Solutions), and for Two Ounce Bottles of Dry Reagents. Price, including bottles, 32s.

INDICATING TESTS.

2558. Sodium, Carbonate.
2450. Ammonia.
2536. Potassium, Hydrate.
2534. ——— Ferridcyanide.
2464. Barium, Nitrate.
2550. Silver, Nitrate.
2470. Calcium, Chloride.
2522. Nitric, Acid.
2511. Lead, Nitrate.

CONFIRMING TESTS.

2532. Potassium, Chromate.
2531. ——— Bichromate.
2535. ——— Ferrocyanide.
——— Antimoniate.
2473. Calcium, Sulphate.
2452. Ammon. Molybdate.
2572. Sulphuric Acid, Concent.
2496. Hydrochloric Acid.
2527. Platinum Chloride, 5°. $\frac{1}{2}$ oz.
2491. Gold Chloride, $\frac{1}{2}$ oz.

TESTS IN DRY STATE.

Calcium Sulphide.
2655. Potass. Bisulphate.
2613. Ferrous Sulphate.
2641. Manganese, Peroxide.
2632. Stannous Chloride.
Copper Sulphate.
Lead Acetate.
Magnesium Sulphate.
2627. Sodium Chloride.

4792. The Complete Set, A, B, C, Nos. 4789, 4790, 4791, price £3, 11s.

This collection can be enlarged by additions from the List given at No. 4826.

4792A. **THE APPARATUS AND REAGENTS** detailed in the following Lists are those in use in the Laboratories of the PHARMACEUTICAL SOCIETY, and recommended by PROFESSOR ATTFIELD in his *Manual of Chemistry.*

APPARATUS FOR EXPERIMENTS IN ANALYSIS.

List of Apparatus suitable for the three months' course of practical chemistry in the summer session of medical schools, or for any similar series of lessons—including the preparation of elementary gases, analytical reactions of common metals and acidulous radicals, analysis of single salts, chemical toxicology, and the examination of urine, urinary sediments, and calculi :—

	S.	D.
One dozen Test Tubes,		9
Test Tube Stand,		6
Test Tube Cleaning Brush,		3
Glass Tubing, 8 to 16 inches long, with a few inches of India-rubber Tubing to fit,		10
Small Flask,		4
Two Small Beakers,		5
Two Small Funnels,		4
Two Watch Glasses,		2
Two Glass Rods,		1
Wash Bottle,	1	0
Small Pestle and Mortar,		5
A 2-Pint Earthenware Basin,		10
Two Small Evaporating Basins,		10
Two Porcelain Crucibles,		11
Blowpipe,		8
Crucible Tongs,	1	6
Round File,		8
Triangular File,		8
Small Retort Stand,	1	9
Sand Tray,		3
Wire Triangles,		3
Platinum Wire and Foil,		9
Test Papers,		4
Filter Paper,		3
Towel,		8
Two dozen Corks,	1	2
Deal Box,	1	6

This Set, packed in a Deal Box, 15s. Nett.

APPARATUS FOR EXPERIMENTS IN SYNTHESIS AND ANALYSIS.

A larger set, suitable for the performance of most of the synthetical as well as analytical experiments described in this manual :—

	S.	D.
Evaporating Basins, of about the following sizes :— One 8-inch. One 7-inch. One 6½-inch. One 4-inch. Two 3-inch.	3	8
Retort Stand, three rings,	2	3
Two Test Glasses,	1	2
One Half-pint Flask,		5
Half quire Filter Paper,		6
Two Porcelain Crucibles,	1	4
One Measure Glass, 5 oz.,	1	3
Blowpipe, 8-inch, Black's,		8
Two Glass Funnels,		6
One dozen Test Tubes,		9
One Test Tube Brush,		3
One Pair of 8-inch Crucible Tongs,	1	6
Two Soup Plates,		6
One Flat Plate,		3
Two Spatula Knives,	1	8
One Pair of Scissors,	1	0
One Round File,		8
One Triangular File,		8
Half pound Glass Rod,		6
Half pound Glass Tubing,		6
One foot small Rubber Tubing,		4
Three dozen Corks, assorted,	1	3
Platinum Wire and Foil,	1	0
Test Papers,		6
A nest of three Beakers,	1	0
Deal Box,	2	0

This Set, packed in a Case, 25s.

A Sponge, Towels, and Note-book may be included.

FURNITURE OF A LABORATORY.

The following apparatus should be ready to the hand of students following an extended course of practical chemistry, in a room set apart for the purpose :—

A Bench or Table and Stool.
Water supply and Waste-pipe.
A Cupboard attached to a chimney, with an outward draught.
A furnace fed with coke ; Tongs, Hot Plate or Sand Bath, &c.
A Waste Box.
Shelves for chemicals and other materials in jars or bottles.
Gas supply and Lamp, with flexible Tube (or a Spirit Lamp and Spirit.)
Test Tube Rack, two dozen holes.
Iron Stand or Cylinder for supporting large dishes.
Iron adaptors for fitting dishes to cylinder.
Pestle and Mortar, 5 or 6 inches.
One 6-inch Funnel.
Brown Pan, 1 or 2 gallon.
White Jug, 1 gallon.
Water-bottle, quart.
Twenty-eight Test Bottles, 6 oz.

Other articles, such as Flasks, Retorts, Receivers, Condensers, large Evaporating Dishes, may be obtained as wanted. In Quantitative Analysis the apparatus described in the sections on that subject will be required.

Reagents.

The bottles employed should be well stoppered, and of 6 ounces capacity. German glass bottles of this size may be had for about 4s. per dozen. The bottles should not be more than about three-quarters full; single drops, if required, can then be poured out with ease and precision. The following list of test solutions is recommended:—

	s.	d.		s.	d.
Sulphuric Acid, strong,	1	6	Sol. of Potash, 5 per cent. or B.P.,	1	9
Nitric Acid, strong,		10	„ Soda, 5 to 15 per cent.,	1	6
Hydrochloric Acid, strong,		7	„ Ammon., 10 per cent or B.P.,	1	0
Acetic Acid, strong,	1	9	Lime Water, saturated,		8

The next eight may contain about 10 per cent. of solid salt:—

	s.	d.		s.	d.
Carbonate of Ammonium, with a little solution of Ammonia added,	1	3	Chloride of Barium,	1	0
Chloride of Ammonium,	1	0	Chloride of Calcium,	1	0
Phosphate of Ammonium,	1	0	Phosphate of Sodium,		9
Sulphydrate of Ammonium,	2	0	Neutral Chromate,	1	0

The succeeding seven may have a strength of about 5 per cent.:—

	s.	d.		s.	d.
Ferrocyanide of Potassium,	1	3	Perchloride of Iron,	1	6
Ferridcyanide of Potassium,	1	6	Nitrate of Silver,	5	0
Iodide of Potassium,	2	3	Perchloride of Platinum,	12	0
Oxalate of Ammonium	1	6			

These prices include the bottles.

Lists of Chemicals.

List of chemicals necessary for the practical study of the non-metallic elements. The quantities are sufficient for several experiments:—

Chlorate of Potassium,	1 oz.	7d.	Phosphorus,	½ oz.	7d.
Black Oxide of Manganese,	1 oz.	5d.	Hydrochloric Acid,	1 oz.	5d.
Zinc,	1 oz.	9d.	Sulphur,	½ oz.	5d.
Oil of Vitriol,	2 oz.	5d.	Iodine,	¼ oz.	9d.

List of chemicals necessary for the *analytical* study of the metallic and acidulous radicals. The eight substances mentioned in the above list are included.

The set of test solutions described on the previous page.

		s.	d.			s.	d.
Carbonate of Potassium,	1 oz.		10	Chloride of Manganese,	¼ oz.		4
Tartaric Acid,	1 oz.		9	Chloride of Cobalt,	50 grs.		9
Litmus,	¼ oz.		5	Nitrate of Nickel,	¼ oz.		8
Sulphate of Magnesium,	1 oz.		5	Chloride of Chromium,	¼ oz.	1	10
Sulphate of Zinc,	1 oz.		6	Gold leaves, half a book,		1	0
Alum,	1 oz.		6	Chloride of Cadmium,	¼ oz.	1	0
Sulphide of Iron,	1 lb.	1	2	Nitrate of Bismuth,	¼ oz.		9
Oak-galls,	1 oz.		9	Bromide of Potassium,	¼ oz.		5
Sulphocy. of Potassium,	¼ oz.		6	Starch,	1 oz.		6
White Arsenic,	½ oz.		5	Nitrate of Potassium,	1 oz.		6
Zinc,	¼ lb.		9	Copper borings or turnings,	1 oz.		8
Charcoal, in paper,	¼ lb.	1	6	Indigo,	¼ oz.		8
Sulphate of Iron,	1 oz.		5	Chlorate of Potassium,	1 oz.		7
Copper Foil,	1 oz.	1	0	Iodine,	½ oz.	1	2
Sulphate of Copper,	1 oz.		6	Spirit of Wine,	1 oz.		7
Tartar Emetic,	½ oz.		6	Sulphur,	1 oz.		5
Mercury,	1 oz.		10	Acid Oxalate of Potassium,	1 oz.		9
Corrosive Sublimate,	½ oz.		10	Citric Acid,	1 oz.	1	0
Calomel,	½ oz.		9	Phosphorus,	1 oz.	1	0
Tin,	1 oz.		8	Borax,	1 oz.		6
Bicarbonate of Potassium,	1 oz.		7	Turmeric,	1 oz.		9
Acetate of Lead,	1 oz.		7	Benzoic Acid,	50 grs.		8
Cyanide of Potassium,	½ oz.		9	Fluor Spar,	1 oz.		5
Hyposulphite of Sodium,	1 oz.		6	Tannic Acid,	50 grs.		6
A Lithium salt,	10 grs.	1	6	Gallic Acid.	50 grs.		6
Nitrate of Strontium,	¼ oz.		5	Pyrogallic Acid,	50 grs.	2	0
Black Oxide of Manganese,	¼ lb.		10				

These prices include the bottles.

The Total Cost of the above five Sets of Reagents is £4, 7s. 0d.

4792B. **PROFESSOR ROSCOE'S "CHEMISTRY PRIMER,"** intended to explain fundamental principles to pupils in Elementary Schools, price 1s.

List of Apparatus Required for each Experiment in Roscoe's "Chemistry Primer."

No. of Expt.		s.	d.
1.	Taper, with wire holder,		2
3.	Glass Tube containing a taper, with U Tube for holding the caustic soda, and caoutchouc tubing to connect to the aspirator,	1	6
	Pair of Hand Scales with glass pans, and weights from 2 oz. downwards, in oak box,	4	6
5.	A 2 oz. Glass Flask, 3d., iron tripod stand, 10d.,	1	1
	Bunsen's Burner, with one yard of caoutchouc tubing,	2	2
	(This will be replaced by a spirit lamp and 1 pint of methylated spirit when desired.)		
6.	A Bell Jar, 1s., Capsule to contain the phosphorus, 5d.,	1	5
12.	Apparatus for decomposing water by electricity, with two collecting tubes and wire to suspend them,	2	0
	A 4-cell Grove's Battery, in wooden tray, with wires.	38	0
14.	Glass Mortar and Pestle, 10d., Gas Eprouvette, 6d.,	1	4
15.	Flask, &c., for generating hydrogen,	1	6
	Stoneware Pneumatic Trough, with beehive shelf,	2	8
	Four wide-mouthed gas-collecting bottles pint size,	1	4
	Three Stoneware Gas Trays,		9
20.	A Pint Flask, Wash Bottle, two U-shaped Calcium Chloride Tubes, and hard Glass Tube to contain the copper oxide,	4	0
21.	Two 8-oz. Stoppered Glass Retorts,	1	6
	A Retort Stand, with three rings, and Clamp for test tubes, &c.,	5	6
23.	A 16-oz. Porcelain Evaporating Dish, 1s. 6d., 4-oz. ditto, 8d.,	2	2
25.	Two 3-in. Glass Funnels, 6d., 100 Filter Papers, 9d.,	1	3
31.	A Horse-shoe Magnet,		4
32.	A Palette Knife,		6
37.	A piece of iron wire gauze, 6 inches square,		3
42.	Iron Tray or Sand Bath,		4
44.	One dozen 5-in. Test Tubes, 1s., Test Tube Holder, 6d.,	1	6
	Test Tube Stand for twelve tubes,	1	3
	One Blowpipe, 1s., two Files (round and triangular), 1s. 4d.,	2	4
	Half a pound of Glass Tubing, 6d., two dozen spare Corks, 6d.,	1	0

Chemicals, &c.

Sulphuric Acid,		4 lbs.
Nitric Acid,		3 lbs.
Hydrochloric Acid,		2 lbs.
Lime-water,		1 pint.
Ammonia	(solution),	4 oz.
Caustic Potash	,,	4 oz.
Sodium Carbonate	,,	4 oz.
Potassium Chromate	,,	4 oz.
Potassium Ferrocyanide	,,	4 oz.
Silver Nitrate	,,	4 oz.
Litmus	,,	4 oz.
Indigo	,,	4 oz.
Calcium Chloride,		8 oz.
Marble,		8 oz.
Iron Filings,		8 oz.
Lime,		4 oz.
Gypsum,		4 oz.
Stourbridge Clay,		4 oz.
Bleaching Powder,		4 oz.
Manganese Dioxide,		1 lb.
Soda Crystals,		4 oz.
Alum,		4 oz.
Sulphur Roll,		4 oz.
Sulphur Flour,		4 oz.
Potassium Nitrate,		4 oz.
Zinc,		2 oz.
Copper Turnings,		2 oz.
,, Oxide,		2 oz.
,, Sulphate,		2 oz.
Antimony,		2 oz.
Mercury,		2 oz.
Lead Acetate,		2 oz.
Castor Oil,		2 oz.
Caustic Soda (solid),		2 oz.
Sodium Carbonate Anhydrous,		1 oz.
Phosphorus, yellow,		1 oz.
,, red,		½ oz.
Tin Oxide,		½ oz.
Mercury Oxide,		½ oz.
Potassium,		1 dram.
Sodium,		1 dram.
Gold Leaf,		6 leaves.
Magnesium Ribbon,		½ yard.
Litmus Paper,		1 book.
Charcoal,		1 piece.

Amounting to	14s. 6d.
43 bottles (various), to contain the above chemicals and preparations,	7s. 6d.
Set of 32 specimens in 1-oz. specimen bottles,	7s. 0d.

Continued on page 430.

LIST OF SPECIMENS.

Aluminum.
Tin.
Lead.
Silver.
Bar Iron.
Cast Iron.
Steel.
Galvanised Iron.
Iron Ore.
Iron Oxide.
Iron Sulphate.
Bronze.
Brass.
Tin Stone.
Galena.
Zinc blende.
White Sand.
Red Sand.
Flint.
Quartz.
Graphite.
Rock Salt.
Sodium Sulphate.
Sodium Nitrate.
Bone Ash.
Limestone.
Magnesium Sulphate.
Potassium Carbonate.
Potassium Chlorate.
White Lead.
Red Lead.
Litharge.

Price of the complete Set in a Box, with Lock and Key, £5, 10s. nett.

GROUP III.—*Collections of Apparatus used by Candidates for Certificates when undergoing their Examinations in Practical Chemistry.*

4793. OXFORD LOCAL EXAMINATION. CANDIDATES in CHEMISTRY must provide themselves with the following APPARATUS for the PRACTICAL EXAMINATION. *Price of the Set, in a packing-case,* 14s. 6d.

4794. This Apparatus can also be supplied in a smooth box, having a lid with hinges and a padlock, price 17s.

CONTENTS.

Six Glass Funnels, 2 inch.
25 Cut Filters for ditto.
24 Test Tubes, 6 by ⅝ inch.
Frame for 24 Test Tubes.
Two Glass Stirrers, 9 inch.
Three Porcelain Basins, 2¾ in.
Retort Stand, Ring, & Triangle.
Spirit Lamp, 3 oz., and wick.
Bottle, with 5 oz. spirit.
Washing Bottle, pint, 2 tubes.
Blowpipe.
Platinum Foil, 2 by 1 inch.
Platinum Wire, 3 inch.
3 Sticks of Charcoal.
3 Closed Tubes, 4 by ½ inch.
Penknife.
Cloth.
Test Tube Brush.

4795. CAMBRIDGE LOCAL EXAMINATION. CANDIDATES in PRACTICAL CHEMISTRY must provide themselves with the following APPARATUS for the EXAMINATION. *Price of the Set, in a packing-case,* 12s.

4796. The same Apparatus in a smooth box, having a lid with hinges and a padlock, price 14s. 6d.

CONTENTS.

Six Funnels, 2 inch.
25 Cut Filters to fit ditto.
24 Test Tubes, 6 by ⅝ inch.
Test Tube Frame, 24 holes.
Two Glass Stirrers, 9 inch.
Porcelain Basin, 3½ inch.
Washing Bottle, pint, 2 tubes.
Three Test Tubes, 4 by ½ inch.
Spirit Lamp, 3 oz., and wick.
5 oz. spirit in a bottle.
Lamp Cylinder, 6 inch.
Iron Top for Cylinder.
Blowpipe.
Platinum Blowpipe Wire, 3 in.
Platinum Blowpipe Foil, 2 by ¾ inch.
Penknife.
Three Sticks of Charcoal.

4796A. REAGENTS to be provided by each CANDIDATE in PRACTICAL CHEMISTRY for the CAMBRIDGE LOCAL EXAMINATION.

The Liquids are of the strength described at page 280. In two-ounce white glass stoppered bottles. *Price of the set, in a smooth deal box with sliding cover,* 16s.

No.		D.
2449.	Ammonium, Carbonate,	7
2450.	„ Caustic,	6
2451.	„ Chloride,	6
2453.	„ Oxalate,	8
2454.	„ Sulphide,	10
2462.	Barium, Chloride,	6
2471.	Calcium, Hydrate,	6
2496.	Hydrochloric Acid,	7
2514.	Magnesium, Sulphate,	6
2522.	Nitric Acid,	8
2536.	Potassium, Hydrate,	9
2535.	„ Ferrocyanide,	7

No.		S.	D.
2550.	Silver, Nitrate,	1	2
2561.	Sodium, Phosphate,		6
2571.	Sulphuric Acid,		7
	Tartaric Acid,		9
	DRY TESTS:—		
2650.	Borax,		11
2652.	Sodium, Carbonate,		10
2640.	Iron Sulphide,		7
	Bottle for Sulph. Hydrogen Gas,	1	0
	Box containing Rods of Copper and Zinc, books of Litmus and Starch Paper,	1	0

GROUP IV.—*Collections of Chemical Reagents in Solutions, of the Systematic Degrees of Strength described at page* 278, Nos. 4809 *to* 4821.

4809. COLLECTIONS OF CHEMICAL TESTS IN SOLUTION, of the DEGREES OF STRENGTH described in the Section commencing at page 278.

The following assortments are given merely as examples. Collections containing any number and any size of Bottles can be made at pleasure, according to the Tariff given in the Table at page 280. Supplies of LARGER QUANTITIES of these Solutions, such as 80 ounce Winchesters, prepared to order.

4810. COLLECTION OF FORTY BOTTLES OF REAGENTS, 2 ounce size, namely thirty-three narrow-mouthed bottles with Solutions, and seven wide-mouthed bottles with Solids. Particulars as given in the following list. Price, with common bottles, Fig. 1550, page 279, and Fig. 1576, page 284, 28s. 6d.

4811. The same Collection in the best bottles, Fig. 1551, page 279, and Fig. 1577, page 284. Price 44s.

		S.	D.			S.	D.
2447.	Acetic Acid, ...	1	0	2523.	Oxalic Acid, ...		7
2449.	Ammon. Carbonate, . .		7	2531.	Potassium, Bichromate, . .		7
2450.	Ammonia, ...		6	2532.	,, Chromate, . .		7
2451.	Ammon. Chloride, . . .		6	2534.	,, Ferridcyanide, .		8
2452.	,, Molybdate, . .		7	2535.	,, Ferrocyanide, . .		7
2454.	,, Sulphide, . . .		10	2536.	,, Hydrate, . . .		9
2462.	Barium, Chloride, . . .		6	2537.	,, Iodide, . . .		11
2464.	,, Nitrate, . . .		6	2540.	,, Sulphocyanide, .		8
2470.	Calcium, Chloride, . . .		6	2550.	Silver, Nitrate, . . .	1	2
2471.	,, Hydrate, . . .		6	2558.	Sodium, Carbonate, . .		7
2473.	,, Sulphate, . . .		6	2571.	Sulphuric Acid, . . .		7
2477.	Copper, Sulphate, . . .		6	2572.	,, concentrated, . .		9
2496.	Hydrochloric Acid, . . .		7		DRY TESTS:—		
2499.	Ferric Chloride, . . .		8	2602.	Ammon. Sesquicarbonate, .		10
2501.	Ferrous Sulphate, . . .		7	2615.	Lime, Chloride, . . .		8
2505.	Indigo, Sulphate, . . .		6	2616.	Litmus, ...	1	1
2511.	Lead, Nitrate, . . .		6	2631.	Tartaric Acid crystals, . .	1	7
2516.	Mercuric Chloride, . . .		8	2655.	Potassium, Bisulphate, . .	1	1
2517.	Mercurous Nitrate, . . .		7	2629.	Sodium, Sulphide, . . .	1	8
2518.	Mercuric Potassium-iodide, .		11	2641.	Manganese, Peroxide, . .		6
2522.	Nitric Acid, ...		8				

4812. COLLECTION OF SIXTY BOTTLES OF REAGENTS, of 2 ounce size, comprising forty-five bottles with Liquids and fifteen bottles with Solids. Particulars below.

4812. Price of the sixty bottles of the common form, £2, 10s.

4813. Price of the sixty bottles of the best form, £3, 13s. 6d.

		S.	D.			S.	D.
2447.	Acetic Acid, ...	1	0	2483.	Ether, Sulphuric, . . .	1	3
2448.	Alcohol, ...	1	1	2496.	Hydrochloric Acid, . .		7
2449.	Ammon. Carbonate, . .		7	2497.	Hydrofluosilicic Acid, . .		10
2450.	Ammonia, ...		6	2498.	Hydrosulphuric Acid, . .		7
2451.	Ammon. Chloride, . . .		6	2499.	Ferric Chloride, . . .		8
2452.	,, Molybdate, . .		7	2501.	Ferrous Sulphate, . . .		7
2453.	,, Oxalate, . . .		8	2505.	Indigo, Sulphate, . . .		6
2454.	,, Sulphide, . . .		10	2510.	Lead, Acetate, . . .		6
2462.	Barium, Chloride, . . .		6	2511.	Lead, Nitrate, . . .		6
2463.	,, Hydrate, . . .		6	2514.	Magnesian Sulphate, . .		6
2464.	,, Nitrate, . . .		6	2516.	Mercuric Chloride, . . .		8
2470.	Calcium, Chloride, . . .		6	2517.	Mercurous Nitrate, . .		7
2471.	,, Hydrate, . . .		6	2518.	Mercuric Potassium-iodide, .		11
2473.	,, Sulphate, . . .		6	2522.	Nitric Acid, ...		8
2475.	Chlorine Water, . . .		6	2523.	Oxalic Acid, ...		7
2476.	Cobalt, Nitrate, . . .	1	9	2531.	Potassium, Bichromate, . .		7
2477.	Copper, Sulphate, . . .		6	2532.	,, Chromate, . .		7

4812. COLLECTION OF SIXTY BOTTLES OF REAGENTS—*Continued.*

		s.	d.
2534.	Potassium, Ferridcyanide		8
2535.	,, Ferrocyanide		7
2536.	,, Hydrate		9
2537.	,, Iodide		11
2540.	,, Sulphocyanide		8
2550.	Silver, Nitrate	1	2
2558.	Sodium, Carbonate		7
2561.	Sodium, Phosphate		6
2571.	Sulphuric Acid		7
2572.	,, concentrated		9
2576.	Stannous Chloride		8
	DRY TESTS.		
2602.	Ammon. Sesquicarbonate		10

		s.	d.
2606.	Barium, Carbonate	1	11
2615.	Lime, Chloride		8
2616.	Litmus	1	1
2621.	Potassium, Bichromate	1	8
2629.	Sodium, Sulphide	1	8
2631.	Tartaric Acid crystals	1	7
2633.	Zinc in rods	2	6
2641.	Manganese, Peroxide		6
2650.	Borax		11
2651.	Microcosmic Salt	1	6
2652.	Sodium, Carbonate		10
2653.	Potassium, Cyanide	1	10
2655.	,, Bisulphate	1	1
2656.	,, Nitrate	1	0

4814. COLLECTION OF SIXTY BOTTLES OF REAGENTS, comprising 45 bottles of 4 ounce size for Solutions and 15 bottles of 2 ounce size for Dry Reagents. Particulars given below.

4814. Price of the 60 bottles of the common form, £3, 4s.

4815. Price of the 60 bottles of the best form, £4, 12s.

		s.	d.
2447.	Acetic Acid	1	4
2448.	Alcohol	1	10
2449.	Ammon. Carbonate		10
2450.	Ammonia		8
2451.	Ammon. Chloride		8
2452.	,, Molybdate		10
2453.	,, Oxalate	1	0
2454.	,, Sulphide	1	4
2462.	Barium, Chloride		8
2463.	,, Hydrate		8
2464.	,, Nitrate		8
2470.	Calcium, Chloride		8
2471.	,, Hydrate		7
2473.	,, Sulphate		8
2475.	Chlorine Water		8
2476.	Cobalt, Nitrate	3	2
2477.	Copper, Sulphate		8
2483.	Ether, Sulphuric	2	2
2496.	Hydrochloric Acid		10
2497.	Hydrofluosilicic Acid	1	4
2498.	Hydrosulphuric Acid		10
2499.	Ferric Chloride		11
2501.	Ferrous Sulphate		9
2505.	Indigo, Sulphate		8
2510.	Lead, Acetate		8
2511.	Lead, Nitrate		8
2514.	Magnesium, Sulphate		8
2516.	Mercuric Chloride	1	0
2517.	Mercurous Nitrate		10
2518.	Mercuric Potassium-Iodide	1	6
2522.	Nitric Acid	1	0

		s.	d.
2523.	Oxalic Acid		10
2531.	Potassium, Bichromate		10
2532.	,, Chromate		10
2534.	,, Ferridcyanide	1	0
2535.	,, Ferrocyanide		10
2536.	,, Hydrate	1	2
2537.	,, Iodide	1	6
2540.	,, Sulphocyanide		11
2550.	Silver, Nitrate	2	0
2558.	Sodium, Carbonate		10
2561.	,, Phosphate		8
2571.	Sulphuric Acid		10
2572.	,, concentrated	1	2
2576.	Stannous Chloride		11
	DRY REAGENTS.		
2602.	Ammon. Sesquicarbonate		10
2606.	Barium, Carbonate	1	11
2615.	Lime, Chloride		8
2616.	Litmus	1	1
2621.	Potassium, Bichromate	1	8
2629.	Sodium, Sulphide	1	8
2631.	Tartaric Acid crystals	1	7
2633.	Zinc in rods	2	6
2641.	Manganese, Peroxide		6
2650.	Borax		11
2651.	Microcosmic Salt	1	6
2652.	Sodium, Carbonate		10
2653.	Potassium, Cyanide	1	10
2655.	,, Bisulphate	1	1
2656.	,, Nitrate	1	0

4816. COLLECTION OF FORTY BOTTLES OF REAGENTS, the same selection as No. 4810, but in bottles of THREE-OUNCE size:—

4816. Price of the 40 bottles of the common form, 36s.

4817. Price of the 40 bottles of the best form, 56s.

4818. Collection of Ninety-three Bottles of Reagents, comprising 61 bottles for Solutions; of which 17 are of 2 ounce, 29 of 6 ounce, and 15 of 10 ounce size; also 32 bottles for Dry Reagents, of which 12 are of 2 ounce, 14 of 6 ounce, and 6 of 10 ounce size. Particulars given below, where the number that follows each name indicates the size of the bottle.
4818. Price of the 93 bottles of the common form, £7, 12s.
4819. Price of the 93 bottles of the best form, £10.
4820. Collection of Eighty-seven Bottles of Reagents. This is the same Collection as the above, with the omission of 4 bottles containing Alcohol, Ether, Gold Chloride, and Platinic Chloride.
4820. Price of the 87 bottles of the common form, £6, 9s.
4821. Price of the 87 bottles of the best form, £8, 14s. 6d.

		oz.	s.	d.
2447.	Acetic Acid	6	1	9
2448.	Alcohol	10	4	0
2449.	Ammon. Carbonate	10	1	6
2450.	Ammonia	10	1	1
2451.	Ammon. Chloride	6		9
2452.	,, Molybdate	2		7
2453.	,, Oxalate	6	1	3
2454.	,, Sulphide	10	2	9
2461.	Barium, Acetate	2		9
2462.	,, Chloride	6		9
2463.	,, Hydrate	2		6
2464.	,, Nitrate	6		9
2470.	Calcium, Chloride	6		9
2471.	,, Hydrate	6		8
2472.	,, Nitrate	2		8
2473.	,, Sulphate	6		9
2475.	Chlorine Water	6		9
2476.	Cobalt, Nitrate	2	1	9
2477.	Copper, Sulphate	6		9
2483.	Ether, Sulphuric	10	4	9
2491.	Gold, Terchloride	2	8	5
2496.	Hydrochloric Acid	10	1	6
2497.	Hydrofluosilicic Acid	6	1	9
2498.	Hydrosulphuric Acid	10	1	6
2499.	Ferric Chloride	6	1	2
2500.	Ferric Sulphate	2		6
2501.	Ferrous Sulphate	6		11
2505.	Indigo, Sulphate	2	2	6
2510.	Lead, Acetate	6		9
2511.	Lead, Nitrate	2		6
2514.	Magnesium, Sulphate	6		9
2516.	Mercuric Chloride	6	1	3
2517.	Mercurous Nitrate	6	1	0
2518.	Mercuric Potassium-Iodide	6	2	0
2522.	Nitric Acid	10	1	11
2523.	Oxalic Acid	10	1	6
2527.	Platinic Chloride	2	6	5
2529.	Potassium, Bicarbonate	6	1	0
2530.	,, Carbonate	10	2	4
2531.	,, Bichromate	6	1	0
2532.	,, Chromate	6	1	0
2533.	,, Cyanide	2		11
2534.	,, Ferridcyanide	6	1	3
2535.	,, Ferrocyanide	6	1	0
2536.	,, Hydrate	10	2	4
2537.	,, Iodide	6	2	0
2539.	,, Sulphate	2		6
2540.	,, Sulphocyanide	2		8
2550.	Silver, Nitrate	6	2	9
2555.	Sodium, Acetate	2		6
2557.	Sodium, Bitartrate	2		8
2558.	,, Carbonate	10	1	6
2559.	,, Chloride	6		9
2560.	,, Hydrate	10	1	11
2561.	,, Phosphate	6		9
2562.	,, Sulphate	2		6
2563.	,, Sulphide	6	1	0
2571.	Sulphuric Acid	10	1	6
2572.	,, ,, concentrated,	10	2	4
2576.	Stannous Chloride	2		8
2577.	Starch	6		9

DRY REAGENTS.

		oz.	s.	d.
2602.	Ammon. Sesquicarbonate	6	1	7
2606.	Barium, Carbonate	2	1	11
2607.	,, Hydrate	2	2	0
2612.	Gall Nuts	2		9
2613.	Ferrous Sulphate	6	2	1
2615.	Lime, Chloride	6	1	0
2616.	Litmus	2	1	1
2617.	Oxalic Acid	6	2	8
2619.	Potass. Hydrate	6	2	5
2620.	,, ,, pure	6	4	6
2621.	,, Bichromate	2	1	8
2625.	Sodium, Hydrate	6	2	5
2626.	,, ,, pure	6	4	6
2627.	,, Chloride	6	1	9
2629.	,, Sulphide	6	3	6
2631.	Tartaric Acid	6	3	3
2632.	Tin, Protochloride	2	1	6
2633.	Zinc in rods	2	2	6

FOR GASES.

		oz.	s.	d.
2640.	Iron, Sulphide	10	1	7
2641.	Manganese, Peroxide	10	1	1
2642.	Potass. Chlorate	10	2	1
2643.	Zinc, Granulated	10	1	4
2644.	Marble	10	2	0
2645.	Fluor spar	10	1	5

BLOWPIPE TESTS.

		oz.	s.	d.
2650.	Borax	6	1	8
2651.	Microcosmic Salt	2	1	6
2652.	Sodium, Carbonate	6	1	6
2653.	Potassium, Cyanide	2	1	10
2655.	,, Bisulphate	6	2	0
2656.	,, Nitrate	2	1	0
2658.	Boracic Acid, fused	2	1	9
2659.	Gypsum crystals	2	1	9

GROUP V.—*Collections of Instruments for performing Qualitative Chemical Analysis, Nos.* 4826 *to* 4837.

4826. INSTRUMENTS required for QUALITATIVE CHEMICAL ANALYSIS.

This list is made tolerably complete, in order that those who require sets of apparatus for special purposes may see the whole before them, and be enabled easily to select such instruments as may seem suited for their projected researches. Blowpipe apparatus is left out, it being supposed that one of the sets described at page 390, may be adopted. Arsenic apparatus is omitted, having been fully described at page 410.

4826. Price of the following Collection of Apparatus, £7, 1s.
4827. Price of the Blowpipe Apparatus, No. 4523, £3, 13s. 6d.
4828. The Combined Collection, £10, 14s. 6d.
4829. Price of the following Collection, without the Platinum Crucible and Spatula, £4, 13s.

For REAGENTS *to accompany this* APPARATUS, *consult* pp. 431–433.

Where coal gas is available for fuel, the Spirit Lamps may be exchanged for the Rose gas burners, Nos. 1 and 2, as described at pages 90–92, which will cause a small variation in the price of the collection.

		s.	d.
62.	Porcelain Mortar, 4 inch, . .	1	0
860.	Spirit Lamp, with rack, . .	2	6
861.	Plaited Cotton Wick, . .		6
132.	Tongs for Lamp, . . .		4
870.	Argand Spirit Lamp, . .	20	0
880.	Wicks for ditto, 12, . . .		8
288.	Retort Stand, 3 rings, . .	2	3
1191.	Lamp Furnace Cylinder, . .		8
1194.	Two Iron Ring tops, . .		4
1195.	Two Hot Plates, . . .		2
1196.	Iron Trellis top, . . .		2
1197.	Sand Bath, 5 inch, . . .		4
1200.	Water Bath, ...		8
1201.	Support for 7 tubes, . . .		6
1323.	Porcelain Crucible, 1¾ inch, .		9
1323.	,, ,, 2¼ inch, .	1	0
1333.	,, ,, Plattner's (2),	1	0
1320.	Platinum Crucible and Cover, No. 3, ...	30	0
96.	Platinum Spatula, . . .	18	0
121.	Crucible Tongs, . . .	1	6
1800.	Porcelain Cups, 12, . . .	2	6
1400.	German Flasks, 1, 2, and 3 oz.,		6
1400.	,, ,, 4, 6, and 8 oz.,		9
1445.	Set of 6 Beakers, . . .	2	3
1482.	Set of 6 Griffin's Beakers, .	4	0
1806.	Plain Retorts, 4 ounce, 2, .		6
1809.	Stoppered Retorts, 4 ounce, 2, .	1	4
1847.	Stoppered Receiver, 4 ounce, .		8
1405.	Plain Receiver, 4 ounce, 2, .		5
1815.	Clark's Retort and Receiver, 2,	2	0
315.	Clamp to support Retorts, .	3	0
	Wood Block support for Receivers,		9
1415.	Curved Flask for solutions, .	1	6
1626.	Glass Funnels, 2, 2¼, and 3 in.,		8
1626.	Cut Filters, 100 for each, . .	1	1
1626.	Box to hold Filters, . . .		10

		s.	d.
343.	Funnel Holder, 2 arms, . .	2	2
1610.	Filter Ring, 2 arms, ...		5
1611.	,, 3 arms, ...		10
1677.	Round Glass Cover, 3½ inch, 3,		4
4466.	Griffin's Quick Filter, . .		3
115.	Glass Stirrers, 3 inch, 12, . .		2
115.	,, 6 and 9 in., 6 each,		6
1743.	Porcelain Basin, 2¾ inch, . .		4
1743.	,, ,, 3½ ,, . .		9
1743.	,, ,, 4 ,, . .	1	0
1743.	,, ,, 6 ,, . .	2	0
1785.	Watch Glass, 2 inch, 6, . .		6
1786.	,, 2½ inch, 2, . .		6
1790.	Capsule and handle, 2, . .		6
403.	Holder for hot Watch Glasses, .		6
2410.	Conical Test Glass, 2 inch, 6, .	1	6
2411.	,, ,, 1 ,, 6, .		8
4468.	Decanting Tubes, 3, . . .		6
1690.	Plain Pipettes, 3, . . .		4
1691.	Bulb Pipettes, 3, . . .		9
2400.	Test Tubes, 6 × ⅝ inch, 12, .		9
2400.	,, 6 × 1 ,, 4, .		6
2400.	,, 8 × 1¼ ,, 3, .		6
380.	Test Tube Frame, 24 holes, .	5	0
4459.	Spring Holder for hot Tubes, .		10
1719.	Washing Bottle, 1 jet, . .	1	0
1725.	,, ,, 2 tubes, . .	1	6
4472.	,, ,, Schuster's, .	1	0
158.	Tube Brush, 2 sizes, . .		5
1616.	Slips of Glass, 4, 6 inch, 6 each,		4
2426.	Box of Test Papers, . . .	1	0
2436.	Box of Test Metals, . . .	1	0
1996.	Bottle for HS Gas, . . .	2	0
2439.	Porcelain Testing Slab, . .	1	9
4509.	Square Plate of Blue Glass, .		4
4510.	Glass Prism with Indigo Solution,	3	0
232.	Open Glass Tubes, 18 in., ½ lb.,		7

4830. **Elementary set of Instruments for QUALITATIVE CHEMICAL ANALYSIS.**

Price of the Collection, 40s.

This set requires the addition of Blowpipe Apparatus, such as the set No. 4521, price 10s. 6d.; or the set No. 4522, price 21s. Also, a set of Liquid Tests, such as No. 4810, price 28s. 6d.; No. 4816, price 36s.; or No. 4812, price 50s.

		S.	D.
62.	Porcelain Mortar, 2½ inch,		7
851.	Glass Spirit Lamp, 3 oz.,	1	0
864.	Cotton Wick for Lamp,		2
132.	Tongs to trim Lamp,		4
288.	Retort Stand, 3 rings,	2	3
1191.	Lamp Furnace Cylinder,		8
1194.	Ring tops, a pair,		4
1195.	Hot plates, a pair,		2
1196.	Iron Trellis top,		2
1197.	Sand Bath, 5 inch,		4
1200.	Water Bath,		8
1201.	Support for Tubes on sand,		6
1323.	Porcelain Crucible, 1¾ inch,		9
1333.	,, ,, Plattner's,		6
121.	Crucible Tongs,	1	6
1800.	Porcelain Cups, *six*,	1	3
1400.	Glass Flasks, 2, 4, and 6 oz.,		7
1464.	Set of 5 Beakers,	2	0
1806.	Plain Retort, 4 oz.,		3
1809.	Stoppered Retort, 4 oz.,		8
1405.	Plain Receiver, 4 oz.,		3
1815.	Clark's Retort and Receiver,	1	0
1626.	Glass Funnel, 2, 2½, and 3 inch,		8
1626.	Cut Filters, 100 for each funnel,	1	1
1626.	Box to hold the filters,		10
342.	Funnel Holder,	1	4
	Open Glass Tubes, six assorted,		4
1610.	Filter Ring, 2 arms,		5
4466.	Griffin's Quick Filter,		3
115.	Glass Stirrers, 3 inch, 12,		2
115.	,, 6 and 9 in., 6 each,		6
1768.	Porcelain Basins, set of 6,	2	3
1785.	Watch Glasses, 2 inch, 2,		2
403.	Holder for hot Watch Glasses,		6
1790.	Capsule and handle,		6
2411.	Conical Test Glass, 6,		8
4468.	Decanting Tubes, 3,		6
1690.	Plain Pipettes, 2,		4
1691.	Bulb Pipette,		4
2400.	Test Tubes, 6 × ⅝ inch, 12,		9
2400.	,, 6 × 1 inch. 2,		3
360.	Test Tube Frame, 12 holes,	1	4
386.	Holder for hot Test Tubes,		6
158.	Test Tube Brush,		3
4472.	Washing Bottle,	1	0
1725.	,, ,, two tubes,	1	6
1616.	Slips of Glass, 4 and 6 in., 6 each,		4
2426.	Box of Test Papers,	1	0
2436.	Box of Test Metals,	1	0
1994.	Bottle for HS Gas,	1	0
4509.	Plate of Blue Glass,		4
4510.	Indigo Prism,	3	0
2440.	Porcelain Testing Slab,	1	2

		£	s.	d.
4831.	Price of the above collection of Apparatus,	£2	0	0
	,, ,, Blowpipe Apparatus, No. 4522,	1	1	0
	,, ,, Forty Bottles of Reagents, No. 4810,	1	8	6
	,, ,, Combined Collection,	4	9	6

4832. Price of a similar collection, but with the set of Sixty Bottles of Reagents, No. 4812, £5, 11s.

4833. CABINET of APPARATUS and REAGENTS for QUALITATIVE CHEMICAL ANALYSIS: comprehending the collection of Apparatus, No. 4830; the forty bottles of Pure Tests, No. 4810; and the Blowpipe Apparatus, No. 4522. The whole in a divided Mahogany Cabinet, price £7, 7s.

4834. Similar Cabinet to No. 4833, but with the forty bottles, No. 4816, instead of No. 4810, the rest as above, price £7, 17s. 6d.

4835. MAHOGANY CABINETS, containing any other combination of Instruments with sets of Reagents, PREPARED TO ORDER. Generally speaking, the cost of a divided Mahogany Cabinet to contain a collection of Analytical Apparatus and Tests is *about half the cost* of the Apparatus and Tests.

4836. "QUALITATIVE CHEMICAL ANALYSIS AND LABORATORY PRACTICE." By THORPE AND MUIR.

The Apparatus requisite for the performance of the Course directed in the above work, ...	£3 15
The Reagents in bottles, ...	5 5
The Complete Set, ...	£9 0

4837. EXERCISES IN PRACTICAL CHEMISTRY. By A. G. VERNON HARCOURT, F.R.S., and H. G. MADAN, F.C.S.

The Apparatus described in the above named volume consists of some 80 pieces, and costs	£9
The Reagents number 120, and cost	4
The Complete Set, ...	£13

GROUP VI.—*Collections of Analytical Apparatus arranged for special purposes, Nos.* 4839 *to* 4846.

4839. TOXICOLOGICAL CABINET; containing the most important CHEMICAL INSTRUMENTS and TESTS required in TESTING for POISONS. In a divided mahogany cabinet, measuring 19 inches in length, 15 inches in width, and 10 inches in depth. Price £4, 14s. 6d.

4840. The APPARATUS AND TESTS, complete, but without the mahogany cabinet. Price £3, 3s.

CONTENTS.

62. Porcelain Mortar, No. 00.
851. Glass Spirit Lamp, 3 oz.
863. Cotton Wick for Lamp.
289. Retort Stand, 1 ring.
4201. Blowpipe.
4321. Charcoal Blowpipe Pastilles, 24.
4320. Porcelain Crucibles, for ditto, 2.
4321*a*. Wire Handles for ditto, 2.
4376. Box of 15 Arsenic Tubes.
4409. Albata Test Spoon.
1464. Set of 5 Beaker Glasses.
1442. Set of 3 Beaker Glasses.
1400. German Flask, 3 oz.
2400. Test Tubes, 4 × ½ inch, 12.
2400. Test Tubes, 4 × 1 inch, 3.
359. Test Tube Frame, 6 holes.
387. Holder for hot Test Tubes.
1785. Watch Glasses, 4.
403. Holder for Watch Glasses.
1419. Bulb Flask, No. 11.
2410. Clark's Conical Test Glass.
4700. Marsh's Arsenic Apparatus.
1994. Sulphuretted Hydrogen bottle.
1815. Clark's Retort and Receiver.
2426. Box of Test Papers.
115. Glass Stirrers, 3 and 6 inch.
1690. Glass Pipette, 6 inch, straight.
1626. Glass Funnel, 1½ inch.
Cut Filters for ditto, 100.
Glass Funnel, 2½ inch.
Cut Filters for ditto, 100.
1610*a*. Porcelain Filter Ring, 2 arms.
1323. Porcelain Crucible, 1½ inch.
,, ,, 1¾ inch.
1743. ,, Basin, 2¾ inch.
,, ,, 3½ inch.
1800. ,, Cups, 8 assorted.
477. Graduated Measure, 1 oz.
236. Glass Tubes, open, ¼ lb.

STOPPERED GLASS BOTTLES FOR TESTS.

6 Narrow mouthed for Liquids, 4 oz.
7 ,, ,, 2 oz.
8 ,, ,, 1 oz.
14 Wide mouthed for Solids, 1 oz.

Containing the following CHEMICALS:—

Ammon. Carbonate.
,, Oxalate.
,, Sulphide.
Barium, Chloride.
,, Nitrate.
Charcoal powder.
Copper, pure foil.
,, Sulphate.
Ferric Chloride.
Ferrous Sulphide.
,, Sulphate.
Galls, Tincture.
Gold, Chloride.
Flux, black.
Indigo, Sulphate.
Lead, Acetate.
Mercuric Chloride.
Platinic Chloride.
Potassium, Bichromate.
,, Carbonate.
,, Cyanide.
,, Ferridcyanide.
Potassium, Ferrocyanide.
,, Hydrate.
,, Iodide.
,, Nitrate.
Silver, Nitrate.
Sodium, Carbonate.
,, Phosphate.
Tartaric Acid.
Tin, Chloride.
Zinc, free from Arsenic.

LABELLED BOTTLES to contain Acids and Alkalies. MAHOGANY CABINET.

4841. **HOSPITAL LABORATORY, CHEMICAL CABINET** for **MEDICAL MEN,** containing a careful selection of CHEMICAL APPARATUS and PURE TESTS suitable for such chemical processes of TESTING as commonly have to be performed by PHYSICIANS in HOSPITALS, or in private practice; such as testing for poisons, examination of blood or urine, testing for adulterations, investigation of the purity of medicines, &c. The instruments are of the best quality, but of small size, arranged in a divided mahogany cabinet with drawers and trays, so as to be always convenient for use. Size of the cabinet, 24½ inches in length, 18 inches in width, and 12½ inches in depth. Price £10, 10s.

4842. The APPARATUS AND TESTS, without the Platinum Crucible, and the Mahogany Cabinet. Price £6, 6s.

CONTENTS.

62. Porcelain Mortar, No. 0.
99. Steel Spatula, with handle, 4 inch.
437. Balance with grain weights.
477. Graduated Measure, 1 ounce.
851. Glass Spirit Lamp, 4 ounce.
864. Cotton Wick for Lamp.
1191. Stoneware Lamp Cylinder.
1197. Sand Bath for ditto, 5 inch.
1201. Support for Tubes on Sand.
1196. Trellis top for furnace.
1194. Ring top for furnace, 2.
1200. Water Bath for furnace.
287. Retort Stand, 3 brass rings.
4204. Brass Blowpipe.
4232. Blowpipe Lamp.
4241. Brass Stand for Lamp.
4321. Charcoal Blowpipe Supports, 72.
4320. Porcelain Crucible for ditto, 2.
4321*a*. Wires to hold ditto, 2.
4270. Platinum Blowpipe Wires, 3.
4277. Platinum Blowpipe Foils, 2.
1741. Platinum Capsule, ½ inch.
1741. ,, ,, ¾ inch.
1320. Platinum Crucible, 1 inch, no cover.
Fine Copper Wire, 1 yard.
92. Iron Spoons, 2.
4283. Spring Steel Tongs for ditto.
4282. Platinum Blowpipe Tongs.
135. Iron Tongs with Spoon handle.
132. Brass Tongs to trim Lamp.
2438. Albata Test Spoon.
4397. Blowpipe Anvil.
4395. Blowpipe Hammer.
3265. Bulb Tube for Hydrates, 4.
1400. Glass Flasks, 3 and 4 oz.
1400. ,, ,, 6 and 8 oz.
1419. Bulb Boiling Tubes.
1482. Set of 6 Beaker tumblers.
1465. Set of 5 Beaker glasses.
1786. Watch Glasses, 3 inch, 2.
2784. ,, ,, 2½ inch, 2.
403. Holder for Watch Glasses.
1306. Watch Glass Springs, 2.
2400. Test Tubes, 5 × ⅝ inch, 12.
2400. Test Tubes, 3 × ⅜ inch, 6.
,, 4 × ¾ inch, 6.
359. Test Tube Frame, 6 holes.
387. Holder for Hot Test Tubes.
2408. Nest of 9 Test Tubes, in case.
1800. Porcelain Cups, 12 assorted.
2410. Clark's Test Glass, Conical, 5.
115. Glass Stirrers, 3 inch, 6.
115. ,, ,, 6 inch, 6.
1690. Glass Pipettes, plain, 6 each.
1691. ,, ,, 1 bulb, 1 bent.
232. Open Glass Tubes, ¼ lb.
1626. Glass Funnels, 1½, 2, and 2½ inch.
Cut Filters for ditto, 100 each.
Glass Funnel, 3 inch.
1610*a*. Porcelain Filter Ring, 2 arms.
1611. ,, ,, 3 arms.
1626. Cut Filters, 1 and 1¼ inch for ditto.
342. Funnel Holder, black wood.
1677. Round Glass Covers, 3 inch, 3.
1723. Washing Bottle, ½ pint.
2436. Box of Test Metals.
2427. Box of Litmus Test Papers.
1800. Porcelain White Testing Plates, 2.
1740. Porcelain Evaporating Basins, 2¾ inch, 3¼ inch, 3½ inch, 3¾ inch, 4 inch, 4½ inch, 4¾ inch, 6 inch, *diameter*.
1323. Porcelain Crucibles with Covers, 1¼ inch, 1½ inch, 1¾ inch, 2¼ inch, 2½ inch, *diameter*.
4700. Marsh's Arsenic Apparatus.
4376. Box of 15 Arsenic Tubes.
1996. Clark's HS Gas Bottle.
1815. Clark's Retort and Receiver.
1809. Stoppered Retort, 4 oz.
1968. Small Gas Bottle, 2 necks fitted.

STOPPERED GLASS BOTTLES FOR TESTS:—

8	Narrow Mouthed for Liquids,		1 oz.
14	,,	,,	3 oz.
3	,,	,,	4 oz.
6	,,	,,	7 oz.
16	Wide Mouthed for Solids,		½ oz.
7	,,	,,	3 oz.

4841. HOSPITAL LABORATORY—*continued.*

Containing the following CHEMICALS :—

Acetic Acid.
Ammon. Carbonate.
„ Chloride.
„ Oxalate.
„ Sulphide.
Barium, Chloride.
„ Nitrate.
Calcium, Chloride.
„ Sulphate.
Charcoal Powder.
Cobalt, Nitrate.
Copper, pure foil.
„ Ammon. Sulphate.
„ Sulphate.
Ferric Chloride.
Ferrous Sulphide.
„ Sulphate.
Flux, black.
Indigo, Sulphate.
Lead, Acetate.
Manganese, Peroxide.
Mercuric Chloride.
Oxalic Acid.
Platinic Chloride.
Potassium, Bichromate.
„ Carbonate.
„ Cyanide.
„ Hydrate.
Potassium, Ferridcyanide.
„ Ferrocyanide.
„ Iodide.
„ Nitrate.
„ Sulphocyanide.
Silver, Nitrate.
„ Ammon. Nitrate.
Sodium, Carbonate.
„ Phosphate.
Tartaric Acid.
Tin, Chloride.
Zinc, Chloride.
Zinc, free from Arsenic.

The bottles to contain the Acids and Alkalies are labelled but not filled.

4843. CHEMICAL CABINET, containing sufficient APPARATUS and TESTS for the Chemical Examination of AIR, WATER, and FOOD, prepared according to the instructions of the late Dr. E. A. PARKES, author of a *Manual of Practical Hygiene.* Size of the divided Cabinet, 27 inches in length, 12½ inches in width, and 7 inches in depth, with lock and key, price £9, 5s.

4844. The SAME COLLECTION, without the balance, in a Cabinet measuring 23 inches in length, 11½ inches in width, and 6½ inches in depth, price £7, 7s.

CONTENTS AS FOLLOWS :—

Hydrometer, Scale ·950 to 1·200, brass, electro-gilt, in paper box.
2780. Flask to hold 50 C. Cubes.
429. Balance in Mahogany box. When loaded with 25 Grammes, it shows 1 Milligramme.
Gramme Weights, 5, 2, 1, 1 Gramme, brass, and ·5 Gramme to 1 Milligramme in platinum.
860. Spirit Lamp with rack.
2688. Mohr's Burette, 25 CC. in ⅕ CC.
2688. Mohr's Burette, 10 CC. in $\frac{1}{10}$ CC. 2 *copies.*
Jets for Burettes, 2 *extra.*
2799. Mixing Bottle, 6 oz. flat stopper.
Support for Burettes, &c., consisting of Brass rod, 2 clamps, jet holder, 3 rings, with screw to attach it to the Box.
1743. Porcelain Basin, 4¾ inch.
1239. Porcelain 4½ inch Water Bath.
1323. Porcelain Crucible, 2½ inch.
2875. Vogel's Milk Tester.
115. Stirrers, 6 and 9 inch, 2 each.
2400. Test Tubes, 6 × ⅝ inch, 6.
2423. Blue Litmus Paper, 6 books.
2423. Turmeric Paper, 6 books.
2426. Box of Test Papers.
1953. Vulcanised Rubber Tube:—
⅜ inch bore, 6 feet.
¼ inch bore, 2 feet.
1626. Box with 200 Filters, 3¾ inch.
1950. Vulcanised Rubber Caps, 1 inch wide, 2 necks, 4.
Stoppered Bottles, flint glass, 4 oz., 3.
Wide mouth Stoppered Bottles, 3 oz. 16.

THE FOLLOWING SOLID CHEMICALS:—

Potass. Ferridcyanide, 1½ oz.
„ Ferrocyanide, 2 oz.
„ Permanganate, 2 oz.
„ Chromate, 2 oz.
Ammon. Oxalate, 1 oz.
Copper, Sulphate, 2 oz.
Barium, Chloride, 2½ oz.
„ Nitrate, 3 oz.
„ Hydrate, 2 oz.
Silver, Nitrate, 2 oz.
Sodium, Phosphate, 2 oz.
„ Carbonate Anhyd., 2 oz.
Oxalic Acid, 1½ oz.
Iron, Sulphide, 6 oz.
„ Protosulphate, 2 oz.
Soft Soap, 2 oz.
Gold, Chloride, 54 grains.

4844A. **Dr. Parkes' Enlarged Cabinet, specially arranged for the ready replenishment of the Test Solution Bottles whilst travelling.**

Apparatus.

12 Bottles, ½-Litre, stoppered, green, with names of Tests and Instructions given on each bottle.
12 Specimen Bottles, ¼-oz., with stoppers.
19 Bottles, 4-oz., stoppered, of green glass, square form, labelled.
4 Bottles, 6-oz., flat headed stoppers, for shaking.
1 Bottle, 3-oz., with stopper and cap, engraved "Sulphuric Acid."
Spirit Lamp, brass.
Balance, to show a milligramme.
Weights, 20, 5, 5, 2, 1 grammes, and ·5 to 1 milligramme.
Retort Stand, with 2 brass rings and
2 Clamps for the Burettes.
2 Glass Flasks, 12 oz.
12 Test Tubes, 6 × ⅝.
No. 4 Filter Box and 200 Filters.
3 B.P. Crucibles, No. 2.
4 Caoutchouc Caps, 1 inch, with 2 necks.
2 B.P. Basins, 4½ inches.
1 ,, 6 ,,
6 Books each of Blue Litmus and Turmeric Test Papers, in a Box.
2 Brushes for cleaning Burettes.
2 Mohr's Burettes, 10 CC. in 100°, in cases.
1 Ditto, 25 CC. in 50, in case.
1 Spouted Jar, 100 CC. = 100°.
1 Urinometer, ivory scale, in leather case.
3 Glass Stirrers, 9 inch.
Glass Funnel, 3 inch, ribbed.
Thermometer, 212° Fahr.
4 Mohr's Pinchcocks, extra.
4 Burette Jets and Tubes, extra.
Vogel's Lactoscope.

Reagents.

½ litre of each of the following Standard Volumetric Solutions :—

Oxalic Acid.
Potash, Permanganate.
,, ,, and Hydrate.
Silver, Nitrate.
Soap Solution.
Baryta, Nitrate.
Nessler's Ammonia.
Ammonium, Chloride.
Lime Water.
Distilled Water, I.
,, ,, II.
Alcohol, "Spirit."

4 oz. of each of the following solutions :—

Potassium, Iodide.
,, Chromate.
Ammonium, Oxalate.
,, Molybdate.
Sulphuric Acid.
Hydrochloric Acid.
Nitric Acid.
Brucine.

The following Dry Reagents in 4 oz. Bottles :—

Potash, Red, Prussiate.
,, Yellow, Prussiate.
,, Permanganate.
Barium, Chloride.
,, Nitrate.
Silver, Nitrate.
Gold, Chloride.
Ammonium, Chloride.
,, Oxalate.
Oxalic Acid.
Soft Soap.

The following in quantities weighed and marked on each ¼ oz. Bottle :—

4 Bottles of Potash, Permanganate.
3 Barium, Nitrate.
3 Bottles of Oxalic Acid.
1 ,, Brucine.

The complete Collection, packed in a divided black deal cabinet, green baize lined, with lock and key, price £12, 12s.

4844B. **APPARATUS AND TESTS FOR THE USE OF MEDICAL OFFICERS OF HEALTH,** Selected by GEORGE WILSON, Esq., M.A., M.D. Edin., Medical Officer, H. M. Convict Prison, Portsmouth.

The following List is given in Dr. Wilson's "Handbook of Hygiene," *in which it is stated that for the convenience of Medical Officers of Health, the following price list of Apparatus and Reagents, mentioned in various parts of the work, has been supplied by Messrs. Griffin & Sons.*

The various articles are priced separately, so that purchasers may select such of them as they may require.

The Nos. on the left-hand column margin refer to those given in Messrs. Griffin and Sons' very useful Catalogue, known as "Chemical Handicraft."

I.—For the Examination of Air.

No.	Article	£	s.	d.
	Set of Gramme Weights—5, 2, 1, 1, to 1 milligramme,	1	1	0
429.	Balance, indicating 1 milligramme, . . .	1	15	0
2791, 8.	1 Litre Measure, graduated in CC.		8	0
1535,46.	4 Glass Jars, 5000 CC. each,	1	2	0
	8 Rubber Caps for do., 2 sets,	1	16	0
2795, 5.	Glass Jar, graduated 30 and 60 CC., ...		1	9
2688, 9.	Mohr's Burette, 50 CC. = 500°.		5	0
2694, *b*.	Support for ditto, mahogany,		5	0
4593.	Bellows with Rubber nose-pipe, to reach bottom of Jars,		4	6
2798, *c*.	2 Mixing Jars, 1 pint, .		2	0
115.	6 Glass Stirrers for ditto, .			6
	4 oz. Turmeric, in powder, .			6
1626, 6.	Box of Filter Paper, . .		1	9
	Glass Funnel, 4 inch, .			4
	4 oz. Oxalic Acid, cryst. pure,		1	4
	Calcium, Hydrate, 1 lb., .			10
	Mason's Wet and Dry bulb Thermometer, . .		9	0
	Rough Deal Case, . .		15	0
		£8	9	6

II.—For the Qualitative Examination of Water.

No.	Article	£	s.	d.
	Two Tall Colourless Glass Cylinders, 24 × 1 inch, .		10	0
1401.	Colourless Glass Flask, W.M., to hold about 1000 CC., .		1	0
1743.	Four Evaporating Basins, 4, 6, 8, and 16 oz., ...		4	5
1323.	Porcelain Crucible, 2¼ inch, .		1	0
2410.	Six Clark's Test Glasses, . .		1	6
2011.	H_2S Water Apparatus, . .		5	0
	The following Solutions in bottles of 2446B quality:—			
	6 oz. Sol. Potash, Caustic, .		2	1
	2 ,, Potash, Iodide, .		1	4
	2 ,, Potash, Permanganate,		1	4
	6 oz. Sol. Ammonium, Oxalate,		1	10
	6 ,, ,, Caustic, .		1	4
	2 ,, Gold, Chlorde, . .		8	5
	2 ,, Indigo, Sulphate, .			11
	6 ,, Barium, Nitrate, .		1	4
	6 ,, Silver, Nitrate, . .		3	4
	6 ,, Nessler's Test, . .		2	5
	6 ,, Acid, Acetic, . .		2	4
	6 ,, Acid, Nitric, dil, .		1	10
	6 ,, Acid, Sulphuric, .		2	1
	6 ,, Acid, Hydro, dil, .		1	7
	6 ,, Ferrous Sulphide, lump,			3
	2 ,, Ferrous Sulphate, .		1	7
	Packing Case, ...		6	0
		£3	2	11

III.—For the Examination of Milk.

No.	Article	s.	d.
620.	Lactometer, graduated to test approximately the percentage of Water, ...	3	0
2874.	Tall narrow Glass Vessel to test percentage of Cream, . .	2	0
		5	0

Mineral Acids.

These cannot be packed with other Chemicals and Apparatus for transport, either by Rail or Shipping.

It is necessary, therefore, to pack them in special cases, and forward them according to the special instructions of the Railway Managers.

Cost and Contents of Pint Bottles of Acid in a Case:—

Article	s.	d.
Pure Acid, Sulphuric, 1·845, 2½ lbs., .	2	0
,, Hydrochloric, 1·120, 1½ lb.,	1	4
,, Nitric, 1·180, 1¾ lb., . .	2	3
Coml. Acid, Sulphuric, 1·845, 2½ lbs.,	1	0
,, Hydrochloric, 1·60, 1½ lb.,		10
,, Ammonia, 0·880, 1¼ lb., .	1	5
Case, with six divisions, . . .	4	0
	12	10

Total cost of Sets I., II., III., and Acids, all Packed, is £12, 10s. 3d.

4844c. **FRANCIS'S PRACTICAL EXAMPLES OF QUANTITATIVE CHEMICAL ANALYSIS,** applied to Water, Urine, &c.

LIST OF APPARATUS REQUIRED.

		£	s.	d.
407.	Balance in glass case, to carry 100 grammes, and show 1 milligramme,	10	0	0
456.	Gramme weights, accurate, 50 gr. to 10 gr. in brass, and ·5 gr. to ·001 gr. in platinum, in a box with tongs,	1	15	0
1740, 3.	Platinum capsule, 1¾ in. diam.,		18	0
1740, 9.	,, 3¼ ,,	4	4	0
1273.	Fresenius's copper air bath,	1	1	0
1248.	Copper water bath, 4 rings,		8	0
1296a.	Exsiccator, glass, 2 pieces,		4	6
M. 286.	Regnault's sp. gr. bottle, 50 CC.,		2	6
2795.	Jar on foot, spouted, 100 CC. 100°,		2	0
1723.	Washing bottle, 2 tubes,		1	3
972.	No. 2 Rose gas burner,		3	0
2688, 8.	Mohr's burette, 50 CC. = 250°,		4	6
2694a.	Stand for ditto, black wood,		3	6
2768.	Pipette delivering 10 CC.,			7
	,, ,, 20 CC.,			9
	,, ,, 50 CC.,		1	0
2874d.	Lactometer for percentage of cream in milk,		2	6
1873.	Retort, litre size, with Liebig's condenser and stand,		14	0
1626.	Funnel, 2 inch,			2
	100 Filters, in a box,			10
	Funnel, 4 inch,			4
	100 Filters, in a box,		1	0

Without any case, £20, 8s. 5d.

4845. **ENGINEERS' CHEMICAL CABINET**: a Comprehensive Collection of CHEMICAL APPARATUS and TESTS, suitable for the performance of the QUALITATIVE ANALYSIS of Ores, Minerals, and most Chemical and Mineral Compounds, the whole selected of small sizes for the sake of portability, but of the best quality; contained in a divided Mahogany Cabinet, fitted with drawer and trays, size of the Cabinet, 25½ inches long, 17 inches broad, and 11 inches deep. Price £10, 10s.

CONTENTS:—

437. Balance and Grain Weights.
478. Graduated Measure, 2 oz.
4399. Steel Crushing Mortar.
50. Agate Mortar, 2 inch.
62. Porcelain Mortar, 2½ inch.
4404. Steel Spatula, 4 inch.
177. Round File in Handle.
4422. Triangular File in Handle.
851. Glass Spirit Lamp, 3 oz.
864. Cotton Wick for Lamp.
4410. Tongs to trim Lamp.
287. Retort Stand, 3 brass rings.
1323. Porcelain Crucible, 1¼ inch.
Ditto, 1¾ inch.
1800. Porcelain Cups, 8 assorted.
4204. Brass Blowpipe.
Extra Jet for ditto.
1320. Platinum Crucible, ⅞ inch.
4232. Blowpipe Lamp.
4241. Brass Stand for ditto.
4397. Blowpipe Anvil.
4395. Blowpipe Hammer.
4282. Platinum Blowpipe Tongs.
4409. Albata Test Spoon.
4270. Platinum Blowpipe Wires (2).
4277. Platinum Blowpipe Foil (2).
92. Iron Spoons (2).
1741. Platinum Capsules, ½ inch (2).
130. Spring Tongs to hold ditto.
4276. Fine Copper Wire, 12 inches.
4321. Charcoal Pastilles, 6 dozen.
1576. Stoppered Bottle for ditto.
4322. Iron Mould to make Pastilles.
4307. Bottle of Charcoal Powder.
4307. Bottle of Rice Powder.
4320. Porcelain Crucibles for Pastilles (2).
4321a. Wire Supports for ditto (2).
4349. Support for Sublimates.
4363. Narrow Test Tubes, 3 to 1½ inch (12)
4439. Magnifying Lens in horn case.
4360. Open Glass Tubes, 6 × ¼ inch (24).
4414. Iron Tongs and Spoon Handle.
4375. Arsenic Tubes in a box.
1484. Set of 4 Beaked Tumblers.
1445. Set of 6 Beakers.
1400. Boiling Flasks, 3 to 5 oz. (6).
1785. Watch Glasses, 2 inch (2).
403. Watch Glass Holder.
1790. Porcelain Capsule, with Handle.
1791. ,, ,, larger.
1995. Clark's Gas Bottle.
1815. Clark's Retort and Receiver.
232. Glass Tube, ¼ lb. assorted.
1626. Glass Funnels, 2, 2½, 3 inch.
1677. Round Glass Covers, 3 and 4 inch.
Glass Funnel, slight, 1 inch.
342. Funnel Holder, black wood.
1610b. Filter Rings, Porcelain (2).
1626. Cut Filters, 2½ inch (100).
,, 3¼ ,, (100).
,, 4¼ ,, (100).
1719. Berzelius's Washing Bottle.
1690. Straight Pipette, 6 inch.
2400. Test Tubes, 6 × ⅝ inch (6).

4845. ENGINEERS' CHEMICAL CABINET—*Continued.*

2400. Test Tubes, 6 × 1 inch (2).
,, 4 × ½ ,, (6).
359. Test Tubes Frame, 6 holes.
387. Test Tube Holder.
158. Test Tube Brush.
2426. Box of Test Papers.
2436. Box of Test Metals.
1743. Porcelain Basin, 2¾ inch.
,, ,, 3½ ,,
,, ,, 4 ,,
115. Glass Stirrers, 6 ,, (6).

SIXTY STOPPERED GLASS BOTTLES FOR PURE CHEMICAL TESTS, namely, 20 of 2 ounce, and 13 of 1 ounce, with narrow mouths for *solutions*, and 27 of 1 ounce with wide mouths for *dry tests*. Contents as follows :—

Acetic Acid.
Ammonium, Caustic.
,, Carbonate.
,, Carbonate, *solution*.
,, Chloride, *sol.*
,, Molybdate, *sol.*
,, Oxalate.
,, Sulphide, *sol.*
Barium, Chloride.
,, Chloride, *sol.*
,, Hydrate.
Calcium, Hydrate.
Cobalt, Nitrate, *sol.*
Copper, Sulphate.
,, Sulphate, *sol.*
Galls, Tincture.
Hydrochloric Acid.
Iron, Protosulphate.
,, Protosulphate, *sol.*
Iron, Perchloride, *solution.*
Indigo, Sulphate, *sol.*
Lead, Acetate, *sol.*
,, Nitrate.
Magnesia, Sulphate, *sol.*
Manganese, Peroxide.
Mercury, Perchloride.
,, Protonitrate.
Nitric Acid.
Oxalic Acid.
Platinum, Chloride, *sol.*
Potassium, Antimoniate, *sol.*
,, Bisulphate.
,, Carbonate.
,, Carbonate, *sol.*
,, Bicarbonate.
,, Chromate.
,, Bichromate.
,, Bichromate, *sol.*
Potassium, Cyanide.
,, Sulphocyanide, *solution.*
,, Ferridcyanide, *sol.*
,, Ferrocyanide.
,, Ferrocyanide, *sol.*
,, Hydrate.
,, Iodide.
,, Nitrate.
Silver, Nitrate, *sol.*
Sodium, Carbonate.
,, Carbonate, *sol.*
,, Hydrate.
,, Phosphate, *sol.*
,, Sulphate.
,, Sulphate, *sol.*
Sulphuric Acid.
Tartaric Acid.
Tin, Protochloride.
Zinc in rods.

Thirteen turned WOODEN BOXES, containing the following BLOWPIPE REAGENTS :—

Borax.
Soda.
Microcosmic Salt.
Bone Ashes.
Potassium, Nitrate.
Potassium, Oxalate.
Fluor spar.
Gypsum.
Nickel Soda-borate.
Silica.
Boracic Acid.
Metallic Lead.
Metallic Iron.

4845A. The "ENGINEER'S CHEMICAL CABINET" described above, was first prepared to meet suggestions of the late Sir HENRY DE LA BECHE, who spoke of it as follows, in a Section on Mineralogy, which he wrote for the *Admiralty Manual of Scientific Inquiry*, Edited by Sir John F. W. Herschell :—

"It is probable that to CHEMICAL COMPOSITION the Voyager will chiefly look for aid [in the *discrimination* of ORES and MINERALS], more especially if he be a Medical Officer, and therefore likely to have become sufficiently acquainted with Chemistry for the purpose. The modes of investigation will readily present themselves to one so qualified, and we would suggest *that no Surveying Voyage should be sent, more particularly to distant countries, without one of those Little Chests of* NEEDFUL THINGS *for* CHEMICAL RESEARCH *which are prepared for the purpose.*

"GRIFFIN (of London) and others fit up very compact and useful Chests of this kind. They necessarily vary in price according to their contents. For about £8, a chest of about 1½ cubic feet, not a cumbrous size for a cabin, may be obtained. It would contain apparatus and substances sufficient for discriminating all well-known ores and minerals, including a Blowpipe Apparatus with the necessary Fluxes and Reagents, as also a selection of the most useful instruments for testing in the wet way, with a collection of tests in the dry state, and stoppered bottles to contain solutions ; also a set of bottles with pure Acids.

"More complete Chests may be obtained for about £15 or £16 ; far more valuable for long voyages, during which deficiencies cannot be expected to be supplied. These are divided into two chests, one containing the things needful for more constant, the other large articles for occasional use, as well as duplicates of apparatus liable to be broken, with an extra stock of chemicals. These chests usually occupy about 4 cubic feet, and contain apparatus and chemicals sufficient for the complete Quantitative Analyses of Minerals, or the separation of the component parts of a mineral, in quantities sufficient for an accurate analysis. They include platinum crucibles, Bohemian test tubes, Berlin porcelain crucibles and capsules, complete blowpipe apparatus, &c., &c."—*Admiralty Manual of Scientific Inquiry*, page 245.

4846. APPARATUS and TEST SOLUTIONS for the CHEMICAL TESTING of WINES and SPIRITS, according to Processes that are fully described in the work called *The Chemical Testing of Wines and Spirits.* By JOHN J. GRIFFIN, F.C.S.

The Collection comprises a Balance, set of Grain Weights, Specific Gravity Bottle and Thermometer; also, a Distilling Apparatus, and a set of Apparatus and Volumetric Test Solutions for estimating experimentally the percentage of alcohol, free acid, distinguishing volatile from fixed acid, sugar extract, ash, and alkaline salts, in wines and spirits of all descriptions.

For detailed Table of Contents, see page 326, No. 2879.

4846. Price of the complete collection, £9, 9s.

4847. Price of the collection, without the Balance and Set of Weights, £6, 6s.

4848. Set of Apparatus and Reagents for TESTING VINEGAR for ACETIC ACID, &c., *as arranged by* Colonel A. Brunel, of the INLAND REVENUE DEPARTMENT, CANADA.

APPARATUS.

1550. Six Pint Bottles, glass stoppers.
1576. One 3-oz. „ „
One 4-oz. „ „
One 16-oz. „ „
2791. Five Decigallon Test Mixers.
2688. Mohr's Burette, 100 Sep. = 100°.
2697. Black Wood Stand for do.
Extra Jet and Tube „
„ Pinchcock „
2768. Delivery Pipette, 50 Septems.
„ „ 25 „
2786. Flask, stoppered, 100 „
1597. Two 5-inch Funnels.
Mahogany Funnel Stand.
1626. 200 No. 7 Filters.
1619. Quire of Filter Paper.
1617. Two Beale's Quick Filters.
Piece of Muslin, 12 inch by 12 inch.
1488. Two Precipitating Jars, 1 pint.
1487. Three „ „ $\frac{1}{4}$ „
Three Test Glasses, conical, 1 oz.
428. Balance in Box, shows $\frac{1}{60}$ grain.
447. Weights, 600 grains to $\frac{1}{100}$ grain.
851. Spirit Lamp, 4 oz.
Box of Lamp Cotton.
Two Books of Blue Litmus in Leather Cases.
12 Extra Books of Litmus.
288. Retort Stand.
Two Watch Glasses.
1225. Copper Sandbath, 5 inches.
1401. Two Flasks, 10 ounces.
"Chemical Recreations," gilt edges.

REAGENTS.

The following in the bottles above named:—

1 pint Ammonia Liq., ·880.
1 lb. Copper Sulph., pure, cryst.
2 pints Ammon. Sulph. Copper, 5°.
1 pint Acid Sulphuric, pure.
$\frac{1}{4}$ lb. Soda Carb., anhydrous.
2 pints Sulphuric Acid, 5°.
4 ounces Baryta, Nitrate.

Black Pine Cabinet, with Lock, Key, and Handles, Price £9.

GROUP VII.—*Collections of Apparatus for the use of Lecturers and Schoolmasters, Nos.* 4860 *to* 4866.

4860. **PROFESSOR CHURCH'S STUDENTS' SETS OF APPARATUS,** as described in his *Laboratory Guide*, and used in the ROYAL AGRICULTURAL COLLEGE, CIRENCESTER.

CLASS I.

No.	Article	s.	d.
62.	Mortar and Pestle, porcelain,		7
1210.	Earthenware Furnace Support,	1	0
1743.	Three B. P. Basins, 0, 5, 7,	4	8
1323.	Three ,, Crucibles, 0, 1, 2,	2	3
371.	Test Tube Stand,	1	2
158.	Two ,, Brushes,		6
2400.	Twelve Test Tubes, 6 inch by $\frac{5}{8}$ inch,		9
1626.	Four Funnels, 2 inch, 3 inch, 4 inch, 6 inch,	1	6
	Four Packets Filters to match,	3	6
1785.	Two Watch Glasses,		2
1464.	Beakers, 5 small,	1	9
1725.	Washing Bottle,	1	6
115.	Two Glass Stirrers, 6 inch,		2
851.	Glass Spirit Lamp, 6 oz.,	1	4
1809.	Retort, stoppered, 6 oz.,		9
232.	Quill Tubing, $\frac{1}{2}$ lb.,		6
288.	Retort Stand,	2	3
121.	Crucible Tongs,	1	6
4200.	One Mouth Blowpipe,		8
4277.	Platinum Wire and Foil,	1	6
1196.	Square of Wire Gauze,		2
1225.	Iron Sandbath, 5 inch,		4
178.	One Round File,		8
	Triangular ,,		8
300.	Triangle, 5 inch,		3
438.	Scales, with Glass Pans and Weights,	5	0
168.	Corks, 36,	1	6
2423.	Test Papers, 2 Books each, Blue and Red Litmus and Turmeric,	1	0
	Duster,		9
	Pint Bottle Lamp Spirit,	1	6
	1 oz. ,, Cobalt, Nitrate, sol.,	1	6
	2 oz. ,, Silver ,, ,,	1	6
	$\frac{1}{2}$ oz. ,, Platinum, Chloride, sol.,	1	10
		£2 4	8

CLASS II.

No.	Article	s.	d.
1464.	Beakers, a second small set,	1	9
	Spirit of Wine, 4 oz.,	1	10
945.	Bunsen's Burner,	1	0
1953.	Five feet Rubber Tube,	2	6
4509.	Square of Dark Blue Glass,		4
1622.	Swedish Filters, 100 each, 2 and 3,	1	11
		9	4

CLASS III.

No.	Article	s.	d.
2688.	Mohr's Burette, 50 CC. = 100°,	3	6
2697.	Black Wood Stand for do.,	4	0
2768.	Bulb Pipette, 20 CC.,		9
4766.	Two Nitrogen Bulbs,	1	2
232.	Combustion Tube, $\frac{5}{8}$ inch, 2 lbs.,	2	0
115.	Two Glass Rods,		2
1576.	One W. M. Stoppered Bottle, 2 oz.,		5
	Soda Lime, 4 oz.,	1	3
	Asbestos, 1 oz.,		6
1320.	Platinum Crucible and Cover,	30	0
96.	,, Spatula,	10	0
306.	Two Tobacco-piped Triangles,		6
342.	Two Funnel Holders,	2	8
	Three Large Beakers, 20 oz., 30 oz., 40 oz.,	3	6
1595.	Four Large Funnels, 4 inch, 5 inch, 6 inch, 7 inch,	2	9
480.	Ten ounce Measure,	1	6
	Ground Top Jar, 6 inch by 5 inch, Ground Glass Cover, Copper Tripod, } Desiccator,	1	9
	Calcium Chloride, fus., $\frac{1}{4}$ lb.,		8
	Carbon Dioxide Apparatus,	2	0
	Four Phials, W.M., corked, 2 oz.,	1	0
	Four Glass Plates,		6
1626.	Packet of Cut Filters, 11$\frac{1}{2}$ inch,	2	0
		£3 12	7

The Three Sets combined, £6, 6s.

The Set of 20 Reagents, not included in above Lists, in 6 ounce stoppered bottles, £1.

4861. AGRICULTURAL CHEMISTRY. GRIFFIN'S COLLECTION OF CHEMICAL APPARATUS and PREPARATIONS, for the Performance of the EXPERIMENTS requisite to demonstrate the Chemical Facts contained in PROFESSOR JOHNSTON'S *Catechism of Agricultural Chemistry and Geology*. Adapted for the use of Schoolmasters. Price £1, 11s. 6d., packed in a case.

AGRICULTURAL CHEMISTRY ASSOCIATION,
8 Baker Street, Edinburgh.

To Messrs GRIFFIN & Co.,

GENTLEMEN—I am much obliged to you for the trouble you have taken in making up a set of Apparatus suited to the EXPERIMENTS mentioned in my *Catechism of Agricultural Chemistry and Geology*. I think it is very complete and excellent, and I am sure that the Schoolmasters in general will feel as grateful to you as I do myself.—Believe me, yours truly,

(Signed) JAMES F. W. JOHNSTON.

1192. Spirit Lamp, stoneware.
1193. Oil Lamp, stoneware.
864. Cotton Wick, 2 feet.
1191. Lamp Cylinder, 6 inch.
1196. Trellis Top, for ditto.
1194. Pair of Ring Tops, ditto.
1963. Hydrogen Gas Bottle, 1 tube.
2254. Jet and Cork for ditto.
2033. Chlorine Gas Bottle, 1 tube.
2014. Oxygen Gas Retort and Tube.
2014. ,, Extra Retort for ditto.
2400. Test Tubes, 3 by ½ inch (2).
,, 4 by 1 inch (2).
2423. Book of Litmus Paper.
2423. Book of Turmeric Paper.
293. Tube Holder, with Stand.
2237. Crook and Cork for ditto.
1559. Bottle for HSO^2, ½ pint, stoppered.
1559. Bottle for HCl, ½ pint, stoppered.
2066. Pneumatic Trough, 11 inch.
2071. Beehive Shelf, 4 inch.
1576. Glass Bottle, ½ pint, stoppered.
1535. Jar, 10 by 3 inch, No. 28.
1535. Jar, 6 by 2½ inch, No. 20.
2101. Deflagrating Jar, 5 inch.
2229. Deflagrating Spoon.
2232. Wire and Taper.
160. Tray for Gas Jar, 3 inch.
160. Tray for Gas Jar, 4 inch.
2417. Test Glass, 6 ounce, cylindrical.
2410. Test Glass, 3 ounce, conical.
115. Glass Stirrer, 3 and 6 inch.
1690. Pipette, plain, 6 inch.
232. Open Tubes, 2 sizes.
1790. Porcelain Capsule and Handle.
135. Iron Tongs, with Spoon.
62. Mortar and Pestle, 2¼ inch.
1770. Porcelain Basin, 4 inch.
1626. Glass Funnel, 1½ inch.
1626. Filters, 100, 2¾ inch.
1610. Filter Ring.
CHEMICALS in *Bottles*:—
Zinc Punchings, 6 oz.
Manganese, Peroxide, 8 oz.
Potassium, Chlorate, 4 oz.
Mercuric Oxide, ½ oz.
Potassium, Nitrate, 2 oz.
Phosphorus, 2 drachms.
Cupric Oxide, 1 oz.
Packing Case.

The following article, No. 4862, describes a superior Collection of Apparatus for the above mentioned purpose.

4862. COLLECTION of CHEMICAL APPARATUS and TESTS, for performing the Experiments described in JOHNSTON'S "*Catechism of Agricultural Chemistry;*" also, suitable for LECTURES on the NON-METALLIC ELEMENTS before a School, or other limited audience. Contained in a portable divided cabinet of pine wood, stained black, measuring 25 inches in length, 18 inches in width, and 13 inches in depth. *Price* £4, 14s. 6d.

62. Porcelain Mortar, No. 0.
1464. Set of 5 Beakers, 0 to 4.
851. Glass Spirit Lamp, 4 oz.
864. Cotton Wick, 1 yard.
1191. Lamp Cylinder, 6 inch.
1195. Pair of Hot Plates, tin plate.
1194. Pair of Iron Ring Tops.
1196. Iron Trellis Top.
1200. Water Bath, 2 pieces.
1197. Sand Bath, 5 inch, tin plate.
1201. Tube Support on stand.
477. Graduated Measure, 1 oz.
437. Balance and Grain Weights.
1404. Flasks, green, 4 and 8 oz.
1400. Flasks, white, 6 and 10 oz.
1743. Porcelain Basin, 3½ inch.
,, ,, 4 inch.
,, ,, 4¾ inch.
1766. Semi-porcelain Basin, 5 inch.
2419. Test Glass, 12 oz., cylindrical.
2410. Test Glass, conical (3).
1488. Conical Glass Jar, ½ pint.
2121. Glass Jars, set of 4, 2½ to 5 inch.
1963. Hydrogen Gas Bottle, ½ pint, 1 tube.
1996. Clark's Gas Bottle.
2014. Oxygen Retort and Tube.
2101. Deflagrating Jar, 5 inch.
2229. Deflagrating Spoon, No. 1.
2071*a*. Beehive Shelf, 4 inch.
160. Gas Tray, 4 inch.
160. Gas Tray, 4½ inch.
1809. Retort, stoppered, 4 oz.
1805. Retort, plain, 4 oz.
1847. Receiver, stoppered, 4 oz.
2254. Cork and Jet for Gas Bottle.
1576. Bottle, 10 oz., wide mo. stoppered.

4862. **Apparatus for Johnston's Agricultural Chemistry**—*continued.*

2232. Wire and Taper.
1626. Funnels, 1 ea. 2 and 3 inch.
1626. Filters, 100 each to fit the funnels.
342. Funnel Holder, black wood.
293. Tube Holder, fitted to ditto.
387. Test Tube Holder, in handle.
287. Retort Stand, 3 brass rings.
359. Tube Frames, 6 holes.
2400. Test Tubes, 6 of 5 by ⅝ in.
,, 6 of 5 by ¾ in.
1690. Straight Pipettes, 6 inch (2).
115. Stirrers, 2 *ea.* 3, 6, 9 inch.
2426. Box of Test Papers.
2438. Albata Test Spoon.
1786. Pair of Watch Glasses.
403. Watch Glass Holder.
1800. Porcelain Cups, 1¼ inch.
1790. Porcelain Capsule with handle.
1323. Porcelain Crucible, 1¼ inch.
,, 1¾ inch.
,, 2¼ inch.
1610. Filter Rings, 2 sizes.
99. Steel Spatula, 5 inch in handle.
4200. Blowpipe.
135. Iron Tongs with spoon.
4277. Platinum Foil, 2 by ½ inch.
4270. Platinum Wire, 2 inch (2).
1741. Platinum Capsule, ¾ inch.

Bottles containing Chemical Preparations.

1 Wide Mouth, 1 oz. stoppered.
1 Narrow Mouth, 1 oz. ,,
17 Wide Mouth, 2 oz. corked.
12 ,, 4 oz. ,,

Chemicals:

Acetic Acid, 1 oz.
Alum, Cryst. 4 oz.
Ammonium, Carbonate, 1 oz.
,, Chloride, 3 oz.
,, Nitrate, 2 oz.
,, Oxalate, 1 oz.
Barium, Chloride, 2 oz.
,, Nitrate, 2 oz.
Copper, Black Oxide, 2 oz.
Calcium, Chloride, fused, 4 oz.
,, Hydrate, 4 oz.
Iron, Protosulphate, 2 oz.
,, Sulphide, 4 oz.
Magnesia, Sulphate, 4 oz.
Magnesia, Calcined, ½ oz.
Manganese, Peroxide, 8 oz.
Mercury, Red Oxide, 1 oz.
Potassium, Carbonate, 1 oz.
,, Chlorate, 4 oz.
,, Hydrate, 1 oz.
,, Nitrate, 4 oz.
Phosphorus, ¼ oz.
Sodium, Borate, 1 oz.
,, Carbonate, 1½ oz.
,, Phosphate, 1 oz.
Silica, in powder, 3 oz.
Tartaric Acid, 1½ oz.
Zinc, Granulated, 6 oz.

4863. COLLECTION of CHEMICAL APPARATUS SUITABLE for SCHOOLMASTERS. This is the Set prepared for Class Teaching in National Schools, and described in the following work:—"*Special Report on Apparatus for Elementary Instruction in Science;* by the Rev. Frederick Temple, M.A., *Her Majesty's Inspector of Schools.*" Education Office, Whitehall, 11th July, 1856.

Considerable improvements in many of the Instruments have been made during the years passed since 1856, and the improved articles are contained in the following collection; but in the main the Set corresponds with that described in the above Report.

4863. Price of the Apparatus without the Chemicals, 18 guineas.
4864. Price, with the Chemicals enumerated, No. 4865, 21 guineas.

The marginal numbers refer to figures and descriptions given in the preceding pages of this work.

1579. Bottle, 6 pints, with stopper.
1766. Porcelain Basin, 6½ inch.
2232. Wire and Taper (2).
2244. Candle Holder.
2236. Cup to hold Phosphorus.
2277. Wire Gauze, 8 inches square.
4360. Open Glass Tubes, 6 × ¼ inch (3).
2400. Test Tubes, 6 × ¾ inch (6).
Flexible Metal Pipe, 18 inches.
1575. Bottles, 4 oz., corked (6).
1579. Bottles, pint, stoppered (2).
1550. Bottles, 3 oz., NM stoppered (24).
1550. Bottles, 6 oz., NM stoppered (24).
1677. Glass Discs, 4 and 6 inch.
1400. German Flasks, 8 oz. (2).
851. Glass Spirit Lamp.
1448. Set of 10 Beaker Glasses.
2251. Gas Bottle for Hydrogen.
2253. Tube for Musical Sounds.
2135. Glass Cylinder, 10 × 2 inch, open.
2077. Tate's Pneumatic Trough.
2067. Griffin's Stoneware Trough.
223. Danger's Glassblower's Lamp.
228. Iron Rod for Glassblowers.
2161. Griffin's School Gasholder.
2162. Stopcock for use with ditto.
1953. Vulcanised Tube, ½ inch, 3 feet.
1953. ,, ,, ⅓ inch, 3 feet.
697. Stopcock, double male (2).
698. Stopcock, male and female.
705. Connector, double male.
704. ,, double female.
706. ,, male and female.
160. Trays for Gas Jars, 2 to 7 in. (6).
2122. Gas Jar, 12 × 2 inches.
2329. ,, graduated into 30 cubic ins.

2103. Deflagrating Jar, 9 × 5 inches.
2104. ,, ,, 11 × 6 inches.
1576. Quart Bottles, stoppered (3).
2224. Globe for Phosphorus.
2226. Cup for Phosphorus.
2227. Pan, 12 inch, for ditto.
2230. Brass Deflagrating Spoons (2).
2233. Hank of Iron Wire.
2110. Gas Jar with brass cap, 12 × 6 in.
2114. Glass Globe for ditto.
920. Gas Burner, gauze top, &c.
2241. Oxygen Blowpipe Jet.
4522. Set of Blowpipe Apparatus for testing Minerals, &c.
2249. Balloon, 9 inch.
2143. Bladder with wood mouth-piece.
2136. Waterproof Gas Bag.
2255. Brass Tobacco Pipe for Gas.
1962. Hydrogen Gas Bottle, 2 tubes.
2014. Oxygen Tube Retort.
2020. Large Retort for Oxygen Gas.
1996. Glass Bottle for Carbonic Acid.
2033. Chlorine Gas Bottle.
293. Support for Small Retorts.
391. Tin Crook to support hot Tubes.
2187. U-tube Condenser.
1806. Glass Retorts, plain, of 5, 10, 20 and 40 ounces (4).
1809. Glass Retorts, stoppered, 10 and 20 oz. (2).
1405. Glass Receivers, plain, 8, 16, and 24 oz. (3).
1865. Adapters, 1½ and 2 inch (2).
1626. Glass Funnel, 4 inch (2).
100 Filters for ditto and Box.
Glass Funnel, 3 inch (2).
100 Filters for ditto and Box.
Glass Funnel, 2 inch (2).
100 Filters for ditto and Box.
342. Funnel Holder, black wood.
907, 2. Argand Oil Lamp.
1219. Griffin's Lamp Furnace, containing 17 articles.
1743. Porcelain Basins, 2¾, 3½, 4, 4¾, 7¼, and 8½ inches (6).
1790. Porcelain Capsule with handle (2).
2400. Test Tubes, 3 × 1 inch (6).
,, 5 × ⅝ inch (6).
,, 6 × 1 inch (6).
2410. Test Glass, conical, 1 oz. (12).
2417. Test Glass, cylindrical, 6 oz. (6).
158. Brush to clean Test Tubes.
387. Clip to hold hot tubes.
115. Glass Stirrers, 3 inch (12).
,, ,, 6 inch (6).
,, ,, 9 and 12 inch (3 each).
1785. Watch Glasses (6).
1953. Vulcanised Tube, ¼ inch (1 foot).
1953. Vulcanised Tube, ⅜ inch (1 foot).
,, ,, ½ inch (1 foot).
1592. Chemical labels, small.
1593. ,, ,, large.
1594. ,, ,, De la Rue's.
1400. Glass Flasks, 8, 16, 20, and 32 oz. (4).
1482. Bohemian Beaked Tumblers, a set of 6.
480. Graduated Measure, 10 oz.
1692. Dropping Tube with bulb.
1690. Straight Pipettes (2).
1534. Jar on foot, 8 by 2 inch.
,, 10 by 2 inch.
,, 12 by 2 inch.
,, 15 by 3 inch.
,, 10 by 1¼ inch.
,, 12 by 1½ inch.
,, 16 by 1¾ inch.
1800. Porcelain Cups (2).
271. Retort Stand, 2 Rings, 1 Triangle.
359. Test Tube Stand, 6 holes.
371. ,, 8 holes and pegs.
2279. Tate's Oxyhydrogen Blowpipe.
2195. Apparatus to produce Water from H. Gas.
2242. Respiration Apparatus.
2245. To collect CO^2 from burning Candle.
246. Water Bottle with Tap, 1 gal.
441. Balance to weigh 1 lb.
459. Pound Pile of Weights.
437. Balance and Weights for under ½ oz.
2783. Specific Gravity Bottle, 250 septems.
2340. Ure's Eudiometer.
1815. Clark's Retort and Receiver.
1817. Faraday's Retort and Receiver.
1886. Still and Condenser.
1354. Set of 5 Hessian Crucibles.
1352. Melting Pots, small (6).
1323. Porcelain Crucible, 1½ inch.
,, 1¾ inch.
,, 2¼ inch.
393. Set of 6 round Wood Blocks.
62, 2. Porcelain Mortar, 4 inch.
170. Case of 6 Cork Borers.
177. Rat-tail File.
184. Half-round Rasp.
229. Triangular File.
168. Corks, assorted, 1 gross.
232. Glass Tubes, assorted, 2 lbs.
1396. Iron Ladles, 2 and 4 inch.
92. Iron Spoons (2).
121. Crucible Tongs.
404. Stoneware Basin Supports (2).
321. Universal Support.
313. Vertical Support.
2426. Box of Test Papers.
2422. Ditto, for Lecturers.

4865. **CHEMICAL PREPARATIONS**, to accompany the above set of Apparatus, all in Glass Bottles, with glass stoppers when necessary. Price without the Apparatus, £3, 3s.

ACIDS :—
Sulphuric, comml., 1 pint.
,, pure, ½ lb.
Hydrochloric, comml., 1 pint.
,, pure, ½ lb.
Nitric, comml., ½ lb.
,, pure, ½ lb.
Acetic, 2 oz.
Oxalic, cryst., 1 oz.
Tartaric, cryst., 1 oz.
Alcohol, 6 oz.
Alum, 4 oz.
Ammonium, Chloride, 2 oz.
Ammonia, Carbonate, 2 oz.
,, Caustic, 1 pint.

4865. Chemical Preparations—*continued.*

Ammonia, Nitrate, 6 oz.
Antimony, Metallic, 1 oz.
,, Sulphide, 4 oz.
Barium, Chloride, 1 oz.
,, Nitrate, 1 oz.
Bleaching Powder, 4 oz.
Calcium, Chloride, cryst., 2 oz.
,, Carbonate, 4 oz.
,, Hydrate, 2 oz.
,, Fluoride, 2 oz.
Camphor, 1 oz.
Charcoal Sticks, 2 oz.
,, Powder, 2 oz.
Cobalt, Chloride, ½ oz., solution.
,, Nitrate, ½ oz., ,,
Cochineal, 1 oz.,
Copper Leaf, 24 leaves.
,, Turnings, 2 oz.
,, Nitrate, 1 oz.
,, Sulphate, 4 oz.
,, Chloride, ½ oz.
Gall Nuts Powder, 1 oz.
Gold Leaf, ½ book of 25 leaves.
Indigo, 1 oz.
Iodine, ½ oz.
Iron, Perchloride, 1 oz.
Iron, Persulphate, 1 oz.
,, Protosulphate, 4 oz.
,, ,, pure, 2 oz.
,, Sulphide, ½ lb.
Lead, Metallic, 1 oz.
,, Red Oxide, 1 oz.
,, Litharge, 1 oz.
,, Acetate, 4 oz.
,, ,, pure, 2 oz.
,, Carbonate, 1 oz.
,, Ore, Galena, 2 oz.
Litmus, ½ oz.
Lycopodium, ½ oz.
Magnesium, Oxide, 1 oz.
,, Carbonate, 1 oz.
,, Sulphate, 2 oz.
Manganese, Peroxide, 1 lb.
Naphtha for burning, 1 pint.
Mercury, Metallic, ¼ lb.
,, Perchloride, ½ oz.
Phosphorus, 1 oz.
Phosphorus, Amorphous, ½ oz.
Potassium, Metallic, 6 grains.
,, Bromide, ¼ oz.
,, Bichromate, 1 oz.
,, Bitartrate, 1 oz.
Potassium, Carbonate, 2 oz.
,, Carb., purif., 1 oz.
,, Chlorate, ½ lb.
,, Chromate, 1 oz.
,, Ferridcyanide, ½ oz.
,, Ferrocyanide, 1 oz.
,, Hydrate, ½ oz.
,, ,, pure, ½ oz.
,, Iodide, 1 oz.
,, Nitrate, 4 oz.
,, Sulphocyanide, ½ oz.
Silver Leaf, 25 small leaves.
,, Nitrate, 2 drachms.
Sodium, Metallic, 10 grains.
,, Borate (Borax), 2 oz.
,, Bicarbonate, 1 oz.
,, Carbonate, cryst., 2 oz.
,, Nitrate, 2 oz.
,, Sulphate, 4 oz.
Stourbridge Clay, ½ lb.
Strontium, Nitrate, ½ oz.
Sulphur, Roll, 2 oz.
,, Sublimed, 2 oz.
Tinfoil, 1 oz.
Tin, Chloride, ½ oz.
Zinc Cuttings, ½ lb.

4866. COLLECTION OF APPARATUS suitable for experiments to illustrate a short course of POPULAR LECTURES on CHEMISTRY, consisting of Instruments that are in general of larger size than those forming the preceding collection. Price £21.

Containing the following Instruments:—

For Pulverisation:—

62, 1. Porcelain Mortar, 3½ inch.
62, 3. ,, 5 ,,
44, 2. Iron Mortar, 6 ,,
99. Steel Spatula, 6 ,,

For Solutions:—

1400. Glass Flasks, two each of 4, 6, 8, 10, 16, 20, 24, 30, 40, and 80 ounce.
1468. Set of 8 Beaker Glasses.
1482. Set of 6 Beaked Tumblers.

Furnaces, &c.:—

805. Evaporating Furnace, 6½ inch.
790. Universal Furnace with appurtenances, 12 articles.
1219. Griffin's Lamp Furnaces, 17 articles, complete.
870. Brass Argand Spirit Lamp, with Stand and Fittings.
863. Wick for small lamp, 12 yards.
880. Wicks for Argand Lamp, 24.
132. Brass Tongs to trim Lamp.
135. Iron Tongs, spoon handle.
133. ,, without spoon.

Supports for Apparatus:—

297,1. Tripod Support.
293. Tube Holder.
333. Table Support, with Crook.
337. Crook for Tubes.
393. Set of 6 Round Blocks.
262. Strong Retort Stand, 3 rings.
319,3. Bunsen's Universal Clamp Support.
315. Hinged Clamp Support.

For Testing:—

2404. Assortment of 60 Test Tubes, 5 to 7 inch.
360. Frame for 12 tubes, without pegs.
371. ,, 8 ,, with pegs.
388. Holder for hot Test Tubes.
158. Test Tube Brush.
2410. Conical Test Glass, 12.
115. Glass Stirrers, 3 inch, 12.
,, ,, 6 ,, 6.
,, ,, 9 ,, 6.
98. Albata Test Spoon.
2441. Porcelain Testing Plates, 2.
2426. Box of Test Papers.
2432 ,, ,, large size.
2436. Box of Test Metals.
1690. Straight Pipettes, 3.
1691. Bulb ,, 2.
2856. Schuster's Dropping Bottle.
477. Graduated Measure, 1 ounce.
479. ,, 5 ,,
481. ,, 1 pint.

For Filtration:—

1627. Set of 7 Funnels, 1 to 4 inch.
1628. Seven Filter Boxes.
100 Filters each, 7 sizes.
1595. Funnels of 4, 6, 8 inch.
343. Funnel Holder, 2 arms.
348. ,, 1 arm, large size.
1610. China Filter Ring, 2 arms.

1611. China Filter Ring, 3 arms.
1719. Washing Bottle, 1 jet.
1725. „ 2 tubes.
254. Water Bottle, to fill tubes.
1677. Glass Covers, 3, 4, 5 inch (6).
1531. Jar with Spout, 4 pints.

For Evaporation:—

1743. Porcelain Basins, 2¾ inch, 3½ inch, 3¾ inch, 4½ inch, 6 inch, 10 inch diameter.
1540. Stoneware Conical Pans, 8, 10, 12 inch.
1766. Semi-porcelain Basin, 12 inch.
1768. „ set of 6 small sizes.
1790. Porcelain Capsule, with handle.
1795. Semi-porcelain Capsule, with Handle and Spout, 4 inch and 5¼ inch.
1800. Thin Capsules for weighing, 2.
404. Biscuit Basin Stand, 2.

For Ignition:—

1323. Porcelain Crucible, 2¼ inch, 2.
1324. „ Cylindrical, 2 sorts.
1354. Nest of 5 Hessian Crucibles.
1800. Porcelain Cups, 6.
120. Charcoal Tongs, 16 inch.
121. Crucible Tongs, bright.
4201. Blowpipe.
4230. Blowpipe Lamp on Stand.
1741. Platinum Cup, ½ inch.
4283. Spring Steel Tongs.
4376. Box of 15 Arsenic Tubes.

For Distillation:—

1806. Retorts, plain, 4 ounce, 10 ounce, 20 ounce, 2 each.
1809. Retorts, stoppered, 4, 10, 20, 40 ounce.
1815. Clark's Retort and Receiver, 2.
1817. Faraday's Retort.
1942. Safety Funnel.
1849. Glass Receiver, 2 necks, 5 ounce.
1849. „ „ 10 „
1405. Receivers, plain, 4, 10, and 20 ounce, 2 each.
1847. Receivers, stoppered, 10, 20, and 40 ounce, 1 each.
1865. Adapters, 2 inch, 2.
1875. Improved Condenser.
1876. Support for Condenser.
246. Two-gallon Water Bottle, with brass tap.

For Experiments on Gases:—

1962. Bottle for Hydrogen Gas.
1963. „ without Funnel.
1964. „ with Wash Bottle.
1996. Bottle for HS Gas.
2014. Retort for Oxygen Gas.
2033. Bottle for Chlorine Gas.
1534. Jar on foot, 9 by 2 inches.
1534. Jar on foot, 12 by 3 inches.
1685. Glass Covers, 3 and 4 inch.
1432. Woulff's Bottle, 3 necks, pint.
2103. Deflagrating Jar, 9 by 5 inch.
2104. „ 11 by 6 inch.
2110. Bell Jar, 12 by 6 inch, with Globe and Brass Fittings, Figs. 2110 and 2112.
2224. Oxygen Globe, for combustions.
2226. Cup for Phosphorus.
2229. Iron Deflagrating Spoon.
2230. Brass ditto.
2048*f*. Chlor.-Calcium Tube.
2049*c*. „ „
2259. Reduction Tube, 1 bulb, straight.
2262. „ 2 bulbs, bent.
2161. School Gas Holder.
2075. Pneumatic Trough, 19 by 12½ inch, Japanned.
2067. Stoneware Trough, 11 inch.
2071. Beehive Shelf, 4 inch.
2087. Trough for Mercury.
2093. Tray for ditto, 12 inch.
2232. Pair of Tapers on Wires.
2233. Hank of Iron Wire to burn.
160. Trays, 3, 4, 5, 6 inch, for Jars.
2105. Deflagrating Jar with Cap and Flexible Tube.
2120. Bottles, Stoppered, 2 pints, 2.
2120. „ 4 pints, 1.
2124. Gas Tubes, 6 assorted.
2125. Gas Tubes, 3 assorted.
2122. Eprouvettes, 6 by 1½ inch, 2.
„ 9 by 1¾ „ 2.
„ 12 by 2 „ 2.
„ 11 by 3 „ 2.
2142. Bladder with brass Collar.
697. Stopcock to fit ditto.
2255. Brass Tobacco Pipe.
2241. Brass Blowpipe for Oxygen.
2279. Tate's Oxyhydrogen Blowpipe.
2310. For the Explosion of Oxyhydrogen Gas.
2245. Carbonic Acid from flame.
2195. Water from burning Hydrogen.
2249. Balloon, 9 inch.
2252. Philosophical Candle.
2253. Tube for Musical tones.
2265. Water from Oxide of Copper.
2277. Iron Gauze for Davy's Lamp.
2317. Gas distilled from coal.
2316. Vinegar distilled from wood.
1953. Caoutchouc connectors, 12.
232. Glass tube for Gases, 2 lbs.
229. File to cut Glass Tubes.

Sundries:—

170. Set of 6 Cork Borers.
177. Round File, 4 inch.
179. „ 6 inch.
186. Flat Rasp, 4 inch.
188. Round Rasp, 4 inch.
1592. Set of Chemical Labels.
1593. Another Set, larger.

GROUP VIII.—*Portable Cabinets of Blowpipe Apparatus* (already fully described at the numbers referred to).

A. SETS FOR QUALITATIVE ANALYSIS:—

No. 4521, 10s. 6d.	No. 4525, 52s. 6d.	No. 4523, 73s. 6d.
„ 4522, 21s. 0d.	„ 4524, 63s. 0d.	„ 4527, 105s. 0d.

B. SETS FOR QUANTITATIVE ANALYSIS:—

No. 4529, £30.

GROUP IX.—*Collections of Graduated Apparatus and Test Solutions for Volumetric Analysis in various branches* (already fully described at the numbers referred to).

A. VOLUMETRIC APPARATUS FOR GENERAL USE:—

No. 2896, *set* A, £5, 18s. 6d.	No. 2898, *set* C, £1, 15s. 0d.
„ 2897, *set* B, £2, 19s. 0d.	„ 2899, *set* C, £0, 19s. 0d.

B. VOLUMETRIC APPARATUS ACCORDING TO THE BRITISH PHARMACOPŒIA:—

No. 2890, set of Solutions, 14s.	No. 2891, set of Instruments, 27s.

C. VOLUMETRIC APPARATUS FOR URINOMETRY:—

4072. Set of Test Solutions after NEUBAUER, 48s.
4074. Set of Apparatus after NEUBAUER, 72s.
4075. Limited set of Apparatus after NEUBAUER, 36s. 6d.
4101. Test Solutions for the Qualitative Analysis of Urine, 13s.
4107. Apparatus and Test Solutions for the Quantitative Analysis of Urine, according to LIEBIG (Beale's arrangement), £3, 3s.
4108. The same in a Cabinet, £4, 4s.
4109. Apparatus and Test Solutions for the Quantitative estimation of Diabetic Sugar, after PAVY, 21s.
4119. Apparatus and Tests for the Qualitative Analysis of Urinary Deposits, after GOLDING BIRD, 30s.
4120. The same in a Mahogany Cabinet, 52s. 6d.

GROUP X.—*Sets of Apparatus for Analytical Processes in Metallurgy.*

2889. For the Volumetric Assay of Zinc Ores, 17s.
For the Assay of Copper Ores.
4540. For the Assay of Gold and Silver by the operation of Cupellation.
4580. For the Assay of Silver in the Wet Way.
4625. For estimating the percentage of Gold in Crushed Quartz, in the Wet Way.

GROUP XI.—*Miscellaneous Collections.*

2872. Clark's Water Test. See page 321.
2882. Shier's Sugar Test. See page 328.
Alkalimetry, Acidimetry, Chlorimetry; Sets of Graduated Instruments and Test Solutions for these and similar branches of chemical testing prepared to order; the graduation of the Instruments being in Septems, Decems, or Centimetre Cubes, as may be desired.

4867. COLLECTIONS OF APPARATUS FOR QUANTITATIVE CHEMICAL ANALYSIS.

Quantitative Analysis is so wide a subject, that it cannot be properly treated in restricted lists. Every chemist, whether engaged in original researches, or employed in technological pursuits, follows a course peculiar to himself, and requires Apparatus and Chemicals which he must himself choose as suitable for his special purposes. It is hoped that the details given in this work, under the several heads into which it is divided, afford all the information which may be expected or required on the respective subjects.

Collections of Specimens of Minerals,

Illustrative of Mineralogy, Geology, and Metallurgy.

These Collections comprise Specimens from all parts of the world. They are well assorted; so fresh as to exhibit perfectly clean surfaces; and all neatly cut to uniform sizes. The more expensive Collections contain Specimens of considerable rarity and elegance, while such a principle of selection has been constantly followed, that even the cheapest collections present those Minerals with which it is most important for the student to become earliest acquainted. The specimens exhibit distinctly, in all cases, the characters whereby the various substances are discriminated, and the collections are accompanied by catalogues, or by tickets with all the specimens, which state the Name and Locality of every specimen.

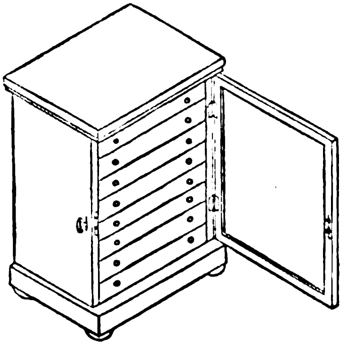
A. Collections of Specimens in Cabinets.

ELEMENTARY COLLECTIONS of MINERALS and ROCKS in MAHOGANY CABINETS.

The five following Collections are contained in handsome polished Mahogany Cabinets, opening with a door, or a pair of doors, and containing mahogany drawers. Every specimen is placed in a separate pasteboard tray. Size of specimens from 2 to 3 square inches.

The Cabinets for 100 specimens have 4 drawers; those for 150 specimens have 6 drawers; and those for 200 specimens have 8 drawers; as represented by Fig. 4884.

4880.	Cabinet of 100 Simple Minerals,	£3	3
4881.	Cabinet of 100 Rocks and Fossils,	3	13
4882.	Cabinet of 150 Simple Minerals,	4	10
4883.	Cabinet of 150 Rocks and Fossils,	4	0
4884.	Cabinet of 200 Minerals, Rocks, and Fossils, ...	6	0



4884.

4891. Collection of 54 Minerals, size one square inch, in 54 round trays, contained in a flat Pasteboard Cabinet, price 10s. 6d.

4893. Collection of 100 Minerals, carefully selected for experiments before the Blowpipe, in a box, price 18s.

4894. Collection of 50 Minerals for experiments before the Blowpipe, in a Pasteboard Cabinet, price 9s.

4895. Collection of 80 small fragments of Minerals for Experiments, named and in a box, price 12s.

4896. Mohr's Degrees of Hardness, choice specimens of Minerals, in box, price 7s.

4897. Von Kobell's Degrees of Fusibility of Minerals, 6 choice specimens, in a pasteboard box, price 7s. 6d.

4900. Fossil Infusoria for examination by the Microscope. A Cabinet containing twelve specimens of Minerals, Siliceous, Calcareous, Carboniferous, Ferruginous, consisting principally of the skeletons of Infusoria, in 12 bottles, in a box, 7s. 6d.

4901. Another Cabinet of Fossil Infusoria, containing 24 varieties, some of them rare, in bottles, in a box, 18s.

B. COLLECTIONS of MINERALS, not in Cabinets.

4910. Collection of 100 specimens, size 2 × 2 inches, 42s.
4911. Collection of 150 specimens, size 2 × 2 inches, 60s.
4913. Collection of 200 specimens, size 2 × 2 inches, £3, 13s. 6d.
4915. Collection of 500 specimens, size 3 × 3 inches, £20.
4916. Collection of 300 specimens, size 3 × 3 inches, £15.

C. COLLECTIONS of METALLIC ORES, not in Cabinets.

These collections contain specimens of the most important ores from which Metals and Metallic preparations are procured in the Arts.

4924. Collection of 100 specimens, size 2 × 2 inches, £4, 4s.
4925. Collection of 200 specimens, size 2 × 2 inches, £10, 10s.
4926. Collection of 200 specimens, size 3 × 3 inches, £16, 16s.

D. COLLECTION of ROCKS, not in Cabinets.

4931. Collection of 100 specimens, size 2½ × 2½ inches, 38s.
4932. Collection of 150 specimens, size 2 × 2½ inches, £2, 12s.
4933. Collection of 200 specimens, size 9 square inches, £6, 6s.
4935. Collection of 500 specimens, size 9 square inches, £20.

E. COLLECTIONS of FOSSILS, not in Cabinets.

4945. Collection of 100 Fossils, 45s.
4946. Collection of 200 Fossils, £6.
4947. Collection of 500 Fossils, £18, 18s.

F. COLLECTIONS of ROCKS and FOSSILS, not in Cabinets.

In these collections, the Rocks are arranged in the order of their superposition in the earth; and are accompanied by the Fossils that chiefly characterise the different strata.

4951. Collection of 150 Rocks and Fossils, £5.
4952. Collection of 200 Rocks and Fossils, £6.
4953. Collection of 300 Rocks and Fossils, £9.
4954. Collection of 500 Rocks and Fossils, £20.

4962. MINERAL ILLUSTRATIONS OF PHYSICAL GEOGRAPHY, for use in Schools. 100 specimens, size four to six square inches, 42s.

4963. A Glass Case, in which all the specimens may be seen at one view, size 3 feet by 2 feet, 31s. 6d.

This collection is adapted to enable a schoolmaster to explain the nature of different kinds of earth, stones, rocks, &c.; the order in which they occur in the crust of the earth; the simple minerals of which the rocks are composed; the geological strata in which metallic ores are found; the ores of some of the chief metals; the minerals which accompany the ores; the relation of coal, chalk, marble, sulphur, salt, gypsum, marl, pumice, &c., to other minerals and rocks, and to the chemical elements; with many other subjects relating to mineralogy, geology, agricultural chemistry, and physical geography.

MINERALS FOR ANALYSIS AND FOR TECHNOLOGICAL USES.

Price per Avoirdupois Pound.

	s.	d.
Alum Shale	1	6
Amber	3	6
Antimony, Sulphide	1	3
Anthracite		6
Arsenic, Native	5	0
Arsenical Iron	1	0
Asbestos,	3	0
Barium, Carbonate	1	0
„ Sulphate		6
Beryll	4	0
Cadmium Blende	5	0
Calcium Minerals:—		
Calc spar		8
Carrara Marble		6
Mountain Limestone		3
Dolomite		6
Arragonite	1	3
Fluor spar		6
Anhydrite		9
Gypsum, granular		6
„ foliated		8
Cerite	6	0
Chrome Iron Ore	1	0
Copper Ores:—		
Copper Pyrites	2	0
Grey Copper. *Fahlerz*	5	0
Cryolite	1	3
Feldspar		8
Graphite		10
Iron Ores:—		
Iron Carbonate	1	0
„ „ Clay Ironstone		4
„ Oxide Hematite	3	0
„ „ Red Fibrous	1	6
„ „ Brown Hydrate		8
„ „ Specular Ore	1	6
„ „ Loadstone	5	0
„ Sulphide. Pyrites	1	0
Kaolin	1	0
„ ground		6
Lead Ores:—		
Carbonate	2	6
Molybdate	15	0

	s.	d.
Lead Ores, *continued*—		
Phosphate, *green. Pyromorphite*	2	6
Sulphide, Galena	1	0
Lithium Ores:—		
Lepidolite	1	0
Lithia Mica	1	0
Petalite	4	6
Spodumene	5	0
Magnesite		8
Manganese Ores:—		
Pyrolusite	1	0
„ ground		3
Psilomelane		6
Marle		2
Mica	2	6
Mica, transparent plates, oz. 4s.		
Mesotype, oz. 1s.		
Nickel, Antimonial	8	6
„ Arsenical. *Kupfernickel*	8	6
Oligoclase	1	6
Olivine	2	6
Phosphorite	1	0
Plastic Clay		2
Prehnite		6
Rock Crystal	10	0
Rock Salt, transparent	1	0
Steatite	1	3
Strontium, Carbonate	1	0
„ Sulphate	1	6
Talc	1	0
Tin Oxide	8	0
Titanium Ores:—		
Nigrine	8	6
Rutile	9	0
Titanitic Iron	3	0
Tungstenum Ore:—		
Wolfram	1	6
Zinc Ores:—		
Silicate, *Galmei*		10
Red Oxide	1	6
Sulphide, *Blende*		9

CRYSTALLOGRAPHY.

4981. A set of 120 MODELS OF CRYSTALS, as described in J. J. Griffin's "System of Crystallography." See page 466.

These Models represent the most important Natural Crystals, both of simple and complicated forms. Their Size is from 2 to 4 inches in diameter. The Material of which they are formed is Cream-Coloured Biscuit Porcelain, which presents the following advantages:—The Models are much *stronger* than those made of paper. Their edges are sufficiently sharp, and their planes sufficiently even, to permit very good *approximate measurements* to be taken by means of the common goniometer. They can be *written upon*, either with a blacklead pencil, the marks from which can be effaced by india-rubber; or with common ink, which is easily removable by muriatic acid. Consequently, the names of the Crystals, or their symbols, or the angles across their edges, or the names of the minerals they represent, can be written upon them and removed at pleasure. These properties are not possessed in the same degree by Models made of glass or wood. When soiled, they can be *cleaned* by soap and water. Finally, they are *cheaper* than Models made of any other material.

4981. Price of the SET OF 120 MODELS, 40s.

4982. SINGLE MODELS OF CRYSTALS, 6d. each.

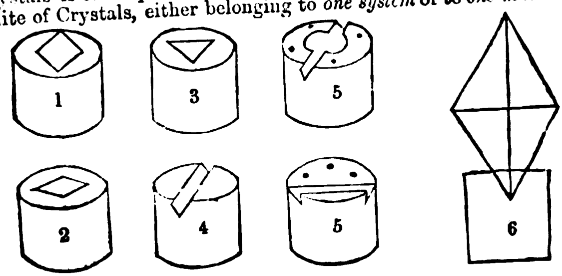
4983. Collection of 12 Models of Crystals, to show what is meant by the Six Systems of Crystallisation, 5s.

I. *Octahedral System:*—1. Cube. 2. Octahedron. 3. Dodecahedron. 4. Cube and octahedron. II. *Pyramidal System:*—5. Pyramid with square base. III. *Rhombic System:*—6. Rhombic prism. 7. Rhombic octahedron. IV. *Hexagonal System:*—8. Hexagonal prism. 9. Ditto, with pyramid. 10. Rhombohedron. V. *Oblique Prismatic System:*—11. Oblique prism. VI. *Doubly Oblique Prismatic System:*—12. Doubly oblique prism.

4984. Collection of 60 Models, arranged according to any specified system, 21s.

4988. SUPPORTS FOR MODELS OF CRYSTALS.

These supports are intended to hold Crystals in a proper position for Crystallographic examination, as represented by No. 6. They are useful for the purpose of exhibiting the Models in a Museum, or when a series of Crystals is to be placed before a Crystallographer for study. It is extremely convenient when a suite of Crystals, either belonging to *one system* or to *one mineral*, are to be examined, to have the means of placing the whole in a proper position for examination, and yet to have the hands at liberty to attend to pen or book.



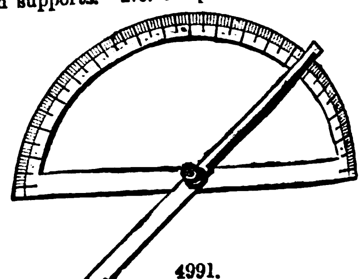
4988.

4989. The Supports, Nos. 1 to 4, Fig. 4988, are made of Pale Blue Biscuit Porcelain; No. 5, is made of Cedar, price 6d. each.

4990. An assortment of twenty Supports for Models of Crystals, 8s.

No. 1 supports all kinds of square based pyramids; No. 2 supports pyramids that have a rhombic base; No. 3 supports rhombohedrons and six-sided pyramids; No. 4 supports all Crystals with dihedral summits; No. 5 (cedar), with the aid of brass pins, supports such crystals as have unsymmetrical summits, and are not adapted to the porcelain supports. No. 6 represents the manner in which the Crystals are supported.

4991. GONIOMETER for measuring the angles of MODELS OF CRYSTALS, &c., where approximate results only are required. A cheap instrument for the student in Crystallography, 7s. 6d.



4991.

4992. UPRIGHT GLASS CASE to hold 120 Models of Crystals, 31s. 6d.

Pure Chemical Tests.

Avoirdupois Weight :—1 lb. = 16 oz. = 256 dr. = 7,000 grains.
1 oz. = 16 dr. = 437½ grains.
1 dr. = 27⅓ grains.

Imperial Measure :—1 gallon = 4 quarts = 8 pints = 160 fluid ounces.
1 gallon = 10 pounds of water = 10 decigallons.

QUANTITIES UNDER HALF A POUND ARE CHARGED AT THE PRICE PER OUNCE.

The Prices of Chemicals are subject to frequent variation.

Mineral Acids Packed for Travelling.

Corrosive and Combustible Chemicals cannot be packed with Apparatus or other goods for travelling, because it is necessary to "Declare" them when delivered to a Railway carrier, or sent on ship-board. They must therefore be put into a separate Package. The safest plan to pack the Mineral Acids is in stoppered blue glass bottles, standing upright in strong wooden cases, with wooden divisions between the bottles, and the spaces filled with straw, the cases being made to hold either four or six bottles.

EXPENSE OF CASES AND PACKING MATERIALS.

For 4 pint bottles, 3s.	For 6 pint bottles, 4s.
For 4 quart bottles, 4s.	For 6 quart bottles, 5s.
For 4 half-gallon bottles, 5s.	For 6 half-gallon bottles, 6s.

COST AND CONTENTS OF THE BOTTLES OF ACID.

The Price includes both Acid and Bottle.

PINT BOTTLES.	lb.	s.	d.
1. Sulphuric Acid, pure, sp. gr. 1·840,	2½	2	0
2. Hydrochloric Acid, pure, sp. gr. 1·120,	1½	1	4
3. Nitric Acid, pure, sp. gr. 1·380,	2	2	6
4. Sulphuric Acid, commercial, sp. gr. 1·845,	2½	1	0
5. Hydrochloric Acid, commercial, sp. gr. 1·160,	1½		10
6. Nitric Acid, commercial, sp. gr. 1·360,	1¾	1	9
7. Ammonia, commercial, sp. gr. 0·880,	1¼	1	5
8. Nitric Acid, commercial, fuming, sp. gr. 1·520,	1½	2	9
QUART BOTTLES (*Corbyn's*).			
1. Sulphuric Acid, pure, sp. gr. 1·840,	5	3	3
2. Hydrochloric Acid, pure, sp. gr. 1·120,	3	2	3
3. Nitric Acid, pure, sp. gr. 1·380,	4	4	9
4. Sulphuric Acid, commercial, sp. gr. 1·845,	5	1	6
5. Hydrochloric Acid, commercial, sp. gr. 1·160,	3	1	3
6. Nitric Acid, commercial, sp. gr. 1·360,	3½	3	0
7. Ammonia, commercial, sp. gr. 0·880,	2½	2	6
8. Nitric Acid, commercial, fuming, sp. gr. 1·520,	3	5	3
HALF-GALLON BOTTLES (*Winchester's*).			
1. Sulphuric Acid, pure, sp. gr. 1·840,	9½	6	0
2. Hydrochloric Acid, pure, sp. gr. 1·120,	6	4	0
3. Nitric Acid, pure, sp. gr. 1·380,	7	9	0
4. Sulphuric Acid, commercial, sp. gr. 1·845,	9½	2	6
5. Hydrochloric Acid, commercial, sp. gr. 1·160,	6	1	10
6. Nitric Acid, commercial, sp. gr. 1·360,	7	5	6
7. Ammonia, commercial, sp. gr. 0·880,	4½	4	0
8. Nitric Acid, commercial, fuming, sp. gr. 1·520,	6	10	0

	Ounce. s.	d.	Pound. s.	d.
Acid, Acetic, anhydrous,	4	6		
— — glac. opt. 60°,		5	4	0
— — — 50° B.P.,		4	3	0
— — — 32°,		3	2	6
— — Fort, B.P.,				9
— — Aromatic,		6	6	0
— Arsenic, pure,		4	3	0
— — liquid,			1	0
— Arsenious, pure, B.P.,			1	6
— Benzoic (from gum), B.P.,	1	6		
— Boracic, cryst., B.P.,		2	1	6
— — fused,	1	0	12	0
— Butyric, pure,	2	6		
— Carbazotic, pure, re-cryst.,		8	7	6
— — (Picric),		6	4	6
— Carbolic, pure, cryst.,		6	6	0
— — coml. white,		3	2	0
— Chromic, cryst.,	1	0	12	0
— Citric, pure,		8	8	0
— — coml.,		6	5	6
— Fluoric, strongest,		3	1	6
— — re-distilled,		4	3	0
— Fluosilicic,		3	1	6
— Formic, pure, concent.,	2	6		
— — sp. gr. 1·020, pure,		3	3	0
— Gallic, pure, B.P.,		9	8	6
— Hydrochloric, pure, sp. gr. 1·120,		1		6
— — coml., sp. gr. 1·160,				2
— Hydrocyanic (Scheele's),		4	2	0
— — B.P. or P.L.,		3	1	0
— Hydrofluosilicic,		3	1	6
— Hydrosulphuric Solution in glycerine,		4	3	0
— Iodic,	4	6		
— Malic, pure cryst.,	6	0		
— Molybdic,	2	0		
— Nitric, pure, sp. gr. 1·380,		2	1	0
— — „ „ 1·180,		2	1	0
— — coml., „ 1·360,				8
— — coml., „ 1·520, } — — fuming, }			1	6
— Oxalic, recryst.,		3	3	0
— — coml., B.P.,		2	2	0
— Phosphoric, anhydrous,	1	6		
— — glacial, pure,			7	6
— — cryst.,	1	0	12	0
— Picric (see Carbazotic),		6	4	6
— Pyrogallic, pure,	5	0		

	Ounce. s.	d.	Pound. s.	d.
Acid, Silicic (Silica), pure precip.,	1	0	12	0
— — coml., white,				6
— Succinic, cryst. pure,	3	0		
— Sulphuric, pure, re-distilled, sp. gr. 1·840,		1		6
— — coml. opt. 1·840°, about				2
— — Anhyd. (Specimen), 7s. 6d.				
— — Nordhausen,			1	4
— Sulphurous, strong,				10
— Tannic B.P., soluble,		6	6	0
— Tartaric, pure,		5	5	0
— — coml.,		4	3	6
— Titanic,	12	0		
— Tungstic, pure,	1	0	12	0
— Uric,	4	0		
— Valerianic, pure, anhydrous,	2	0		
— Vanadic, per dr. 12s.				
Alcohol, absolute, ·795, B.P.,		8	7	6
— sp. gr. ·805,		6	6	0
— 60° O.P., per gal. 36s.		4	4	0
— Methylated, 60° O.P., per gal. 6s., per pint 1s.				10
Aldehyde, pure,	3	0		
Alloy, fusible,	1	6		
Almond Meal,		2	1	0
Alum, pure, recryst.,		2		9
— coml., cryst.,		1		3
— Ammonia, pure,		2		9
— Chrome,		3	1	6
— Iron,		3	1	6
— Potash, pure,		2		9
Aluminum, metallic in sheet or wire,	15	0		
— in thin leaves, per book, 1s. 6d.				
— Acetate,	1	0	12	0
— Chloride, concent. sol.,		3	2	0
— Nitrate,		8	8	0
— oxide (Alumina, pure),	1	0	12	0
— — Hydrated, pure,		6	6	0
— Sulphate, purif.,		2	1	6
Amber,		3	3	0
Ammonia, Liq. fortiss., sp. gr. ·880,				8
Ammonium acet., cryst.,	1	6	15	0
— Bromide, pure, cryst., B.P.,		5	4	6

	Ounce s.	Ounce d.	Pound s.	Pound d.
Ammonium, Carbonate, resublimed,		3	3	0
— — coml.,		2	1	0
— Chloride, pure, cryst.,		2	1	6
— Chloride, coml.,		2	1	0
— Chromate,	1	0	12	0
— Bichromate,		10	9	0
— Hydrosulphuret (sulphide),		2		10
— Iodide, pure, cryst.,	2	0		
— Molybdate,	3	0		
— Nitrate, pure, cryst.,		2	1	6
— Oxalate,		4	4	0
— — recryst.,		6	6	0
— Binoxalate,		10	10	0
— Phosphate,		5	4	6
— Succinate,	3	0		
— Sulphate, pure,		2	1	0
— Bisulphate,		6	6	0
— Sulphide, solut. conc.,		2		10
— Sulphocyanide,		4	4	0
— Urate, pure,	3	0		
Aniline, coml. opt.,		6	5	0
— Sulphate,		8	7	6
Antimony, Metallic,		3	3	0
— — pure,	1	6		
— Chloride, ter. cryst.,	1	0	12	0
— — Penta (Liquid, anhydrous),	1	8		
— Oxide, ter. B.P.,			3	0
— Sulphide, ter. (black) B.P.,		2	1	0
— — Amorphous (Kermes native min.),		6	6	0
Arsenic, Metallic, pure,		4	4	0
— Iodide,	2	0		
— Sulphide, ter. lump (Orpiment),		2	1	0
— — Penta, lump, Realgar,		2	1	0
Argol, Red,		2	1	0
— White,		2	1	9
Asbestos,		3	3	0
Barium metal, per dr. £3.				
— Acetate (dry),		4	4	0
— Carbonate, puriss. precip. by ammonia,		6	6	0
— — pure, by soda,		3	2	6
— — precip. coml.,		2	1	0
— Carbonate, native,				6
— Chlorate,		6	6	0
— Chloride, pure, recrys., B.P.,		3	1	6

	Ounce s.	Ounce d.	Pound s.	Pound d.
Barium, Chloride, coml.,				6
— Nitrate, pure, recrys.,		3	1	6
— — coml.,				6
— Oxide Baryta, pure,		6	6	0
— — Hydrate (Baryta Hydrate),		6	5	0
— — Hydrate, Baryta Solu. (Baryta water),		2	1	0
— Peroxide (Hydrate),		10	9	0
— Sulphate, pure, precip.,		3	1	6
— — native,				6
— Sulphide,		5	4	6
Bee's Wax,		3	2	6
Benzole, puriss. by Sulphuric Acid,		6	6	0
— pure, B.P., No. 1,		4	3	0
— — — No. 2,		3	1	6
Bismuth, Metallic, pure,	3	0		
— purif., B.P.,	1	4	16	0
— Metallic, coml.,	1	0	12	0
— Chloride,	2	6		
— Nitrate, cryst.,	1	6		
— — sub. B.P. (Trisnitrate),	1	0	12	0
— Oxide, pure, B.P.,	1	4	16	0
— — per,	4	6		
Bone Ash, for Cupellation, fine,		2	1	0
— — — coml.,		1		6
Borax, Glass of,		10	9	0
Boron, pure, cryst., per gr., 2s. 6d.				
Bromine, pure,	1	0	10	0
Brucine, pure, cryst.,	1	4	16	0
— Sulphate,	1	4	16	0
Cadmium, metal,	1	6	18	0
— Bromide, pure, cryst.,	1	4	16	0
— Carbonate,	2	0		
— Chloride,	2	0		
— Iodide, opt., pure,	1	6		
— Nitrate,	2	0		
— Oxide,	3	0		
— Sulphate,	2	0		
— Sulphide,	2	0		
Coesium Chloride, per gr. 1s. 6d.				
Calcium, Metallic, per gr. 3s.				
— Borate,		6	6	0
— Bromide,	1	4	16	0
— Carbolate, rough (disinfecting purposes),				6

	Ounce. s.	Ounce. d.	Pound. s.	Pound. d.
Calcium, Carbonate, pure, precip., B.P.,				10
— — puriss. (precip. by ammonia),		6	6	0
— — Native white marble,				6
— — (Calc spar),		3	1	6
— — Iceland spar,		9	8	0
— Chlorate,	1	6		
— Chloride, pure, anhydrous, B.P.,		3	1	6
— — cryst., pure,		2	1	6
— — rough, fused,		1		6
— — common, in lumps,				4
— Fluoride, pure,		8	7	6
— — native (Fluor spar),				6
— Hypochlorite (Chloride of Lime), B.P.,		1		6
— Iodide,	2	6		
— Nitrate,		4	3	0
— Oxalate,		5	4	0
— Oxide, pure (quick lime from marble),		4	3	0
— — coml., B.P. (quick lime),				6
— — Hydrate, B.P. (slaked lime),				6
— Phosphate, precip. B.P.,		3	1	6
— — — pure,		4	3	0
— Phosphide,	1	0	9	0
— Sulphate, pure, precip.,		4	3	0
— — coml. (plaster of Paris),				4
— Sulphide,		4	3	0
— — Solut.,				6
— Sulphite, pure, precip.,		4	3	0
— — coml.,				9
— — Bisulphite Solut.,				6
Camphor,		4	3	0
Canada Balsam,		4	3	0
Caoutchouc, Liquid in cans, ½ lb. can, 1s. 9d.			3	0
Carbon, Bisulphide puriss.,		6	6	0
— — purif. (redrawn),		3	1	6
— — coml. opt.,		2		9
— Chloride-mono,	7	6		
— Chloride Sesqui,	5	0		
— — Tetra, pure,	1	0	12	0
Cerium Metal, per grain 2s. 6d.				

	Ounce. s.	Ounce. d.	Pound. s.	Pound. d.
Cerium, Chloride,	2	6		
— Nitrate,	1	10		
— Oxide,	3	0		
— Sulphate,	2	6		
Chameleon Mineral,		4	2	6
Charcoal, animal, pure, B.P.,		5	4	6
— — coml. B.P. (Bone Black),				6
— Bark,		3	2	6
— for Blowpipe, best,		3	2	6
— wood sticks,				3
— powder,				6
Chlorine (Aqueous solution, B.P.),				6
Chloroform, pure, B.P.,		10	9	0
— Methylated,		5	4	6
Chromium Metal, per dram, 10s.				
— Chloride, Sesqui (sublimed),	6	0		
— — — Solut.,	3	0		
— Oxide, green,	6	0		
Cobalt metal, pure,	12	0		
— — coml.,	6	0		
— Carbonate,	2	6		
— Chloride,	2	6		
— Nitrate,	2	6		
— Oxide, pure Hyd.,	6	0		
— — coml. opt.,	2	6		
— Sulphate,	1	6		
Cochineal,		5	4	6
Copper foil, electrotype,		5	4	6
— Filings,		4	3	0
— Metallic, flattened wire,		10	10	0
— — turnings,		3	2	0
— Acetate, cryst.,		6	6	0
— Arseniate,		6	6	0
— Carbonate, precip.,		4	3	0
— Chloride, cryst., pure,		4	3	0
— — coml.,		2	1	6
— — Oxychloride,		5	4	0
— Chlorate,	1	6		
— Iodide,	1	6		
— Nitrate, cryst.,		3	2	0
— Oxide, pure (from Nitrate for organic analysis),		6	6	0
— — pure, dense,		9	8	0
— — coml. (black),		4	3	0
— Sulphate, puriss.,		4	3	0
— — recryst.,		2	1	0
— — coml,		2		9

	Ounce. s.	Ounce. d.	Pound. s.	Pound. d.
Copper, Sulphate, Ammonio,		4	3	0
— Sulphide, precip.,		5	4	6
— Tartrate,		6	6	0
Cotton Wool, best,		4	4	0
— — coml.,		3	1	6
Creosote, B.P., from wood tar,	1	0	12	0
Dextrine, opt.,		2		9
Didymium, Sulp. pure, per dram, 5s.				
Distilled water, B.P., per gallon, 1s.				
Dutch Metal, per book, 2d.				
Ether, from pure spirit, sp. gr. ·720, B.P., absolute,		10	9	0
— from pure spirit, ·735, B.P.,		8	7	6
— from Methylated spt., ·730 (highly puri.),		5	4	0
— ·730 (ordinary),		3	2	0
Fireclay, cwt. 7s.,				3
Flux (Black) from cream of tartar,		8	7	6
— Fresenius, pure,		8	7	6
— white (from cream of tartar,		8	7	6
Fusel Oil,		4	3	0
Fusible Metal,	1	6		
Gall Nuts, in powder,		4	2	6
Glycerine (Price's), best,		4	3	0
— coml.,		2	1	0
Gold, pure, precip., per dram, 12s.				
— Leaf, metallic, per book, 2s.				
— Chloride,	73	0		
— — 15 grn. tubes, 3s.				
— — and soda, pr. dr. 5s.				
— Oxide, per dram, 12s.				
Grape Sugar,		2	1	0
Gum Arabic,		3	2	0
— Benzoic,		5	4	0
Hydrogen, perox., 10 vol.,		6	5	0
Indigo,		9	8	0
— Sulphate, Solution, strong,		4	3	0
Iodine, pure, resublimed,	1	6		
— Bromide,		4	2	6
— Chloride,		4	3	0
Iridium, per dram, 8s.				

	Ounce. s.	Ounce. d.	Pound. s.	Pound. d.
Iridium, Chloride, per dr. 7s.				
— Perchloride anhyd. (sublimed),		3	1	6
Iron Chlor., per. (cryst.),		3	1	6
— — proto,	1	0	12	0
— Chromate,		6	6	0
— Filings,		2		9
— Wire, pure,		9	7	6
— Iodide,	1	0	12	0
— Lactate,		8	7	6
— Nitrate, per.,	1	0	12	0
— — — Solut., B.P.,		2	1	0
— — proto, Solution,		3	1	6
— Oxide Magnetic, pure precip., B.P.,		5	4	0
— — Sesqui, coml.,		2		9
— Phosphate, per. (white),		6	6	0
— Phosphide,	4	0		
— Sulphate, per. (powder),		5	4	0
— — (Liquor), B.P.,		2	1	0
— — per. and Ammonia (Mohr's),		4	3	6
— — proto., pure,		1		6
— — — gran. dry, B.P.,		3	1	6
— — — and ammonia, double salt for photography,		2	1	0
— Sulphide, fused,				6
Kaolin, pure,		2	1	0
— coml.,				6
Lead, pure,		6	6	0
— Assay,		3	2	0
— granulated,		2		9
— Acetate, pure, recryst.,		3	1	6
— — coml.,		2	1	0
— — sub. solut.,		3	2	0
— Carbonate. precipit., B.P.,		4	3	0
— — coml.,		2	1	0
— Chloride,		3	2	0
— — Oxy.,		4	3	0
— Chromate, pure, precip.,		5	4	6
— — — fused,		6	6	0
— Iodide, B.P.,	1	0		
— Nitrate, pure, recrys., B.P.,		3	1	6
— — coml.,		2		9
— Oxide (Lith.), B.P.,		2		9
— — per. pure,		6	6	0
— Sulphate, precip. pure,		3	1	6
— Sulphide,		4	3	0

	Ounce s.	Ounce d.	Pound s.	Pound d.
Lead, Tartrate,		5	4	6
Liq.Hydr.Nit.acid,B.P.,		5	4	0
— potass., B.P.,				6
— — concent., 1270°,		3	1	6
— — Permanganat, B.P.,		2		9
— Soda, B.P.,				6
— — concent.,		3	1	6
Lithium metal,per grain, 3s.				
— Carbonate, B.P.,	2	0		
— Chlorate,	6	0		
— Chloride,	3	0		
— Oxide (pure Lithia),	6	0		
— Sulphate,	2	6		
Litmus, B.P.,		3	2	6
— — (blue and red), in books, per dozen, 1s. 6d.				
— Tincture, B.P.,		5	4	6
Lycopodium powder,		6	6	0
Magenta, cryst.,	2	6		
Magnesium,pure Metall.,	16	0		
— in wire or riband,	16	0		
— powder,	12	0		
— Carbonate(light)B.P.,		4	3	0
— Chloride, Hydrated cryst., pure,		3	2	0
— Nitrate,		4	2	6
— Oxide (Cal.), light, B.P.,		5	4	0
— Sulphate (recryst.),		2	1	0
Manganese metal, per dram, 7s.				
— Chloride,		4	3	0
— Nitrate,		4	3	0
— Oxide, pure hyd., precip.,		6	6	0
— — coml. opt., B.P.,				6
— — per. native, ground,				3
— — — coarse lumps,				3
— — — cryst.,			1	6
— Sulphate, cryst.,		6	6	0
— — pulv., pure,		3	2	6
Marine Glue,		3	1	6
Mercury, Metallic, *varies.*				
— Chloride, ammonio, B.P.(white precip.),		8	7	6
— — Bi. B.P. (Corrosive Sublimate),	1	0	10	0
— Chloride, B.P., sublimed (calomel),		9	8	0

	Ounce s.	Ounce d.	Pound s.	Pound d.
Mercury, Cyanide,	2	0		
— Iodide,Bi.(Red),B.P.,	1	0	16	0
— — proto,	1	0	12	0
— Nitrate, per solid,		10	9	0
— — proto, cryst.,		10	9	0
— Oxide, per. (orange) precipitated, B.P.,		10	9	0
— — — (Red), by Nitric acid, B.P.,		10	9	0
— — proto (black),	1	0	11	0
— Sulphate, per. B.P. (for Batteries),		6	6	0
— — proto (for Batteries),		7	7	0
— Sulphide (black),		6	5	0
— — per. (Red, Vermilion),		6	6	0
— Sulphocyanide,		10	9	0
Microcosmic Salt,		6	6	0
Milk, Sugar,		3	2	0
Molybdenum metal, per dram, 3s.				
— Oxide,	6	0		
Naphtha, Potassium,		6	6	0
Nickel, metal, in cubes,	2	0		
— Chloride,	1	0		
— Nitrate,	1	0		
— Oxide, Hydrated,	2	6		
— Sulphate, cryst.,	1	0		
Nitrobenzole, opt.,		4	3	0
Oil,Olive,per pint, 1s. 6d.				
Osmium, per dram, 20s.				
Oxygen Mixture,		3	2	0
Palladium metal, per dram, 16s.				
— Chloride, per dr. 16s.				
— — Solution,	5	0		
— Nitrate, per dram 16s.				
— — Solution,	5	0		
— Oxide, per dram, 16s.				
Paraffin,		4	2	6
Phosphorus,		6	3	0
— Amorphous, coml.,		8	6	0
— Solution in Ether,		10	7	6
Platinum Foil or Wire,	33	0		
— Sponge,	40	0		
— Black, B.P.,	52	0		
— Bichloride,	24	0		
— — Solut., B.P.,	4	0		
Platinised Silver Sheet,	12	0		
Plumbago, Electrotype,		4	2	6
Potassium, Metallic,	9	0		
— — 50grs.in bottle,2s.				

	Ounce. s.	Ounce. d.	Pound. s.	Pound. d.
Potassium, Metallic, 20 grains in bottle, 1s.				
— Acet., B.P.,		3	2	6
— Antimoniate (Solub.),	1	0	12	0
— Arseniate,		5	4	6
— Arsenite,		5	4	6
— Borate, neutral,		5	4	6
— Bromide, pure, B.P.,		5	4	0
— Carbonate, pure,		6	6	0
— Bicarbonate, cryst., B.P.,		3	1	6
— — (powder),		4	2	0
— Chlorate, pure, recryst., B.P.,		3	2	0
— Chloride, recryst.,		2	1	0
— — coml.,				6
— Chromate, pure, cryst.,		4	2	6
— — fused,		6	5	6
— — Bi., recryst.,		3	1	6
— — — coml.,		2	1	0
— Cyanide, cryst.,	2	0	18	0
— — fused, opt. (Gold Cyanide),		9	7	6
— — — coml. (Silver do.),		4	2	6
— — Sticks,		5	4	0
— Ferridcy., pure, B.P.,		9	8	0
— — coml. (Red prussiate of potash),		5	4	0
— Ferrocyanide, pure, B.P.,		5	4	0
— — coml. (yellow prussiate potash),		4	2	6
— Fluoride,	1	0	12	0
— Hydrosulphuret,		3	1	6
— Hyposulphate,	6	0		
— Hyposulphite,		4	3	0
— Iodide, pure, B. P., *varies*,	1	8		
— Nitrate, pure, recrys., B.P.,		2	1	4
— — coml.,		2		10
— Nitrite,		5	4	6
— Oxalate, neutral,		5	4	6
— — Bin.,		5	4	6
— — Quadra (Salts of Sorrel),		4	3	0
— Oxide (Caustic Potash), purif. by Alcohol,		8	6	0
— — coml., white (cake),		3	2	6
— — sticks (Potassa Fusa), B.P.,		3	2	6

	Ounce. s.	Ounce. d.	Pound. s.	Pound. d.
Potassium, Permanganate, cryst., B.P.,		6	5	6
— — recryst.,		10	9	0
— — fused,		6	5	0
— Phosphate,		6	6	0
— Silicate, opt. (white),		5	4	0
— — Solut.,				6
— Sulphate, cryst., B.P.,		2	1	0
— — coml.,		2		8
— Bisulphate, fused,		2	2	0
— Sulphide, opt. B.P. (Liver of Sulphur),		3	1	6
— Sulphocyanide,		8	7	6
— Tartrate (neut.), B.P.,		4	3	0
— — Bi. cryst. (Cream of Tartar),		5	4	6
— — and Soda, cryst. (Rochelle Salt),		3	2	0
— Tungstate,	1	0	12	0
Pumice Stone,				8
Quinine, Sulphate, neutral (Soluble),				
Rhodium, per dram, 16s.				
Rouge, Jeweller's,		9	8	0
Rubidium, Alum,		8	7	6
— Chloride, per dram, 7s.				
Ruthenium, per dr. 45s.				
Rutile,		2	1	0
Saffron,	4	0		
Selenium, per dram, 2s.,	18	0		
Shellac,		4	3	0
Silica, pure, precip.,	1	0	12	0
— coml., white,				6
Silver, Metallic, pure,	10	0		
— — leaf, per book, 1s. 6d.				
— Carbonate,	9	0		
— Chloride,	7	6		
— Cyanide,	9	0		
— Iodide,	9	0		
— Nitrate, pure, recryst.,	4	6		
— — fused, pure,	4	6		
— Oxide, pure, B.P.,	9	0		
— Sulphate,	9	0		
Soap Cyanogen,		8	6	0
Sodium Metallic,	1	6	16	0
— — 150 grains in bottle, 1s.				
— Acetate, pure, B.P.,		2	1	0
— Arseniate, cryst.,		6	4	0
— Arsenite,		7	5	0
— Borate, neutral,		5	4	6

	Ounce. s.	Ounce. d.	Pound. s.	Pound. d.
Sodium, Borate, Bi. fused (Glass of Borax), .		10	9	0
— — — cryst., .		2	1	6
— Bromide, dry, . .	1	0	12	0
— Carbonate, pure, cryst.,		3	1	6
— — pure, dry, .		4	3	0
— — coml., anhyd., .		2		9
— — Bi. cryst., .		2		9
— Chloride, pure, .		3	1	6
— pure, Rock salt, .		2	1	0
— pure, fused, . .		5	4	0
— Hydrosulphuret, .		3	1	6
— Hyposulphite, pure,				6
— — recryst., .		2	1	0
— Iodate, . . .	4	6		
— Iodide, dry, . .	1	8	18	0
— Nitrate, recryst., B.P.,		2	1	0
— Nitrite, . . .		5	4	6
— Nitro-prusside, .	6	0		
— Oxide (Caustic Soda), puriss. (from Sodium), . .	1	6	16	0
— — purif. by Alcohol,		7	6	0
— — coml. (white, stick), B.P., . .		4	2	6
— — coml., lump, .		2		9
— Phosphate, recryst.,		2	1	0
— — coml., . .		2		9
— — Ammonia (Microcosmic Salt), .		6	6	0
— Silicate, white, fused,		5	4	0
— — coml., . .		2		9
— — Solution, conc.,				6
— Stannate, . .		3	1	6
— Succinate, . .	3	0		
— Sulphate, pure, recrys., B.P., ...		2	1	0
— Bisulphate, fused, .		3	1	6
— Sulphide, cryst., .		4	3	0
— Sulphite, . .		1		6
— — recryst., . .		3	1	6
— — Bisulphite, .		3	1	6
— — Solut., sp. gr. 1·330, . . .		2	1	0
— Sulphocyanide, .		10	9	0
— Tartrate, neutral, .		4	3	0
— Bitartrate, . .		4	3	0
— Tungstate, pure, .		3	1	6
— — coml., . .		2		9
Soda Ash, . . .		1		6
— Lime, . . .		4	3	0
Starch powder, . .		1		6
Stearine, . . .		5	4	0

	Ounce. s.	Ounce. d.	Pound. s.	Pound. d.
Strontium, per gr. 2s. 6d.				
— Carbonate, precip., .		4	2	6
— Chlorate, . .	1	6	15	0
— Chloride, . . .		2	1	0
— Nitrate, pure, recrys.,		3	1	6
— — pure, dry, .		4	2	0
— — coml., . .		2		9
— — coml., dry, .		2	1	0
— Oxide (Strontia, pure), . . .	1	0	12	0
— Sulphate, precip., .		4	2	6
Sugar, Grape, . .		2	1	0
— Milk, B.P., . .		3	3	0
Sulphur, Roll, . .				2
— Sublimed, . .				6
— Precipitated, . .		2	1	0
— Iodide, B.P., . .	1	4	14	0
Sulphuretted Hydrogen, Sol. in Glycerine, .		4	3	0
Tellurium, per dram, 7s.				
Thalluim, metal, pure, per dram, 2s. 6d.				
— Chloride, per dr. 2s. 6d.				
— Nitrate, „ 2s. 6d.				
— Sulphate, „ 2s. 6d.				
Tin, metal, grain Tin, .		4	3	0
— — granul., B.P., .		5	4	0
— — Foil, pure, .		4	2	8
— — — coml., .		3	1	6
— — Powder, . .		10	9	0
— Chloride, Bi. Anhyd.,	2	0		
— — per. Solution, sp. gr. 1350, . .		2	1	0
— — proto. cryst., pure, . . .		4	3	0
— — — — coml.,		3	1	6
— — — Solut., .		2	1	0
— Oxide, proto., pure (black), . .		6	6	0
— — Bi. pure (white),		6	6	0
(grey), Putty-Powder, . .		4	3	0
Titanium, per dr. 15s.				
Tripoli, opt. (for photography), . .		5	4	6
Tungsten metal, pure, .	12	0		
— — coml., . .	1	6		
— Chloride, . . .	24	0		
— Oxide, . . .	3	0		
Turpentine, purif., .			1	6
Turmeric, root and powder, . . .		3	2	6
Uranium, per dr. 18s.				

	Ounce.		Pound.	
	s.	d.	s.	d.
Uranium, Acetate, .	2	6		
— Nitrate, pure, cryst.,	3	0		
— Oxide, pure (orange),	2	0		
— — — (black), .	4	6		
Urea, pure, . . .	4	6		
— Nitrate, . . .	4	6		
Vanadium, Chloride, .	12	0		
Water, dist., per gall. 1s.				
Wax, pure, white, .		6	6	0
Wolfram (see Tungsten), pure, . . .	12	0		
— — coml., . .	1	6		
Wool, Cotton, coml., .		3	1	6
— — — best, .		4	4	0
Yttrium, Oxide, per dram, 12s.				
Zaffre, ...		6	6	0
Zinc, pure, redistilled, .		10	9	0
— purified from Arsenic (Sticks), . .		5	4	0

	Ounce.		Pound.	
	s.	d.	s.	d.
Zinc, granulated, . .		2		9
— Foil, . . .		6	6	0
— Carbonate, precip., .		4	3	0
— Chloride, pure, white, fused, . . .		3	2	0
— — pure, in sticks,		5	4	0
— — coml., fused, .		2	1	0
— Iodide, . . .	2	0		
— Nitrate, . . .		4	3	0
— Oxide, pure, . .		3	2	0
— — coml., . .		2	1	0
— Sulphate, cryst., B.P., . . .		1		6
— — recryst., . .		2	1	0
— Sulphide, . .		5	4	0
Zircon, . . .	6	0		
Zirconium, pure, per grain 4s.				
— Oxide, per dram 10s.				

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