

“On the Degree of Accuracy displayed by Druggists in the Dispensing of Physicians’ Prescriptions in different towns throughout England and Scotland,”* by WILLIAM THOMSON, F.C.S.

The results obtained by Mr. Allen, the public analyst for Sheffield, a short time ago in reference to the inaccuracies displayed by druggists in making up prescriptions, led me to believe that it would be interesting to have the same prescription dispensed by different druggists, in different parts of England and Scotland, and by analysis to decide the *range* of inaccuracies, if any. By the aid of my friend, Dr. Sinclair, of Manchester, to whom I am indebted for much subsequent help, I was furnished with two ordinary prescriptions, the principal ingredients of which admitted of very accurate determination, as I shall afterwards show.

The prescriptions were as follows :—

R. Potass Iodid..... ℥ij Sp. Chlorof. ℥j Aq. ad ℥vj M. ℞ss ter die.		R. Zinci Sulphat. ʒij Aq. Pur..... ℥ij M. Fiat Lotio.
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The processes of analysis were so simple for both that it leaves little doubt as to the accuracy of the results. The specific gravity of each solution was first taken. 100 grains measure at 60° Fahr. were then placed in clean, accurately tared and marked platinum capsules, weighing from 180 to 200 grains each; the fluids were then carefully evaporated to dryness on a water bath, those containing the potassium iodide being afterwards heated in an air-bath at 220° Fahr. till they ceased to lose weight, whilst those containing the zinc sulphate were dried at 220° Fahr. and afterwards heated to dull redness to drive off the last molecule of water

* The facts contained in this paper were accepted by the Committee of the Pharmaceutical Society of Great Britain, to be read before them, and subsequently, on the day advertised by them for its reading, rejected by the Council.

of crystallization, and the anhydrous zinc sulphate calculated into the crystalline or hydrated zinc sulphate; these prescriptions, then, contained no ingredient which could interfere with the direct determination of the salt introduced. I give the dispensers, in this paper, the advantage of not estimating the actual proportion of the pure salt, but the total, of what had been added by them. The first prescription should have been made up to a total fluid measure of 6 ounces (2625 grains) which quantity should have contained 120 grains of potassium iodide. The second prescription should have been made by adding 40 grains of crystallized zinc sulphate to 2 ounces of water, which would make a total fluid measure of 893 grains, but as few gave either the exact measure of liquid, or weight of solid, I found it necessary to make three columns of figures, in the following tables, for each prescription; the first to show the amount of liquid measured out; the second to show the total amount of solid weighed out; and the third, as a comparison of the actual strength of the different fluids, which is made by calculating the amount of potassium iodide which would be contained in exactly 6 ounces (2625 grains measure) of the mixture, and the amount of zinc sulphate which would be contained in exactly 893 grains measure of the lotion, supplied by each druggist.

It will, of course, be clearly seen, that if the potassium iodide or zinc sulphate were damp, or in bad condition, although the weighings may have been made with absolute accuracy, the actual amount of the salts found on analysis would be less than that weighed; but this is equally a fault, because dispensers ought to have all their drugs in good condition. The following table will show the results of the analysis of eighty-one samples of the potassium iodide mixture, and the same number of the zinc sulphate lotion, one sample of the mixture, and one of the lotion, having

been dispensed by each druggist; besides which, at the suggestion of Dr. Sinclair, I have annexed the prices charged by each, for the two bottles, as in his opinion it might prove of general interest to dispensers, and will make the table more perfect, because from those who charge most, the greatest degree of accuracy should be expected. I may further state, that from each important town, I endeavoured as far as possible to have one lot dispensed by a druggist having the highest reputation and another by one of the lowest class, but I found it difficult to carry out this exactly, so that the prescriptions have been made up more generally by high class or respectable druggists than by those of a lower class. I have, however, as far as possible, marked those who could be recognised as having decidedly large and respectable shops, and those that were decidedly low class; the others may all be accepted, I believe, as respectable, and many may even be termed high class druggists.

TABLE I.

No.	Name of Town, &c.	Designation of Shop.	Prescription containing IODIDE OF POTASSIUM.			Prescription containing SULPHATE OF ZINC.			Prices.
			Total amount of Fluid measured out by the Druggist.	Total amount of Potassium Iodide weighed out by the Druggist.	Strength equal to amount of Iodide contained in 6 fluid ounces.	Total amount of Fluid measured out by the Druggist.	Total amount of Zinc Sulphate weighed out by the Druggist.	Strength equal to amount of Sulphate contained in 893 fluid grs. (about 2 ozs.)	
			Grains, measure.	Grains, weight.	Grains, weight.	Grains, measure.	Grains, weight.	Grains, weight.	
According to the prescriptions the solutions <i>ought</i> to contain,									
			(6 oz.) 2,625	120	120	(about 2 ozs.) 893	40	40	s. d.
<i>Scotland.</i>									
1	Aberdeen	Large	2650	119.3	118.1	860	40.1	41.7	1 6
2	"	Medium.	2650	120.6	119.4	910	41.2	40.4	1 6
3	Small village in } Kincardineshire }	"	2830	122.5	113.7	890	36.5	36.6	2 0
4	Cupar Fife	"	2740	128.5	123.1	850	40.4	42.5	1 10
5	Inverness	Large	2760	122.3	116.3	760	39.3	46.1	2 2
6	"	Medium.	2840	118.7	109.7	910	41.2	40.4	1 8
7	Banff	"	2710	120.0	116.6	940	47.4	45.0	1 6
8	"	"	2800	122.4	114.7	810	36.1	39.8	1 1
9	Dundee	Large	2590	120.7	122.3	870	41.2	42.3	2 2
10	"	Medium	2740	119.7	114.7	910	35.7	35.0	1 6
11	Glasgow	Large	2730	103.6	99.6	810	45.2	49.8	2 2
12	"	Medium	2520	116.4	121.3	880	36.5	37.1	2 4
13	"	Low	2600	116.7	117.9	950	42.5	39.9	2 2
14	Edinburgh	Medium	2520	119.4	124.4	870	42.3	43.4	2 4
15	"	Large	2600	135.7	137.1	910	40.5	39.8	2 6
16	"	Low	2790	128.9	121.3	860	32.5	33.7	2 0
17	Airdrie	Medium	2750	141.6	135.2	860	43.2	44.9	2 0
18	"	"	2800	121.8	114.2	920	41.3	40.1	2 6
19	Greenock	"	2320	120.4	136.2	810	53.8	59.3	1 10
20	"	Large	2440	121.5	130.7	800	40.9	45.7	2 8
21	Dumfries	Medium	2580	120.5	122.6	940	45.7	43.4	2 0
22	"	"	2490	127.6	134.5	920	41.6	40.4	2 0
<i>England.</i>									
23	Carlisle	Medium	2590	112.9	114.5	890	39.3	39.5	2 0
24	"	"	2810	102.1	95.4	965	40.7	37.7	2 0
25	Lancaster	"	2560	121.6	124.7	825	41.0	44.4	1 8
26	"	"	2730	120.7	116.6	820	39.9	43.4	1 10
27	Preston	Low	2700	116.9	113.7	920	35.2	34.2	2 0
28	"	Large	2560	118.3	121.3	920	56.1	54.4	2 6
Manchester :									
29	City	"	2590	121.6	123.3	885	38.3	38.7	2 9
30	"	"	2660	123.2	121.6	1020	39.8	34.8	2 8
31	"	"	2750	135.9	129.7	910	41.8	41.0	2 8
32	"	Medium	2360	118.3	131.6	900	39.9	39.6	2 4
33	"	Large	2670	115.3	113.4	870	37.8	38.8	2 9
34	Oxford-street	Medium	2650	114.1	113.0	900	40.9	40.6	2 9
35	"	Large	2630	119.0	118.8	940	40.4	38.3	2 9
36	Didsbury	Medium	2610	119.8	120.5	965	42.1	39.0	2 6
37	Strangeways	"	2700	113.0	109.8	830	38.7	41.7	2 0
38	"	"	2800	121.8	114.2	870	40.8	41.8	1 0
39	Lower Broughton	"	2400	116.6	127.5	840	38.3	40.7	2 4
40	Deansgate	Low	2520	104.2	108.5	1190	45.6	34.2	1 6
41	Gt. Ancoats-st.	"	2630	119.1	118.9	860	40.4	42.0	2 0
42	Ardwick	"	2300	117.8	134.4	860	57.2	59.3	1 6
43	Pendleton	Medium	2690	120.8	117.9	820	44.0	47.9	2 2
44	"	"	2720	117.8	113.6	900	40.1	39.8	2 6
45	Patricroft	Low	2560	107.6	110.3	930	45.4	43.6	2 0
46	"	"	2780	119.4	112.7	950	39.1	36.8	2 0
47	Eccles	Medium	2820	119.1	110.9	900	41.5	41.2	2 6
48	"	Low	2620	126.7	126.9	960	39.9	37.1	1 8
49	Stretford-road	Medium	2590	123.0	124.8	900	46.0	45.7	2 4
50	Stretford	"	2440	116.5	125.4	950	41.5	39.0	2 0
51	"	"	2620	120.0	120.5	830	42.3	45.4	1 9
52	Bowdon	"	2590	110.9	112.4	840	28.6	30.4	2 3
53	"	"	2600	114.9	116.0	990	39.7	35.8	2 6
54	Altrincham	Low	2550	104.8	107.9	810	8.1	8.9	2 0
55	"	Medium	2660	126.1	124.4	800	45.3	50.6	2 0
56	Southport	"	2670	122.8	120.8	940	38.2	36.3	2 6
57	"	Low	2670	99.9	98.2	960	22.6	21.0	1 6
58	Blackpool	Medium	2520	120.9	126.0	890	41.7	41.8	2 2
59	"	"	2560	116.7	119.7	955	42.5	39.8	2 2
60	Oldham	Low	2620	60.5	60.6	985	31.8	28.8	1 4
61	Ashton-under-Lyne	Medium	2720	122.1	117.9	900	39.4	39.1	2 0
62	Warrington	"	2820	125.8	117.1	850	38.9	40.9	1 9
63	"	"	2940	119.1	106.3	960	38.3	35.6	2 0
64	Nantwich	"	2680	119.5	117.1	890	39.6	39.8	1 10
65	Derby	"	2810	120.3	112.4	980	39.8	36.3	1 6
66	"	Large	2710	121.1	117.3	840	41.9	44.6	2 2
67	Loughborough	"	2550	116.3	119.7	880	38.6	39.1	1 6
68	"	Medium	2690	44.2	43.1	930	39.9	38.3	1 1
69	Nottingham	"	2640	128.8	128.1	890	39.6	39.8	1 4
70	"	Large	2690	122.4	119.4	850	40.0	42.0	1 0
71	Kegworth	Small	2530	116.9	121.3	910	40.2	39.4	2 9
72	Chesterfield	Medium	2640	117.7	117.1	920	36.9	35.8	1 9
73	Birmingham	Large	2580	119.5	121.5	810	39.8	43.9	2 2
74	"	Low	2520	115.7	120.5	900	38.0	37.7	1 6
75	Norwich	"	2490	114.5	120.8	890	38.2	38.3	1 9
76	"	Large	2620	121.6	121.8	930	41.3	39.6	2 4
77	London	"	2660	118.4	116.8	940	39.7	37.7	2 9
78	"	Low	2580	101.6	103.4	870	41.5	42.6	0 9
79	Weymouth	Medium	2550	123.7	127.3	860	40.6	42.2	2 0
80	"	Large	2660	117.0	115.5	910	39.2	38.5	2 0
81	Liskeard, Cornwall.	Medium	2610	104.0	104.6	850	43.3	45.4	1 8

(The figures given in the above table show the amounts of Anhydrous Potassium Iodide in the mixture, and of Zinc Sulphate, containing 7 molecules of water of crystallization in the lotion.)

It might be well to mention here with regard to the verification of these figures, that the analysis of each sample which deviated beyond five grains in the potassium iodide, or zinc sulphate, from the prescribed amount, was repeated, and the result, of the second analyses found in each case to agree with that of the first. The specific gravities of all the lotions closely coincided with the amounts of zinc sulphate found, but in the mixtures, owing to the different amounts of spirit of chloroform which had been added, on the one hand, and the difference in the actual composition of that spirit of chloroform on the other, the specific gravity was no indication to the quantity of potassium iodide present. In looking over the above table it will be seen that only two druggists out of the eighty-one have given exactly the required weight of potassium iodide; thirty-four have given *more* than the prescribed amount, and forty-five *less*; but it may be of further interest to notice that when the whole of the quantities of potassium iodide given by the eighty-one different druggists are added together that the total quantity comes to $220\frac{1}{2}$ grains *less* than it would have been if each druggist had dispensed the exact quantity. Again, in the lotion, only one druggist out of the eighty-one gave the exact weight of zinc sulphate; forty-three have given *more* than the prescribed amount, and thirty-seven *less*; and when the whole of the quantities of the zinc sulphate given by the eighty-one different druggists are added together it comes to only $12\frac{1}{2}$ grains *more* than it would have been if each druggist had dispensed the exact quantity. This *résumé* seems to show that a larger percentage of druggists have given less weight for the more expensive drug, viz., potassium iodide, than for the zinc sulphate, the value of which is infinitesimally small, but still, no one can come to the conclusion that this is really done with dishonest intention in the large majority of cases.

I think, however, that no one can have a doubt about the want of care which is shown generally in dispensing, by the above table. A large percentage have dispensed within a range of accuracy which many might consider reasonable. I have, however, made all my estimations with analytical accuracy, and I think it must be left to the medical profession to decide what limits of error they consider might be allowed. With the view to decide what amount of inaccuracy a pharmacist would consider allowable, I consulted a gentleman who is a partner in an establishment which does a considerable business in dispensing. After informing him of the investigation I had been making, I asked him what amount of inaccuracy he would consider allowable in dispensing 120 grains of potassium iodide in 6 ounces of fluid, and also for 40 grains of zinc sulphate in 2 ounces of fluid; he considered that in both cases they ought to be absolutely accurate, but if I allowed three-tenths of a grain either way I should be allowing sufficient for all practical purposes. I have, however, been still more lenient than my pharmaceutical friend, and have allowed five-tenths of a grain on either side of the prescribed quantity as the range of practical accuracy. I know that many dispensers will take objection to this range of inaccuracy as impracticable. We, as analysts, can weigh easily to the one-hundredth part of a grain, and I know that balances used by dispensers for weighing such quantities as 120 grains are capable of turning with the tenth part of a grain if kept in good condition, and I think under such circumstances it would be absurd for any one to contend that it is impracticable to weigh drugs within half a grain on these premises. I have formed the following summaries of the above results:—For the potassium iodide mixture, two druggists out of the eighty-one have given the exact weight prescribed; nine out of the eighty-one have come within the practical

range of accuracy; fifty-five out of the eighty-one have weighed within 5 grains either way of the prescribed amount; whilst the remaining twenty-six have made greater errors. For the zinc sulphate lotion, one druggist out of the eighty-one gave the exact weight prescribed; nineteen out of the eighty-one have come within the practical range of accuracy; fifty-one out of the eighty-one have weighed within 2 grains either way of the prescribed amount; whilst the remaining thirty have made greater errors.

In the actual measuring of the fluids, I have assumed that measurements within 5 fluid grains either way are absolutely correct, whilst those within 15 grains either way are practically correct.

For the potassium iodide mixture, six dispensers out of the eighty-one have measured correctly; eleven out of the eighty-one have come within the range of practical accuracy; thirty-two have measured within 50 grains (a teaspoonful) of the prescribed amount; whilst the remaining forty-nine have made greater inaccuracies. For the zinc sulphate lotion, six dispensers out of the eighty-one have measured correctly; sixteen have measured within the range of practical accuracy; twenty-eight have measured within 25 grains of the prescribed amount; whilst the remaining fifty-three have made greater inaccuracies. Lastly, with respect to the strength of the solution, some dispensers may make both their weighings and measurements in excess or deficiency, and in either case the strength might be exactly what is required; whilst others may have weighed correctly and measured incorrectly, or *vice versa*, and in these instances, the strength of the solution, which is the most important point, would be wrong. The following shows the amount of deviation made in this respect:

Not one dispenser has succeeded in making the prescription to the exact strength in either the mixture or lotion.

In the potassium iodide mixture, five out of the eighty-one dispensers have come within the range of $\frac{1}{2}$ a grain more or less than the prescribed amount; forty have made the strength of the mixture within 5 grains more or less than the prescribed amount; whilst the remaining forty-one have made greater errors.

In the zinc sulphate lotion fourteen out of the eighty-one dispensers have come within the range of $\frac{1}{2}$ a grain more or less than the prescribed amount; forty-five have made the strength of the lotion within 2 grains more or less than the prescribed amount; whilst the remaining thirty-six have made greater errors.

It may be interesting, before leaving this part of the subject, to make a few further observations on the dispensing of these solutions. We found that the mixture of No. 74, dispensed by a man in Birmingham, was strongly alkaline to test paper, and I submitted its contents to further analysis and found, that out of the 115·7 grains represented in the table, 100·1 was composed of carbonate of potash, and 15·6 of iodide of potassium, etc. From this large proportion, it seems as if the former salt had been intentionally added, along with a small proportion of potassium iodide. One (No. 48) from Eccles contained 2·5 grains of Potassium Carbonate in the 126·7 grains weighed out. Many were absolutely free from Potassium Carbonate and many contained traces of that salt. No. 46 had both the mixture and lotion corked with very dirty corks. The dispenser of No. 16 (from Edinburgh) put in a preparation of orange

instead of spirit of chloroform. No. 4 (from Cupar Fife) added the spirit in such proportion that it possessed the smell of whisky; whilst No. 18 (from Airdrie) dispensed the chloroform without any spirit, so that it remained insoluble at the bottom of the bottle. This error might have proved serious if the last dose in the bottle, containing all the chloroform, had been swallowed by the patient. The seven mixtures to which the following numbers relate contained disagreeable looking sediments—17, 24, 45, 46, 56, 74, and 78. One more potassium iodide prescription was made to contain the same quantity of salt as the others, but the solution made up to two instead of six ounces. The following shows the result:—

TABLE II.
POTASSIUM IODIDE PRESCRIPTION.

No.	District.	Description of shop	Actual measure of the mixture dispensed. (In fluid grains.)	Actual amount of Potassium Iodide weighed out by the Druggist.	Strength of the mixture calculated on the two ounces.	Price.
		The mixture as prescribed.	875	120 grs.	120 grs.	s. d.
1	Manchester: Stretford-road		895	123·1	120·4	1 2

With the view to test further the range of inaccuracies in other and more valuable medicines, Dr. Sinclair and I arranged to have a few different prescriptions dispensed, and he accordingly wrote out five, having the following composition:—

R. Argent. Nitrat. ʒj
Aq. Distillat..... ʒj

M. Fiat lotio. To be kept from the light.

These were subject to analysis, and the following Table shows the results:—

TABLE III.
SILVER NITRATE PRESCRIPTION.

No.	District.	Description of shop.	Actual measure of the lotion dispensed. (In fluid grains.)	Actual amount of Silver Nitrate weighed out by the Druggist.	Strength of the lotion calculated on 447·5 gr.	Price.
The lotion as prescribed.			447·5	60·0	60·0	s. d.
1	Manchester : Moss Lane W.	Low.	410	59·8	65·3	1 0
2	do. London-rd.		425	44·8	47·2	1 0
3	do. Oxford-st...		425	57·4	60·4	1 6
Liverpool :		Low.				
4	Gt. Homer-st..		433	73·2	75·6	1 4
5	London, E.C....		365	59·0	72·3	0 8

The figures in this table show the amounts of anhydrous silver nitrate contained in the solution.

These show that not one of them has given the weight of this drug accurately; one came within the range of practical accuracy; three came within the range of 5 grains, and two made inaccuracies of upwards of 13 grains. In measuring, none came within the range of absolute accuracy, viz, 5 grains either way, and only one came within the range of practical accuracy. In strength, one came within the range of practical accuracy, the others made errors of over 5 grains.

The next prescription was the following :—

R. Quin. Sulphat. ʒj
 Acid. Hydrochlor. dil..... ʒj
 Aq.....ad. ʒij

M. Sig. One teaspoonful to be taken in a wineglass of water twice a day.

Two of these prescriptions were dispensed, and three more containing the same amounts of quinine sulphate and hydrochloric acid, but made up to 6 instead of 2 ounces measure.

These were submitted to analysis, with the following results :—

TABLE IV.
QUININE SULPHATE PRESCRIPTIONS.

No.	District.	Description of shop.	Actual measure of the mixture dispensed. (In fluid grains.)	Actual amount of Quinine Sulphate weighed out by the Druggist.	Strength of the mixture calculated on the two ounces.	Price.
The mixture as prescribed.			875	60 grs.	60 grs.	<i>s. d.</i>
1	Liverpool:					
	Lime Street		920	59·7	56·8	3 6
2	London, E.C.	Low.	900	42·0	40·6	2 6

In No. 2, the hydrochloric acid of the prescription had not been introduced, and most of the quinine sulphate remained undissolved.

No.	District.	Description of shop.	Actual measure of the mixture dispensed. (In fluid grains.)	Actual amount of Quinine Sulphate weighed out by the Druggist.	Strength of the mixture calculated on the six ounces.	Price.
The mixture as prescribed.			2625	60 grs.	60 grs.	<i>s. d.</i>
3	L'ncaster, Town		2660	56·8	56·1	3 0
4	Manch. Lnd.-rd.		2700	64·5	62·7	1 6
5	Liverp'l, Bootle		2810	59·7	55·8	2 2

The figures in these two tables represent the amounts of Quinine Sulphate containing 7 molecules of water of crystallization.

In this it will be noticed that in the quantities weighed none of the five dispensers arrived at absolute accuracy, two came within the range of practical accuracy, and the remaining three are outside this mark; none measured within the range of either absolute or practical accuracy, and none came within the range of either absolute or practical accuracy in the strength of their solution.

The third and last prescription was the following:—

R. Ferri et Quin. Citrat..... ʒij
 Aq. ʒvj
 Sig. ʒss, ter die.

Two of these prescriptions were dispensed, and one containing the same amount of salt, but made up to 2 instead of 6 ounces.

The results of the analysis are as follows:—

TABLE V.
 IRON AND QUININE CITRATE PRESCRIPTIONS.

No	District.	Description of shop.	Actual measure of the mixture dispensed (In fluid grains.)	Actual amount of Quinine and Iron Citrate weighed out by Druggist.	Strength of the mixture calculated on the 2690 grains.	Price.
The mixture as prescribed.			2690	120 grs.	120 grs.	<i>s. d.</i>
1	Manchester:		2690	122	122	1 6
2	Hulme. London, E C.		2570	140	146·5	1 9

No.	District.	Description of shop.	Actual measure of the mixture dispensed (In fluid grains.)	Actual amount of Quinine and Iron Citrate weighed out by Druggist.	Strength of the mixture calculated on the 940 grains.	Price.
The mixture as prescribed.			940	120	120	<i>s. d.</i>
3	Manchester:		985	107	102·1	2 6
	Oxford.road.					

The figures in these tables represent the dry iron and quinine citrate, plus 10·5 per cent, the amount which we found the salt to lose on drying at 212° F.

Not one of these three came within the range of absolute or practical accuracy in either the weight or the strength of solution. One, however, measured with absolute accuracy,

the remaining two were out of the range of practical accuracy in every respect.

In concluding, it may be of some importance to mention that in the dispensing of these prescriptions, in the large majority of cases, and generally in the more respectable shops, no questions were asked of the purchasers, and no remarks made, but in some cases, and especially in those shops of a lower class, questions of rather an impertinent nature were asked ; in one, not only was the patient's name demanded, but the name of the medical man who prescribed ; and in another instance the druggist actually refused to dispense a prescription containing 10 grains doses of quinine sulphate on the ground that the dose was excessive, and one who did dispense it remarked that the dose was a strong one. The bearing of these facts on the relative position of the physician, patient, and druggists, although of much importance, especially to the medical profession, does not come within the scope of my paper.

In conclusion I must express my best thanks to our assistant, Mr. Percy J. Winsor, for the painstaking and accurate manner in which he had helped me in this investigation

MICROSCOPICAL AND NATURAL HISTORY SECTION.

February 14th, 1876.

CHARLES BAILEY, Esq., in the Chair.

Mr. E. W. Nix, M.A., was elected a Member, and Dr. John Roberts an Associate of the Section.

Mr. Percival, through Mr. Rogers, exhibited specimens of a new British moss—*Hypnum nitidulum* (Wahl), belonging to the sub-genus *Plagiothecium*—found by him and Mr. Whitehead on June 8th, 1868, at Penneghant Gill, Craven,