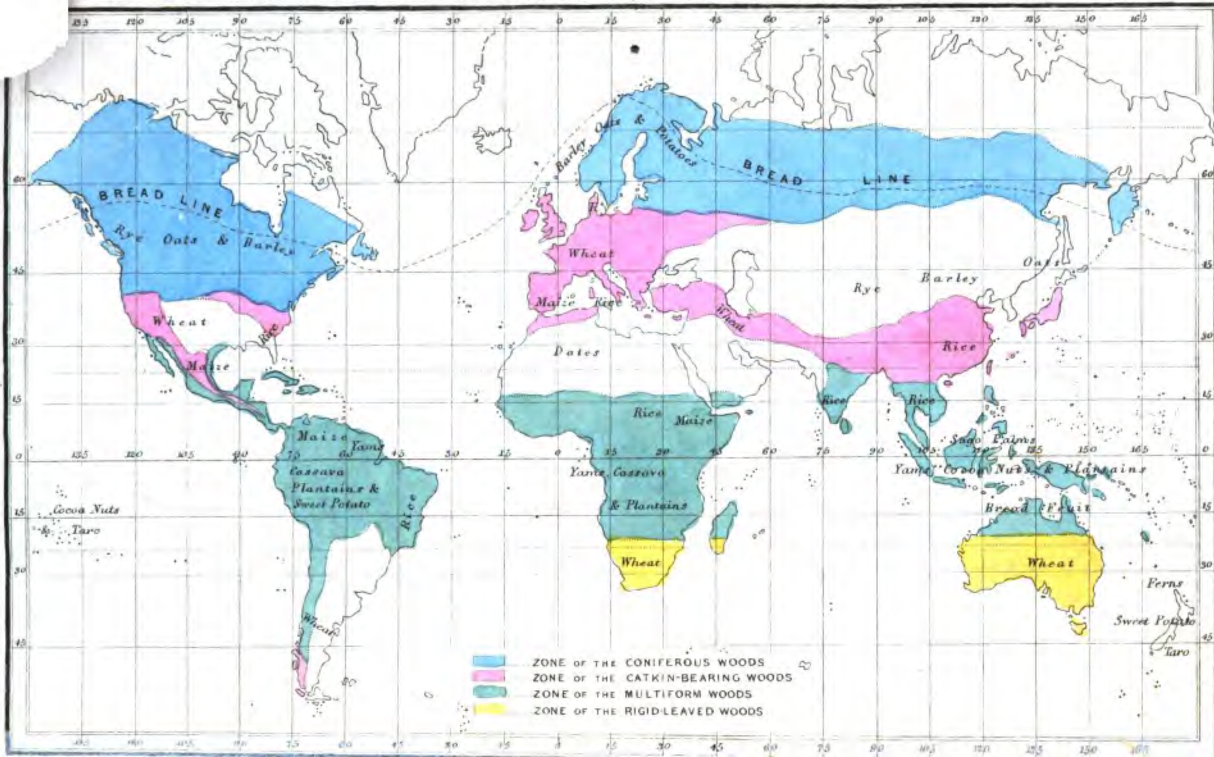
BOHN'S SCIENTIFIC LIBRARY.

THE EARTH, PLANTS, AND MAN.

AND

THE MINERAL KINGDOM.

P OF THE DISTRIBUTION OF WOODS AND OF THE PRINCIPAL BREAD PLANTS



THE

EARTH, PLANTS, AND MAN.

POPULAR PICTURES OF NATURE.

BY

JOACHIM FREDERIC SCHOUW,

PROFESSOR OF BOTANY IN THE UNIVERSITY OF COPENHAGEN.

AND

SKETCHES FROM THE MINERAL KINGDOM.

BY

FRANCIS VON KOBELL.

TRANSLATED AND EDITED BY

ARTHUR HENFREY, F.R.S., F.L.S., &c.

LECTURER ON BOTANY AT ST. GEORGE'S HOSPITAL, AUTHOR OF "THE VEGETATION OF EUROPE," &c. &c.

LONDON:
HENRY G. BOHN, YORK-STREET, COVENT GARDEN.
1852.

WHITING, BEAUFORT HOUSE, STRAND.

PREFACE.

The Author of "The Earth, Plants, and Man" is so well known to all who have made any acquaintance with Physical Geography, that no apology seems necessary in presenting a work of his to English readers,—the less when it is one so entertaining and instructive as the present.

Some of Professor Schouw's views respecting the origin and early history of plants are opposed to those entertained by many distinguished naturalists; a few of these cases have been briefly indicated in notes.

The present translation is from the German version, in the preparation of which the Author co-operated, and which, therefore, is regarded as equivalent to the original. Most of his works have been published in this way, owing to the comparatively narrow circle of Danish readers out of the country.

Kobell's interesting "Sketches from the Mineral Kingdom" have been appended to the preceding work, since the subject, mode of treatment, and manner of original production, viz., as public Lectures, seemed to render them a desirable addition.

A. H.

CONTENTS.

THE EARTH, PLANTS, AND MAN.

SKETCHES FROM THE MINERAL KINGDOM.

THE

EARTH, PLANTS, AND MAN.

CHAPTER I.

THE PLANTS OF FORMER EPOCHS.

Rocks contain remains of the animals of past ages, and a vegetable world also lies buried under our feet. When we examine a piece of brown coal from Iceland, we see clearly that it is wood (used even for fuel), yet it occurs in layers alternately with those of a rock. The fibres are distinguishable in petrified wood; entire stems with branches exist in our collections; but the vegetable structure is converted into hard stone, which sometimes, in the form of calcedony, horn-stone, and opal, strikes fire with steel. In clay-slate we find enclosed leaves, so well preserved that we can distinguish the ramifications of the veins in them.

These examples are not selected from contemporaneous plants; these vegetables belonged to different periods of the world's history, for the strata lying between them contain sea-shells, mollusks and fishes, and demonstrate that the plants in the older (more deeply situated) layers must have been destroyed, before those which occur in the more recent were formed.

I must not here enter into a complete description of the different systems of vegetation which have successively existed in the various periods. The comprehension of this would require a previous acquaintance both with the rocky strata and the principal forms of plants. I will confine myself to the oldest period of all, and this the rather, that it is the best known, and at the same time the most characteristic.

When we investigate the many different strata which lie one above another, we find that those situated lowest down, although partly deposited from water, do not contain the slightest trace of animals or plants; this is the case, for example, with many clay-slates; we call these primitive rocks, and include with them those which, having been formed under the action of fire, cannot contain any organic remains. Hence we conclude that no animals or plants existed in the periods in which such rocks were formed.

Upon the primitive rocks rest certain others, in which the vegetable kingdom is represented only by fucoids (sea-weeds), while they contain abundance of marine animals.

These formations, of vast thickness, have been greatly investigated of late years, but little has been revealed in them interesting to the botanist; and it is not until we leave these, the older and middle palæozoic rocks, that we arrive in the new palæozoic period at a system containing a vast quantity of vegetable remains. The most characteristic rocks of this series are those connected with the coal formations, and the period in which they were formed has been called the coal period. In the strata of this period great abundance of animal and vegetable remains are met with. The coal lies in layers (seams), alternating repeatedly with sandstone and shale. The vegetable remains occur most abundantly in the shale and iron-stone. The leaves and twigs rest closely one upon another; but their remains are also met with in the sandstone, and entire stems of considerable length (40—50 feet) are sometimes found standing quite upright in this. The coal itself must also be regarded as composed of altered vegetable structures, although great doubt may exist as to the mode in which it was formed. We have here the choice of two hypotheses: either the coal-beds have been formed of vast masses of trunks of trees, which have been carried along by streams and deposited in the places where the coal is now found; or they have originated in these spots, in a manner similar to that in which peat is formed in our own times. We have examples in the drift-wood in the North American and North Asiatic rivers, that such depositions of trunks of trees are capable of forming vast compacted layers which remain fixed upon the soil of the river-banks; this is seen in the Mississippi, where they are driven on to the banks, and are sometimes arrested there, sometimes again carried off by the stream during floods; they are frequently even quite overgrown with herbs and bushes. But the first view is opposed by the circumstance that leaves and twigs are not unusually well preserved; while the fact that trunks of trees are found standing upright, speaks in favour of the coal having been formed *in situ*. Whichever of these two assumptions we accept, the pressure from above and the subterranean heat below suffice to explain the carbonization.

Investigating the plants of which the shale furnishes abundant remains, we arrive at the remarkable conclusion, that a decided majority of them, perhaps two-thirds of the number of species, and four-fifths of that of the individual specimens, belong to one single, very strongly marked family of plants, the ferns.

The ferns, as we at present know them, are distinguished by their leaves, which are rolled up in a spiral line before they are unfolded; further by the fact, that although the leaves are highly developed, they bear no true flowers, but present a kind of small fruit seated upon the back of the leaves, containing extremely minute seeds of very simple structure. In cold climates the ferns are only herbaceous, but in the torrid zone they present themselves in the form of trees of considerable height, with palm-like, unbranched trunks; these trunks are clothed with the remains of fallen leaves, and thus they acquire a scaly or tesselated surface.

In the shales we find not only fern-leaves, which are readily recognized by their forms and the branching of their veins, but also trunks, which, like the fern-stems of the torrid zone of the present day, are clothed with the remains of leaves, and unbranched. The ferns play a much more subordinate part among the vegetation of the present time; they constitute scarcely a thirty-fifth or a fortieth part of all known species, and hardly bear a greater proportion in number of individuals to the entire vegetation of the globe.

The second family found in the coal-formations, is that of the Lycopodiaceæ, or club-mosses, and these exhibit a much greater difference from existing conditions in regard to the part they play. Those we meet with living now are dwarf plants, resembling mosses, of such small size and number, that, generally speaking, they are only noticed by the botanist; they consist of small, usually branched stems, with scale-like leaves lying over one another, like tiles, upon the stem; like the ferns, they do not bear true flowers, but little fruits between the leaves. Among the remains of the ancient world this family appears much more frequently than at present, for about a quarter of the known ancient species belong to it. And they present themselves as arborescent plants, with branched trunks as much as sixty or seventy feet high; so that they were giants in proportion to the existing plants of this family.

The third family of the coal-formation, is that of the Equisetaceæ, or horse-tails. This group is distinguished by jointed, furrowed stems, with branches jointed and furrowed in like manner standing in circles; little scale-like leaves which are coalescent into sheaths; absence of proper flowers, which are represented by fruits seated on the under surface of little shield-shaped bodies. They are usually herbs of moderate height; the largest attain but a few feet, and they perform an unimportant part in vegetation generally. The coal-formation exhibits large and arborescent trunks, indicating by the peculiar and very regular manner in which the furrows alternate in the contiguous joints that they belong to this family. We find these trunks ten feet high, and five or six inches in diameter. But this family is less numerous than the two preceding; it exists now as an isolated and very peculiar form, which it is a matter of difficulty to refer to a suitable place among other plants.

These three families include almost three-quarters of the species of the coal period, and a far larger proportion of the individual specimens. The remainder belong to the gymnospermous Dicotyledons (Conifers, &c.). No other Dicotyledons appear to occur, and the Monocotyledons are either entirely wanting, or only very sparingly met with.

But it may, perhaps, be asked how we know that there were not other plants which, having been completely destroyed, have left no traces of their existence. We certainly cannot oppose any definite facts to this objection; but it is in the highest degree probable that no other vegetables existed; for we find no structure in the leaf or the trunks of the ferns which could account for their being preserved better than the leaves of other plants or trees, and we do find in the more recent strata many stems and leaves, belonging to the vegetable forms now prevailing, which are not met with in the coal period, without any reason presenting itself why they should have been preserved in the more recent, in preference to the older, strata.

We can therefore demonstrate, or at least assume it as highly probable, that the three families in question, which all belong to *one natural primary group*, of which we are acquainted with at least three hundred species from the coal period, constituted a greatly preponderating part of the entire vegetation. At the present time these three families form, perhaps, scarcely one-thirtieth of the vegetable world, this being now represented by several hundred families, or different primary forms.

A high degree of uniformity, or monotony, may consequently be named as the chief feature of the vegetation of that age; considered in this point of view it may be compared with our pine forests or heaths, remembering, however, that they exhibited greater variations in the subordinate forms; something akin, therefore, to what is seen in the pine forests of North America, or the heaths of the Cape, which are composed of numerous species. The uniformity shows itself also in another respect; for the same plants which are found in the English coal measures, are met with not only in Belgium and on the Rhine, but in North America; thus in countries which at present possess a very different vegetation.

The second great feature in the vegetation of the coal period, is the *absence of true flowers*;* a trait which is the more worthy of note, when we recollect that not only our herbs of the fields, meadows, and marshes, but also the bushes in our thickets and the trees of our forests, all possess flowers. The presence of flowers is rightly regarded as the mark of the higher development of the plant; we therefore account the flowerless plants less perfect, even when other organs, such as the leaf, have attained a considerable development, which is actually the case in the ferns. Since the coal period thus affords only flowerless plants, while the more recent periods present vegetation with flowers, we have in this a new confirmation of the interesting fact to which we are conducted

* We do, indeed, meet with traces of reproductive organs in these families; particularly germens, and sometimes even a surrounding envelope,—but these organs are not perfectly developed in any of them.

by the study of animal remains, that the living creation has been developed historically to greater perfection.

The absence of *fleshy, juicy fruits*, is another feature which essentially distinguishes that vegetation from the present; as also, apparently, does the want of graminaceous plants; for the traces which some have imagined that they found of plants of the grass family, are doubtful and of sparing occurrence.

Thus we see, that the vegetation of that period was in the highest degree uniform, exhibited no true flowers, no succulent fruit, and no kind of grass, but almost exclusively ferns and a few allied plants. Let us proceed, however, to acquire an idea of the appearance of nature at that time.

I have already mentioned that the ferns now constitute but a small part of the vegetable world. It must be noted here, however, that this only holds in its full extent of the vegetation as a whole; certain local conditions exist under which the ferns play a much more important part. Thus the ferns constitute one-eighth of the vegetation of the islands of Jamaica, Mauritius, and Bourbon; of that of the Society Islands, as much as one-sixth; in New Zealand the vegetation is principally composed of ferns, which clothe the earth in place of grasses; even in the small islands of Ascension, Tristan d'Acunha, and St. Helena, the ferns, together with the other two families, form almost one-half of the very poor and uniform vegetation. Since all these places are islands, and all lie in a warm climate, we are quite warranted in supposing that those plants grew upon islands, and that the climate was warm during the coal period. We may also arrive at the latter result in another way. We have seen that many of the ferns of ancient times were arborescent; at the present time we find tree-ferns only in warm climates.

Turning to the animal world of the oldest period of living creatures, we find a countless abundance of corals, radiata and marine mollusca (marine univalves, bivalves, and cephalopods, allied to the cuttle-fishes, the last far more abundant and in greater number of species, which are of gigantic size compared with those of the present time). We also find many crustaceous animals and traces of fishes. On the other hand, we miss all traces of remains of mammalia and birds; nay, even of reptiles.* Thus the forests were without birds, without the apes, now so numerous in hot countries, and without snakes.

In this way we arrive at a not very imperfect picture of nature in the time of the older coal period. Islands rising out of a vast ocean, with a warm climate, an uniform forest vegetation chiefly composed of ferns, without flowers and grass, without juicy fruits, without snakes and lizards, and also without the song of birds, the voices of animals, or of man. Further than this we may not go. It is true that pictures of the landscapes of the ancient world have been presented to us; these, however, are not from the pencil of a painter of the ancient world, but of a naturalist of the present time, and we cannot answer for their verisimilitude.

Perhaps it may be asked: why were not these islands, endowed with a mild climate and a rich though uniform vegetation, destined for the abode of human beings? I might answer, that it was necessary that the house should be fully prepared before the master was invited to inhabit it, and that a country without domestic animals, a field without flowers, a wood without birds, a climate warm indeed, but probably unhealthy, would be no desirable abode. But I prefer to leave the question unanswered, and to own, that although we are often able to perceive in *little things* the regulation by law which rules in the household of nature, our conclusions become adventurous and faulty when we deal with the grand plans laid down by the Lawgiver of Nature; and we should here rather own at once, that with all our cleverness, we are only children feeling our way about.

(* This is incorrect—traces of reptiles, in one case the skeleton, have lately been met with in rocks still older than the coal-formations; facts which strongly support the arguments which have recently been advanced against some of the hypotheses of the defenders of the historical development theories.—Ed.)

CHAPTER II.

FURTHER CONTRIBUTIONS TO THE HISTORY OF PLANTS.

In the preceding chapter, we have attempted to give a picture of the oldest vegetation. It must be admitted, this sketch can have no pretension to perfect accuracy; yet it appears that both the memorials of that period (namely, the remains of plants and animals buried in the bosom of the earth), and the conclusions which may be drawn from them, are of a character which affords something bordering upon certainty; and it will certainly be allowed, that we have arrived at a greater degree of clearness in regard to this part of the most remote history of plants, than has been attained in respect to the primitive history of the human race.

But a vegetation such as we have described, existed only in the oldest period. Between that and the present lie several, perhaps many, vegetable systems, differing not only from that, but from ours and from each other. As it happens not unfrequently in the history of the human race, and in the history of particular races, that an older period is better elucidated, and lies more clearly before us, than a more recent; so also, in the present condition of science at least, the vegetation of the coal period is much better known than those which are presented by the more recent periods of the earth. Since, therefore, in a popular exposition of the acquisitions of science, only that should be included which is complete or to a tolerable degree certain, I am compelled to confine myself to a few general remarks in respect to the succeeding periods.

In the vegetation of our own time there exist four great primary groups. The first, which we will here call the *leafless plants*, are devoid not only of flowers and seeds, but we may say that they have neither stem nor leaf; for either the organs of the plants, as, for instance, in the Fungi, bear no resemblance to the organs of other plants, or the stem and leaves are, so to speak, blended into one, as is the case in the sea-weeds. The second group may be called the *flowerless plants*. We are partly acquainted with these through the preceding chapter; they include the ferns and the plants allied to these; they possess roots, stem, leaves, and organs resembling seeds, but have not perfectly-developed flowers.

The last two primary groups agree in all the plants having flowers and seeds, and are principally distinguished by the one, to which, for example, the grasses, lilies, and palms belong, exhibiting a predominance of the number *three* in the parts of the flowers and fruit, while the number *five* prevails in the other; the former have three or six leaves in the perianth, three, six, or nine stamens, and frequently a three or six-chambered fruit; the latter generally present five or ten sepals and petals, five, ten, or twenty stamens, and often a five-chambered fruit, as in the apple. These two groups are also distinguishable by their leaves, which, in the former, are almost always long, narrow, undivided, and traversed only by longitudinal veins; while in the latter, they are frequently broad, divided, and exhibit a net-like intercommunication of their veins. The former are called Monocotyledons, the latter Dicotyledons (*ternary* and *quinary* plants). Taken as a whole, the latter group must be regarded as the most perfectly developed.

The first main-group contains, for the most part, plants which would readily disappear during a revolution of nature; this is probably the cause why, on the whole, but few traces of them are met with in the strata, yet the number of seaweeds is not inconsiderable. The second main-group appears as the predominant in the coal period, in which the great majority of the plants belong to this division. In the more recent periods, first appear the naked-seeded Dicotyledons, namely, the Cycadaceæ, Coniferæ, and certain families now lost. In the later periods the rest of the Dicotyledons present themselves, and gradually increase, so that in the most recent period their numerical proportion corresponds to that in existing vegetation.

The vegetable thus appears, like the animal kingdom, to have been gradually developed to a more compound, to a more perfect structure.

Since the less-developed forms persisted after the more developed made their appearance, it is readily seen that vegetation has become more varied in proportion to the proximity of the period to the present time.

The nearer the periods lie to the present, the greater becomes the resemblance of the vegetable remains met with, to existing plants, and in some of the most recent strata we find plants which cannot be distinguished from those of the present time.

After this brief survey of the order in which the various forms of plants have originated, we have still a great question in the history of plants to answer, namely: in what manner have they originated? This, however, is one of those problems which will probably for ever lie beyond human powers of conception. Creation itself is the great enigma, which no one has solved, and it is unlikely any one ever will. That which takes place before our eyes, offers nothing similar from which we can draw probable conclusions; and the two hypotheses which have been formed in regard to it, are equally inconceivable, according to what happens at the present day; these are: *either* the organised creatures (plants and animals), all originated at once from inorganic bodies (water, earth, air, or from the particular substances of which these, or the organic bodies themselves are composed), *or*, only the lower creatures originated in this manner, and the more complex were developed from them by modification and transformation; for example, a moss from a fungus, or herb from a moss; an insect from a worm, a fish from a mollusk, &c. For we have no certain fact whatever to prove, either that an organic body, even of the lowest grade, can originate from inorganic bodies or substances; or that one species of animal or plant is capable of transformation into another; neither do the fossil remains of plants and animals bear out the last supposition. For example, we find that the many teeth and bones of the extinct elephants (mammoth) are always the same, and exhibit no transition of structure toward that of the teeth and bones of the existing elephants. And there is just as little trace of transition between the extinct and existing rhinoceroses, &c. Therefore, we are compelled to say, that forces have been at work in ancient times, which are now no longer in action.

But it will, perhaps, be asked, is creation at an end? Has no new plant appeared during the historical period; do not new species of plants, perhaps, still come into existence? I believe that this question can be answered in the negative, if we exclude from our consideration those modifications which have been produced, either mediately or immediately, through the influence of man.

The first method by which we may arrive at the answer is, to mark how parts of the earth's surface, formerly bare of vegetation, have gradually acquired one. This occurs when lava-streams, which have flowed from craters, through volcanic eruptions, by degrees become covered with plants; it happens on volcanic islands which are protruded from the sea; or coral islands which are gradually elevated above the surface of the ocean; and on tracts of sea-bottom which are dyked in and drained.

Standing upon the summit of Etna, a giant mountain, forming a single cone more than ninety miles in circumference at the base, and 11,000 feet high, lava-streams are seen stretching in all directions along its sides, having flowed down like rivers; and these are especially perceptible where they break through the zone of trees which girdles the mountain about half way up. These lava-streams are of very different ages. We possess historical data and reports concerning the origin of the more recent. By investigating and comparing these lava-streams, we have an opportunity of seeing how the vegetation is gradually formed; some are still quite naked; others have only a few plants scattered here and there in hollows and crevices; and in others, a layer of decaying vegetation is beginning to form mould, in which, more and more plants can by degrees strike root. The lava upon Vesuvius, Ischia, and other volcanoes, exhibits the same phenomena as the lava-streams of Etna. According to my own observations, the plants which first settle upon the naked lava, are especially those lower plants which are called lichens.* Certain succulent and fleshy plants, chiefly nourished by the aqueous vapour of the air, which they absorb by the stem and leaves, are among the earliest inhabitants of lava-streams; and this is especially the case with the cactus, or Indian fig, as it is called (*Opuntia vulgaris*), upon Etna; it is, indeed, industriously planted on the lava, in order to render it fertile. But these plants which thus arise upon the lava are not new species; they are found not only upon the older lava-streams, but also in other soils, not

* *Stereocaulon paschale*, in particular, is very general upon Vesuvius and Ischia.

volcanic; the Indian fig, as it is termed, is, in fact, an exotic in Sicily, derived originally from America.

The same is the case in the coral islands of the South Sea. At first an island of this kind is bare; gradually it becomes clothed with plants which are found upon older islands, and upon the continent of Asia. The two plants which constitute the mass of the vegetation of the lower coral islands, are the cocoa-nut palm and *Barringtonia speciosa;* but the fruits of these two plants are seen floating in abundance on the surface of the ocean; they are especially adapted for this, since in the cocoa-nut the nut is enclosed in a particularly hard shell excluding the air, the shell again having a fibrous coat, which renders the fruit comparatively light; the other is also exceedingly well protected and buoyant. The remarkable poverty in forms displayed by the South Sea islands, in contrast to the rich vegetation elsewhere met with in a hot, and at the same time moist climate, must be ascribed, at least in part, to the circumstance that nature no longer produces new species.

This is seen again in various little volcanic islands in the South Atlantic Ocean, which have probably been elevated above the sea in recent periods; for instance, in Tristan d'Acunha, and St. Helena. When Europeans first visited them, these islands presented very few plants; but introduced plants, and the weeds accompanying them, have multiplied there in an astonishing manner, and to an extent of which countries where the soil was already stocked with other plants present no example.

Lastly, the same occurs also on tracts reclaimed from the sea, on land enclosed by dykes. We have an interesting example of this in the island of Funen. A little bay of the Odenseefiord was dyked in about thirty years ago. One of the landowners resident there is fortunately a meritorious botanist, M. Hofman. He has been very attentive to the overgrowing of the reclaimed land, and kept a journal of the changes which occurred upon the tract converted from sea-bottom into dry land. A scientific and friendly contest arose between my friend and myself, whether the plants which gradually came to light in this way, originated from seeds which had come in one way or another on to the reclaimed land, or owed their existence to the so-called spontaneous origin (equivocal generation), which latter opinion was maintained by M. Hofman. Whichever opinion be adopted, this much is certain, that the newly originated plants were not *new species;* so that we have here again, as it appears, an evidence that the natural forms now at work are incapable of producing new ones.

Another way in which we can at least approximate to an answer to the question, is by comparing the floras of the present with those of the past, within the limits of historical time. About one hundred and sixty years ago, in the time of Christian V., there lived in Copenhagen a skilful botanist called Peter Kylling. He industriously investigated the forest of Charlottenland, situated a mile from the town, and compiled a catalogue of the plants which he found in this wood. Comparing this with the plants now growing there, we find that the vegetation of that time must have been the same. It is true, we now find certain plants there which were not mentioned by Kylling; but these are either such as so closely resemble nearly allied species, that the distinction may have been readily overlooked; or they are so small and so inconspicuous, that they may have been passed unobserved on this account; or, finally, they are plants which it is highly probable have been introduced by the aid of man.

We come to the same conclusion when we take up Kylling's "Vindarium," or his catalogue of plants found in Denmark, with Hornemann's "Study of Plants," written one hundred and fifty years later, or when we compare the oldest German or Italian "Floras," which go back two hundred or two hundred and fifty years, with the existing Floras of these countries.

It may be objected that the interval of time is too short here. Well, we can go back still further, and direct our inquiries to the reports of the botanists of antiquity, relating to the most important plants in the different countries known in those times. Among these authors, Theophrastus of Lesbos, who lived three hundred years before the birth of Christ, deserves especial attention, because his descriptions are the most accurate, and his statements the most trustworthy. Such comparisons certainly present not a few difficulties; the ancients did not add any drawings to their descriptions, and the latter were not written with the accuracy and definition of the descriptions of plants drawn up now; thus great doubt often prevails as to what plant they have meant to indicate. But if we keep to the plants which, from their size or abundance, or through the importance of their applications, have occupied the chief place, the uncertainty is considerably diminished; and we have grounds for assuming that, so far as nature has been left to itself, the agreement between the vegetation of antiquity and that of the present day is most striking.

According to Theophrastus, as also according to Herodotus, Egypt presented the Arabic gum-tree, the sycamore, the papyrus, the lotus-plant, and the date-palm, which are also now the plants characterising that country. The Thebaic or Doum palm, as it is called (*Cucifera Thebaica*), remarkable for its branched trunk, grew of old in Upper, but not in Lower Egypt; the same is just the case now.

The ancients mentioned as the characteristic plants of India, the bamboo-cane, the cotton-tree, the canella-tree, rice, the pepper, the cardamum, the banyan-tree, and several others; which are likewise so now. Among the products of Arabia mentioned by the ancients, are the myrrh and the balsam-plants; which are now, also, characteristic of these regions.

The Flora of Southern Europe is very different from that of Northern Europe; the Balkan Mountains, the Alps, and the Pyrenees here form a natural barrier. Among the plants which especially distinguish the vegetation of the South from that of Northern Europe, are the many evergreen-trees—the ilex, the cork oak, the myrtle, the laurel, the arbutus, the oleander, &c.; and these are cited by the old Greek and Roman authors, as the common trees of the countries around the Mediterranean.

But at a certain elevation above the sea, we meet, on the Apennines and the Greek mountains, several trees and shrubs which require a cooler climate, and these are, for the most part, the same as those which we find in Northern Europe—such as the beech, the pine, the fir, the yew, the service-tree, the birch, the bog-myrtle, the hazel, and the holly; and when we consult Theophrastus and Pliny—especially the former—we find these mentioned as mountain-plants.

As a further evidence of the unchanged condition of vegetation, we may mention, that corn, pomegranates, grapes, dates, and olive-branches, have been found well preserved in Egyptian sepulchres, and that these agree with the species growing at present. Olives, which cannot be distinguished from those now growing, have also been found in Pompeii.

Although the natural historians of antiquity have left us no representations, we do possess a few—namely, the paintings on the buildings in Pompeii and Herculaneum, in the old Roman baths, and in the caves of Elytheia, in Egypt. Notwithstanding that these pictures were not drawn with any reference to natural history, and we are therefore no more justified in drawing inferences from them than from wall-paintings of the present day, yet many of them—some very good representations of plants, which can be recognised readily—indicate again that vegetation was the same then as now; this is particularly the case with the numerous pictures of plants which have been found in the chambers at Pompeii.

If the vegetable kingdom has remained unaltered for more than 2000 years, it is in the highest degree probable that it was not subject to change long further back in historical time; and, therefore, it is in this way also rendered exceedingly likely, though not strictly proved, that no new species of plant has originated in the historical period.

If the vegetable kingdom has remained unchanged, this must have been the case with the climate also; for climate and vegetation stand in such close connexion, that alterations of climatal conditions must necessarily bring about changes in vegetation; a total change when the climate is greatly altered; a partial when the alterations are slighter. But there are other reasons besides, which testify to the constancy of the climate.

The changes which the surface of the earth itself has undergone, through volcanic eruptions, elevations, earthquakes, altered course of rivers, the action of the sea on coasts, &c., are, taken as a whole, too inconsiderable to be taken into consideration when speaking of Nature at large.

We thus arrive to the remarkable conclusion, that the same Nature which surrounds us, also surrounded our Pagan forefathers thousands of years ago; that the same Nature in which the ancient Egyptians, Greeks, and Romans lived, also surrounds the Egyptians, Greeks, and Romans of the present day; that Nature (material Nature) has remained unchanged, or been but little altered, while the human race, both as a whole and also the individual races, have undergone such great change; that Nature has stood still, or moved but little, while the human mind has become developed to its present standing.

At the same time, it is far from my intention to deny that physical Nature has gone through a development; we have, in fact, sought to prove that the vegetable, like the animal kingdom, exhibits an historical development, in which the imperfect has first appeared, and the more complete gradually succeeded; but this development has happened during far longer periods, and, apparently, in such a way, that the development, when it had attained a certain point, stood still, while the human mind, as a whole, has unfolded itself unceasingly, or with inconsiderable interruptions. The contrast is lost, however, when we direct our attention to individual races, which, like Nature, have been little, or not at all, developed in the historical period—as, for example, the Australians of New Holland, and the Botecudos of South America; others remain stationary after they have attained a certain point, as the Hindoos and the Chinese.

When we say, however, that Nature has remained unaltered during the historical period, we mean only in so far as it has been left to itself; for man is capable of transforming Nature in a certain, and not inconsiderable degree, and this the more, the higher the stage of cultivation in which he stands. But this investigation into the influence of man in transforming Nature is so comprehensive, that it certainly merits a separate consideration.

CHAPTER III.

THE ORIGIN OF EXISTING VEGETATION.

THE history of the earth has made gigantic steps forward in the course of the last half century. Arbitrary theories have been replaced by abundant facts, and conclusions derived from them. We have already mentioned, that as, in human history, an older epoch is often better elucidated than a more recent, so also the more ancient periods of the history of the earth are better known than the newest; for while we possess tolerably good knowledge of the condition of the earth, its plants and animals, in the coal period, our information is very imperfect concerning the age which formed the transition between the ancient world and that of to-day. It is only quite recently that geologists and zoologists have begun to work in this field of inquiry; botanists have contributed very little to the illustration of this period. Among the most important questions in this investigation, is undoubtedly that of the origin and diffusion of the vegetation which now clothes the earth; and there exist certain fundamental problems, which must be decided in the first instance.

1. It is asked, *whether each species of plant first made its appearance in one place* (the so-called centre), from which it subsequently became diffused over larger or smaller areas, sometimes over very extensive tracts? or whether it may be assumed that the same species of plant originated in several, and often very widely separated spots?—in connexion with which, again, stands the question whether it is necessary to assume one single individual (or two, when the sexes are represented in distinct plants) for each species, or whether we may suppose several original individuals to have existed.

When the idea of a species is defined in this way—that it is a collection of individuals which have all descended from one individual, the idea is built upon an hypothesis; or, in other words, that is presupposed which it is the object to prove, for no evidence is offered of a community of origin of this kind. And when we look at the facts presented by existing geographical distribution, this hypothesis becomes highly improbable; in certain cases altogether inadmissible. For, in order to bear out the idea of the common centre for each species, the means of diffusion must be demonstrated. But it will readily be perceived, that although these are frequently in action, they are in many cases wholly insufficient to explain the occurrence of the same species of plant in widely distant countries. These means are various: mankind, who in their operations, convey plants from one place to another, sometimes intentionally, sometimes unintentionally; currents of the ocean, which carry fruits from coast to coast (the cocoa-nut); rivers, which float down the fruits or seeds of mountain-plants into the valleys; the winds, which disperse seeds and fruits, especially such as have a covering of hair, plumes, or the so-called wings, which facilitate the diffusion; and birds, which likewise may sometimes favour the propagation. It may be further assumed, that in places where the geographical distribution presents difficulties, tracts of land have subsided (the Channel, the Mediterranean, &c.), which formerly connected countries now divided from each other. But it is readily seen how insufficient these means are, when we reflect that many species of plants are common, on the one hand, to the Alps and the Pyrenees, on the other, to the Scandinavian and Scotch mountains, without these species being found in the plains or on the lower mountains lying between; that the flora of Iceland is almost the same as that of the Scandinavian mountains; that Europe and North America have many plants in common, particularly in the northern regions, which have not been transported by man; and still further difficulties, bordering on impossibility, arise for such an explanation, when we know that species occur in the Straits of Magellan, and in the Falkland Isles, which belong to the flora of the Arctic Pole—for example, *Phleum alpinum*, *Erigeron alpinus*; that various European plants occur in New Holland and Van Dieman's Land, as well as in New Zealand, which are not found in the tropical countries intervening, and which cannot be assumed to have been conveyed over; this holds especially of various fresh-water plants, as of the fescue-grass, our common reed, our common frog-bit, several species of duck-weed and sedges, the bull-rush, and *Aira flexuosa*. The accounts of those species which are common to the Arctic and Antarctic countries, are not merely derived from former times, when the species were not so strictly defined as at present, but the most recent researches, in particular those of Dr. Hooker in the South Polar Expedition, have both confirmed the old examples and added new ones to them. The number of such plants becomes still greater when we direct attention to the flowerless and leafless plants (Cryptogams); these afford manifold examples of species which are common to the most distant regions, without occurring in the intermediate countries; and yet there is no reason for assuming that these species of plants are better adapted for wandering; on the other hand, it is quite conceivable, that the simpler organisms should more readily appear independently in different places. Again, there is no evidence that plants which the fruits or seeds render more apt for diffusion, are more frequently common to distant places than any others. The fact, too, that the different floras of the ancient world agreed more closely together than those of the present time, affords an argument against attributing a great influence to diffusion; for, since there was less land then, probably consisting only of islands, diffusion was more difficult at that time. Neither does the agreement or difference of floras at present stand in any proportion to the facility or difficulty of diffusion; although the effect of this cannot be denied, for example, in the poverty which the floras exhibit in small islands distant from continents. Even in regard to those regions where nothing hinders diffusion, as between the west coast of France and the Ural, it would be strange to assume that this great tract must have remained as good as barren, until the species common all over it had completed their migration from one end of this great plain to the other, or from the middle to both ends.

When the idea of *one progenitor* for countless individuals of any one species is maintained, it seems to be overlooked that the idea of a species can scarcely be made good of the lowest plants and animals—for example, in Lichens, Algæ, and Zoophytes; and that even among the more developed forms of plants (perhaps also of animals), the definition of the species frequently depends upon the individual views of the naturalist. It is no argument against the hypothesis of several places of origin for plants, that this can hardly be demonstrated of the mammalia, that even much speaks against it; for example, that America and the old continents have no species in common; that no hares, moles, or squirrels occur in Ireland; no moles in the island of Moën (near Zealand), as well as that most of the reptiles of England are wanting in Ireland; for, just as we have seen that the leafless and flowerless plants are oftener rediscovered in distant countries, than those bearing flowers, we may assume that the more perfect animals are less prone to, perhaps never do, make their appearance in several places independently.*

Perhaps the matter may be rendered clearer by a single example. Forbes, the distinguished English author who has treated this subject, and starts from the hypothesis of a single progenitor, as an axiom, endeavours to explain whence the British Islands have obtained their existing flora. The presence of a few Spanish plants † in the west of Ireland, leads him to the assumption of the existence of a great continent, which not only occupied the space where the deep Spanish Sea now lies, but extended as far as the Azores, and farther into the Atlantic Ocean; certain plants, which are common to the south of France on the one side, and the south of Ireland and south-west of England on the other, made their way in, according to him, at a period when the Channel had not yet been formed; the Alpine plants (Polar plants)

(* The above statements are contrary to the views pretty generally entertained by naturalists in this country, and appear to me to contain several erroneous judgments.

In the first place, as to the origin of species, it is just as hypothetical to say that a species was created in many places, as to say it had a *single* origin, for we have no proof of either. Secondly, if cases of transport be admitted at all, it follows that it must be a matter of evidence and opinion as to what is, or has been, the possible extent; and the defender of the *single* origin may fairly demand time and opportunity for far more investigation than has yet been applied, before he is called upon to explain every case of diffusion. Thirdly, Prof. Schouw himself illustrates strikingly, both in this and some other chapters, the extent to which diffusion takes place, even under our own eyes; and therefore, when geological time is taken as an element in the question, and a gradual and successive creation of forms is admitted, there seems a fair case for arguing that all plants had single specific centres. Fourthly, the statement that species depend on opinion in the lower forms of organization, is to us an absurdity, when it is argued, a little further on, that the higher forms never change. Either species do exist throughout nature, or they do not exist at all. The mere fact of naturalists disagreeing about definition, proves nothing but the imperfection of knowledge.—Ed.)

(† The above is by no means a correct account of Prof. E. Forbes's views; in particular, no mention is made of the geological and zoological evidence on which the suppositions are *principally* based.—Ed.)

which the mountains of Scotland, Westmoreland, and Wales, share with the mountains of Scandinavia, in his opinion, made their way in from the north, at a time when the climate was as severe upon the coasts as it is now at the summits of the mountains. He believes that the diffusion was effected by icebergs, or by a great northern continent between Scotland, Scandinavia, and Iceland, which has subsequently subsided. Finally, the bed of the North Sea was elevated in more recent periods, and England thus rendered continuous with Denmark and Germany; and German plants, which then made their way in, drove back the Scandinavian, on the right side, to the Scotch Highlands, while a few found a refuge in Wales, Cumberland, and Westmoreland,—on the left, displaced the southern forms of vegetation, and in this way came to occupy the greatest part of the country.* He considers that the Polar flora formerly came into close contact with that of the Mediterranean, which is contrary to all analogies of the present time.

But if we set out from the hypothesis of several progenitors, the explanation of the conditions of the botanical geography of the British Islands is extremely simple. The west of Ireland, and the south-west of England, had then, as now, a climate unusually mild in proportion to its latitude, especially a mild winter; hence came into existence a portion of the plants which are also developed under the similar climate of Spain and the south of France: the Scotch and English mountains had then, as now, a Polar climate; consequently pretty nearly the same plants were produced there as in Lapland and on the Scandinavian mountains. The German colonization is superfluous under this hypothesis.

2. Another fundamental question is, *whether new species still originate, or the creation of existing system of vegetation is completed?*

It is true, as we have already mentioned, our newer lists of the plants which grow in a given country or province, or in the environs of a certain town, contain many species which do not appear in the older catalogues; but this does not prove that they are new productions. In former times, it is well known, greater differences were requisite than at pre-

* The bridge of communication once existing, we can just as well suppose that English plants made their way into Germany.

sent to form the ground for making a species; and when we examine the newly-added species, we find that they are usually forms which the older botanists have or would have included under other species. We frequently meet with them also in old herbaria, or in the figures of old books. Plants do undoubtedly occur, not unfrequently, which were not formerly met with in the stated places; these, however, are not cases of new species, but merely of new stations for existing species. I have endeavoured to prove, in another place,* that the plants which, according to the old Greek and Roman authors, formed the predominant characteristics of those countries especially situated on the Mediterranean, were the same which now distinguish the Mediterranean flora. The easiest way in which we can imagine the origin of new species, must be, either that an existing species assumes other characters through alterations of the climate or soil, or that accidental deviations from the normal type become constant through isolation. In this manner fixed varieties are formed, which sometimes deserve to be regarded as species; but in cases of this kind which present themselves, the result has been brought about by the assistance of *cultivation;* so far as I am aware, we have no certain facts in regard to this point from natural conditions. On the other hand, there seems to be much evidence in favour of the supposition that when the external circumstances are changed, a species vanishes rather than undergoes transformation, except in the case of those plants which appear in different forms under different conditions—for example, amphibious plants, or such as exhibit one form in shady spots and another when freely exposed. When peat-bogs are drained, *Primula farinosa*, the species of sundew, *Andromeda polifolia*, *Scheuchzeria*, &c., gradually disappear, but they are not transformed into new species. When a wood is rooted up, the wood anemone, the hepatica, the wood-sorrel, &c., vanish, but do not become new species. When lakes are laid dry, the water-lilies, the arrow-head, &c., are no longer seen, but do not undergo change of form. The phenomena when a tract, originally bare, becomes clothed with vegetation, as we have already described in some detail, also speak against the origin of new species. For when the bed of the sea is dyked in, the naked tract does not become

* *Brewster's Edinburgh Journal.* See also above, page 14.

occupied by new species, but by the plants of the nearest coast; it is the same when bare lava-streams become gradually overgrown by plants, or coral islands rise above the surface of the ocean, and by degrees acquire a vegetation. In the last case, apparently, in the first instance only those plants are found, the seeds of which can be conveyed by the sea; particularly the cocoa-nut palm, the fruits of which are well fitted for transport by currents, and preservation in water. Consequently such islands, particularly when isolated, are very poor in species; as, for example, according to Darwin's account, Keeling Island, south-west of Java; according to Chamisso, several such islands in the South Sea. To the same cause must we ascribe it that the vegetation of extensive alluvial formations—formations which are now in constant progress, is, if not poor, extremely trivial, that is to say, without peculiarities. The valley of the Nile, Lombardy, and, indeed, Holland also, may be mentioned as examples.

For these reasons, I hold it in the highest degree probable, if not strictly proved, that no new species originate at present.

3. A third fundamental question, which presses itself upon us, is: *whether the appearance of the existing vegetation of the earth, took place at once, or by degrees?*

It appears to me, that much speaks in favour of the latter alternative. The surface of the earth only became gradually fitted, through various elevations, for the growth of plants upon it, and the characters of the soil and climate were different in different quarters of the globe; therefore, there is the greatest probability in the assumption that such vegetation originally made its appearance in that, or in those places where the conditions were most favourable. Moreover, plants exist the conditions of whose existence depend upon other plants, and the appearance of the latter must, therefore, have preceded that of the former. Parasitical plants, as well the higher as the lower, could not exist before those plants upon which they grow were in existence. Plants flourishing in the shade—for example, the wood and forest plants of the present time—could not have made their appearance before trees existed; nor bog-plants before the mosses and confervas which form peat-bogs. The appearance of manure-plants was equally impossible, so long as no manure existed. The growth of vegetation upon naked cliffs commenced with lichens and mosses,* which produced a little mould and accumulations of water, in which the seeds of other plants could germinate, and plants of greater dimensions, bushes and trees, gradually made their appearance.

It is, therefore, altogether improbable that in the first appearance of vegetation, the majority of plants would have presented themselves before the conditions in which they live had come into existence.

I must, consequently, assume a gradual creation as in the highest degree probable.

4. A fourth question: *whether there exist among the plants of the present time, certain which have descended to us from the ancient world?* can scarcely be adequately answered in the existing position of geology, for we are acquainted scarcely with one fixed limit between the present and the immediately preceding age of the world's history. To this must be added the fact, that if, as I believe, examples of existing species may be named, which have been found in older strata, this is no proof, according to what has been assumed in the foregoing, that they have survived the revolutions of nature which immediately preceded our existing period; for if we assume that the same species can have appeared in different places at the same time, it may also have appeared at different times.†

5. Assuming, as I believe we must, that existing vegetation appeared at different times, we might wish to know *which of our existing species are the oldest, which the youngest;* we might wish to become acquainted with the different *vegetable formations*, just as we know the geological formations. In order to arrive at a clear view of this subject, we may have recourse, in part, to the external conditions under which the different floras, or geographical vegetable systems of existing vegetation, made their appearance, and in part to the composition and the properties of those systems. As a specimen, I will here first take the *Alpine flora,* that is, the vegetation which is found upon the Alpine system, *above* the tree-limit and *below* the snow-line—a flora which

* Or with succulent plants, which derive their nourishment chiefly from the watery vapour of the atmosphere.

(† Neither of which are to be considered warrantable assumptions.—Ed.)

displays a high degree of peculiarity, in contrast to the Central-European flora of the plains and highlands; for this latter I will take as a type the German flora, in the sense it is understood by the German botanical authors, namely, including the Littoral, Istria, and South Tyrol;* so that here the foot of the Alps and the lower mountains will be contrasted with the high Alps, or Alpine region, as it is called.

Looking, in the first place, at the external conditions of this flora, and in particular at what we ascertain from a geological point of view, it is well known that, according to Elie de Beaumont, the main chain of the Alps is more recent than the other mountain masses of Europe, having made its appearance in the latest considerable elevation, indeed, after the diluvial formation; and that, in like manner, what he calls the West Alps, are of very recent origin, and, in fact, appeared subsequently to all the tertiary formations. This late date gives some probability to the idea that the vegetation is of recent origin—in any case, that part of the Alpine flora which is not found elsewhere; partly, because those mountains most recently upheaved must have been the latest to be fitted for the growth of plants, just as at present the newest lava-stream, as a rule, receives plants subsequently to the older ones; partly, because it cannot readily be conceived where those Alpine plants, now growing between 6000 and 9000 feet, could have grown at the time when no mountains of such a height existed, or only at a distance which rendered a colonization almost impossible; while we are unable to explain the presence of many plants peculiar to the high Alps, altogether wanting in the previously upheaved Apennines and Pyrenees. Yet it must be admitted that no decisive proof can be sought in the more recent elevation of the Alps, so long as we are ignorant how far back existing vegetation lived, and how far it can have survived the great revolutions which the upheaval of such gigantic mountain-chains must have caused.

Another reason for attributing an inferior age to the Alpine flora is the decreasing temperature of the earth. For if the earth has gradually cooled down, the plants which flourish at

* It is scarcely necessary to remark, that in other botanico-geographical researches this union of the flora of the Mediterranean with the German, or Central-European, flora, is altogether inadmissible.

the lowest temperature must have made their appearance last, because, at earlier periods, the climatal conditions favourable to these plants did not exist. An argument against this is furnished by Agassiz's theory,* which supposes a period to have existed before the present, in which not only Switzerland, but also France and Germany, lay buried under a permanent covering of ice, such as now exists at the extreme poles. Without mentioning the numerous points which can be fairly objected to this theory, I will merely remark that many traces of trees in Northern Europe, from the newer and most recent tertiary formations, speak strongly against it; while the abundant remains of arborescent vegetation in the oldest peat-formations and submarine forests, show that trees grew in Northern Europe in or immediately after the diluvial period, which could not have been the case if Central Europe lay buried in snow. Lastly, the fossil elephants and rhinoceroses in Siberia testify against it; for even if it must be regarded as having been erroneously assumed, formerly, that the existence of these animals involved that of a warm climate, yet is it certain that they could not live in regions which were constantly buried beneath ice; and if Central Europe had such a frozen climate, it must naturally have been still colder in North Europe and Northern Siberia.

Thus the climatal conditions also seem to argue for the recent origin of Alpine vegetation. But it must be admitted that this does not fully complete the proof.

Perhaps more important evidence might be derived from the *special character of the Alpine vegetation*, and this in several respects. It is abundantly proved and attested by fossil plants, that the lower plants appeared earlier than the higher; that, consequently, the history of the earth, in respect to the plants as in respect to the animals, exhibits a progressive development from the simple to the compound organisms. In the oldest period (that of the coal), the flowerless plants prevailed *(plantæ vasculares cryptogamæ)*; and in the middle coal periods, Conifers and Cycadaceæ, which belong to the Dicotyledons devoid of a corolla *(Dicotyledoneæ apetalæ)*.

(* The author has taken the crude, extreme terms of the *glacial* theory. It is not now supposed that Northern Europe had a climate like that close to the Poles; but there is every reason to believe that it had one like the North American coast within the line of the summer floating ice during the glacial period.—Ed.)

When these facts stand clearly before us, we are inclined to assume that a similar condition must also be traceable, although in a smaller degree, in the existing vegetable world; and that, therefore, of two existing floras, that in which the higher forms most predominate must be the younger. To test whether this conjecture corresponded to the truth, I have compared the Alpine flora with the existing flora of Germany and with the flora of the ancient world, and have arrived at the following numerical proportions*:

	FLORA OF THE ANCIENT WORLD.		EXISTING FLORA.	
	Before the Chalk.	After the Chalk.	Germany.	Alps.
Flowerless	,81	,02	,02	,02
Monocotyledons	,06	,13	,21	,16
Dicotyledons:				
Apetalous	,12	,45	,08	,04
Petaliferous	,01	,40	,69	,78

According to this, the Alpine flora has 78 per cent. of petaliferous Dicotyledons, the German flora only 69 per cent., and the ancient world, after the chalk formation, 40 per cent., before it only 1 per cent. On the other hand, the apetalous Dicotyledons form only 4 per cent. of the Alpine flora, but 8 per cent. in the German flora (7 per cent. if we exclude sea-side plants); while in the ancient world, they constitute (including the Cycadeæ) 12 per cent. before the chalk, and 45 per cent. after it. In regard to the flowerless plants, in which the proportions are so completely different from those of the ancient world, the quotients are alike. We must not, however, confine our examination to the numerical proportions, but inquire what groups are especially predominant on, and characteristic of the Alps, and develope a multiplicity of forms there; and in this respect it deserves to be mentioned, that the Ranunculaceæ, Rosaceæ, Saxifragaceæ, and Cruciferæ, are the families which chiefly prevail and appear in peculiar forms—families which are among the most highly developed; next to these come the Primulaceæ and Gentianaceæ, which also must be regarded as well-developed groups. On the other hand, neither the apetalous Dicotyledons nor the

* In reference to the German and Alpine floras, I have used Koch's Hand-book; for the ancient flora, Bronn's Catalogue, in the "Natural History of the Three Kingdoms." 1846.

Monocotyledons offer any family which plays an important part in the Alps, and still less one which presents itself in peculiar forms. The Alpine plants belonging to these groups are merely representatives of well-known German forms.

If we compare in this manner the Lapland flora, or what amounts to the same thing, that of the Scandinavian mountains, with that of the remainder of the country, according to Hartman's flora, we obtain the following numerical proportions:

	Scandanavia.	Lapland.
Flowerless	,03	,05
Monocotyledons	,26	,31
Dicotyledons:		
Apetalous	,08	,09
Petaliferous	,63	,55

Geologists assume that the mountains of Scandinavia are older than the Alps. But we find that the Lapland flora, which is at the same time that of the Scandinavian mountains, approaches nearer to those of the ancient world; since the proportion of the flowerless plants is somewhat larger, that of the apetalous Dicotyledons a little larger, and that of the petaliferous Dicotyledons considerably smaller. We find, moreover, in comparing the Lapland flora, or that of the Scandinavian mountains, with that of the Alps, a greater divergence in reference to the numerical proportions between the large groups, than when we compare the Alps and Germany, or Scandinavia and Lapland; nevertheless, when we regard the habitual character of the floras, as of the families, genera, and even of the species, the agreement of the Alpine and Scandinavian mountain floras is much greater than that which exists, or climatal conditions would suffer to exist, between them and their corresponding lowlands. This becomes clearer when we combine the above tables:

	EXTINCT FLORAS.		EXISTING FLORAS.			
	Before the Chalk.	After the Chalk.	Germany.	Alps.	Scand.	Lapl.
Flowerless	,81	,02	,02	,02	,03	,05
Monocotyledons	,06	,13	,21	,16	,26	,31
Dicotyledons:						
Apetalous	,12	,45	,08	,04	,08	,09
Petaliferous	,01	,40	,69	,78	,63	,55

Another peculiarity *of a part* of the Alpine flora, is the remarkably indefinite condition of the species—a striking uncertainty of form, which renders it infinitely difficult, not to say impossible, to define the species; so that in certain forms one author assumes many, another a few species to exist. I need merely call attention to the genera, *Draba*, *Arabis*, *Hieracium*, *Gentiana*, and *Salix*. The want of definition in the forms is the more remarkable here, that the Alpine plants are multiplied more by buds than by seeds; and the propagation by buds, as is well known, preserves the character of species better than the multiplication by seeds.* If the view which I have indicated above, that the plants are not descended from single progenitors, but from many individuals, were correct, it might, indeed, be considered probable that species had been gradually produced by certain of the closely allied forms establishing their type by degrees, through propagation by seeds or buds, while other forms were exterminated by them. But if this had been the case, the older flora must have possessed more forms, and those of greater fixedness, than the recent. Under this point of view, the production of new forms (varieties) by human agency, would be a kind of retrogression to a primitive natural condition. This conclusion, however, loses much of its force from the fact of the Scandinavian mountain flora, which must be regarded as the older, exhibiting a greater uncertainty of the forms; so that one would be rather inclined to seek the causes thereof in the great variety of the local conditions.

Although I believe that we have here fair grounds for considering the Alpine flora as more recent than those of Central Europe and the Scandinavian mountains, it is by no means my intention to assume this as proved. Before we can attain to certainty in this matter, we require a quantity of elucidations of geological conditions, in which we are at present deficient; and for the deduction of conclusions respecting the intimate character of the floras, evidence of the importance of the numerical proportions exhibited between the primary groups of the floras, as well as of their other characters, must be obtained by comparison of several, or of a large number of floras. Secure acquisitions will only be obtained by a right earnest co-operation of botanists, geologists, and zoologists. It was my especial object to incite bota-

(* It is rather the fact that propagation by buds perpetuates varieties, while seedlings tend to return to the primitive type. This is seen daily in horticultural operations.—ED.)

nists to a thorough study of the geographical vegetable kingdoms, the different characters of these, and the geological and physical conditions under which they are met with. The foregoing statements must be regarded as merely tentative propositions, destined to a more minute investigation. Hence a few more indications may be added in reference to this subject. It is well known that New Holland and South Africa are remarkable for a high degree of variety of forms, and thus possess great peculiarity; while, on the other hand, the flora of extra-tropical South America is devoid both of variety and of peculiarity, approximating not a little to the floras of Europe and North America. That variety cannot have arisen from migration of the plants, for both New Holland and South Africa are but little adapted to admit this; the former is entirely surrounded by the ocean, the latter bounded by it on three sides, and on the fourth by mountains and barren deserts. Neither can the variety be derived from the climatal conditions, for these exhibit much less variation in the southern hemisphere, on account of the greater influence of the ocean. Might not these remarkable relations of the three continents of the southern hemisphere be best explained by *historical* conditions? In New Holland and South Africa, the species appear to be less definitely fixed; and the families, also, which must be accounted among the more perfect, here exhibit great development and become strongly predominant, as the Acacias and Myrtaceæ. One more suggestion. Most of the saline plants (Halophytes) belong to the least-developed Dicotyledons, namely, to the apetalous—to the group which played a greater part in the ancient world than it does at present. May not this indicate, perhaps, that these plants belong to an older vegetable formation, which, from the fact of these plants occurring upon the sea-coast, would be preserved more readily during the revolutions?

Some persons, perhaps, may regard these remarks as barren, and leading to no certain results. But when we consider what paleontology was fifty years ago, and what it is now, we cannot give up the hope of making progress in these investigations. It is true there are limits to human knowledge, but we can only find what these limits are by trial. The naturalist must not be frightened by the mute Sphynx of nature. He must endeavour to compel her to speech.

CHAPTER IV.

THE POMPEIAN PLANTS.

SOME eighteen centuries ago, Vesuvius was not known as an active volcano; its foot and its declivities exhibited great fertility, the summit was rather flat; but the effect of fire was evident upon the mountain mass, and it was conjectured to be a volcano which had lost its activity, just as we at present draw such conclusions respecting the extinct volcanoes in Auvergne, on the Rhine, or in the Alban Mountains, and several other places in Italy.

During the reign of Nero, A.D. 63, a very violent earthquake shook the neighbourhood of Vesuvius; part of Pompeii was destroyed. Herculaneum suffered greatly; Naples, and the other more distant cities, less. But this was only the forerunner of a far more violent revolution of nature.

In the reign of Titus, A.D. 79, the naturalist Pliny, commanding the Roman fleet, lay at Cape Misenum, to the west of Naples. One evening, his sister, the mother of the younger Pliny, called his attention to a cloud, of extraordinary size and of unusual aspect, which rose perpendicularly upwards like a column, and spread out above into a crown, so that it bore resemblance to a pine-tree. Pliny immediately caused a swift-sailing ship to be prepared, and steered in it towards Vesuvius, from which, as was soon evident, this cloud, or more correctly, this smoke, originated. The dense showers of cinders, the pumice and blocks of stone thrown out, soon made their appearance, and spread terror over the whole vicinity. The naturalist advanced fearlessly towards the danger. "Fortune favours the bold," was his encouragement to his people. He passed the night in a little villa at Stabiæ, and slept so peacefully that his breathing could be heard without; he slept, until he was awakened in the morning lest he should be shut up in the house, for the fallen cinders had almost blocked up the door. At break of day, which, however, was darker than night from the showers of cinders, he went out to observe and note down the phenomena. The flames and sulphurous vapours, which drove the others away, excited him. A cloth was spread upon the ground for him to lie upon; but he had scarcely remained a moment on it, when, attempting to rise, with the assistance of his two slaves, he suddenly fell down dead, probably suffocated.

In this violent eruption of Vesuvius, the first noticed in history, the cities of Pompeii, Herculaneum, and Stabiæ, were destroyed; Pompeii and Stabiæ by showers of cinders, Herculaneum by a stream of lava.

These cities lay buried for 1600 or 1700 years after that time, and even their exact position was unknown when accident led to their discovery, towards the close of the seventeenth and the commencement of the eighteenth century. At present, they are in great part laid open—Pompeii in particular—the ashes having been removed; we ramble over the market-place, through the streets, temples, theatres, and private dwellings, as in a city of the present day; we make acquaintance with the arrangements of the homes of the ancients, their furniture, their cooking utensils, the ornaments of the ladies, the tools and workshops of their artisans, and their, in some instances, excellent works of art; and here we obtain, better than in any other place, an immediate conception of the public and private life of antiquity.

An acquaintance with the plants known to the Pompeians may, perhaps, possess some interest; and for this, two principal sources present themselves—namely, the pictures and other representations of plants found in Pompeii, and other buried cities, and the actual remains of plants. Some circumspection is necessary in the use of the first means. Of course, many representations of plants are so indistinguishable that they cannot be determined, as would also be the case in the present day. Even when the plant is distinguishable, it is not made out that it occurred in Pompeii; for the vegetation of foreign lands was frequently depicted. Thus we often find the Nile scenery represented—marshy regions, with the lotus and the Egyptian bean (*Nelumbium*), the hippopotamus, the crocodile, the ichneumon and ducks, with the date-palm upon the shores; for example, in the lower compartment of the celebrated Mosaic, which is supposed to represent Alexander and Darius. The representations are frequently fancy-pictures; for instance, a laurel-tree, out of which grows a date-palm—nay, even springs from it as a root-sucker—a physiological impossibility; perhaps, as Tenore thinks, this indicates the strange custom which the ancients had of placing plants, the most diverse from each other, so close together that they looked as if they were all one.

Among the trees which especially contribute to give character to the landscape in Italy, are the stone-pine and the cypress. Both occurred with the ancients, of which the authors and the pictures in Pompeii bear testimony, for representations of the pine-cones have been many times met with. In like manner carbonized seeds of the stone-pine have been found in Herculaneum. The cypress is very frequently found in the landscapes which decorate the walls of the chambers in Pompeii, and sometimes in combination with the stone-pine. A third conifer peculiar to the countries of the Mediterranean, the Aleppo pine, is also met with in Pompeii.

The oleander, which now ornaments the banks of the rivers, and the ivy, which clothes walls and trunks of trees, are both represented in Pompeii.

On the other hand, there are two plants which at present play an important part in the landscape, but did not grow in Italy in ancient times. The aloe, as it is called (more correctly, the agave), which has become such a favourite with landscape painters, on account of its large, fleshy leaves, and tall candelabrum-like flowering stem, and which occurs around the Mediterranean, both cultivated and run wild, was derived from America, and therefore could not be known to the Pompeians. The Indian fig, belonging to the cactus group, remarkable for its peculiar aspect, especially through the flattened leaf-like shoots, a plant which occurs now as universally as the aloe in the countries of the Mediterranean, and is in like manner found in a wild state, also came from America. And there is just as little trace, in Pompeii, of a representation of this very peculiar plant, as of the aloe.

It is doubtful whether isolated trees of the date-palm, without ripe fruit, occurred in Italy of old, as they do at present. We, indeed, frequently see them represented in Pompeii, but generally in combination with Egyptian objects, or used in a symbolical signification. But the dwarf-palm undoubtedly played the same part then as now, since Theophrastus reports that it was very general in Sicily; this is the case at present, while it is only sparingly met with in the Bay of Naples.

Turning our attention to the cultivated plants, we find that most travellers who visit Pompeii first make acquaintance there with the cultivation of cotton. Close upon the ruins of Pompeii occur cotton-fields, and the northern limit of the cotton-plant in Italy lies there. We find no trace of this important clothing plant in the memorials of antiquity; we know from other sources, that it was only known to the ancients as an Indian, and, according to the later authors, also as an Egyptian plant, and the Arabs first diffused it through the Mediterranean countries.

Another vegetable which at present is indirectly important for clothing in Italy, namely, for the food of the silkworm, is the *white mulberry*. This also was unknown to the Pompeians. In their time, silk was a foreign article of luxury, regarded as of the highest value. The cultivation of silk and the mulberry came first into Europe in the sixth century.

Wheat was the prevailing grain with the ancient Romans; barley was also general; but they were without the more northern kinds of corn, oats and rye. Charred wheat and barley grains are found in Pompeii. There exists upon a wall a fine painting of a quail picking the grains out of a spike of barley. A side-piece to this represents a quail pecking at a spike of millet (*Panicum italicum*), which, therefore, was in like manner known at that time.

On the other hand, we miss drawings of the maize, a grain of such distinctly marked form; but we know that we owe this to America. At the present time it is cultivated in the vicinity of Pompeii.

Neither do we meet with rice; it was then confined to the East Indies. It is not cultivated even now near Pompeii, but to a great extent in other parts of Italy. It is doubtful whether the "durra" (*Sorghum*) was known to the ancients, or was first brought into Europe by the Arabs; the Pompeian pictures give no information on this head.

Among the leguminous fruits, we meet with the broad beans in a charred condition, perfectly resembling those of the present time.

In paintings representing culinary articles, we find represented a bundle of asparagus, which, however, is probably the wild, eaten then as it is now; for it does not appear that the ancients were acquainted with cultivated asparagus. In other pictures of culinary subjects, occur onions, radishes, turnips, and a kind of small gourd. Among the culinary vegetables unknown to the ancients, were the Pomi d'oro (*Lycopersicum esculentum*), which have since been introduced from America. The olive appears to have played the same important part in the time of the Pompeians as it does at present; the writers also testify to this. Olive-branches are frequently found represented, and a glass has been dug up in Pompeii containing preserved olives, which agreed perfectly with those of to-day, and still retained their flavour when first dug up.

The fruits which are most eaten at the present time are grapes and figs; and these are what we find most frequently depicted in the many fruit-pieces which occur on the walls in Pompeii. The vine also played an important part, from being dedicated to Bacchus, and we meet with it in many pictures in connexion with the worship of this deity.

Fruit and animal pieces also frequently present pears, apples, cherries, almonds, plums, peaches, pomegranates, and medlars.

Some have thought that they found the pine-apple represented in Pompeii; if this were true, it would be very remarkable, since this fruit is regarded as American. But the object which has been taken for a pine-apple, and which is placed upon a dish, is what Tenore undoubtedly more correctly supposed, namely, the terminal bud of a young dwarf-palm, which is also eaten in Sicily at the present day.

A much more important deficiency among cultivated plants is that of the common and Seville oranges, the lemon, and the citron. It is made out beyond doubt that some of these were known in the time of Pliny; he states that attempts had been made in vain to introduce the Medic apple (the citron) into Europe. The culture of this in Italy commenced in the third century; the lemon and the Seville orange came later into Europe—probably through the Arabs; while the common orange, which is derived from China, and was brought by the Portuguese to Europe, was the last.

We see, therefore, that the vegetable kingdom, and especially the cultivated plants, have undergone several modifications since the time when Pompeii flourished; and that while the ancient Pompeians were so much better off than the moderns in regard to the enjoyments of life, in particular the pleasures of art, they nevertheless were without certain important plants, which extended geographical knowledge and expanded commerce have procured for their successors. The most important among the newly-introduced products are: rice, maize, cotton, silk, and the orange tribe. So that in those days Italy was not

> The land where the lemon-tree blows,
> And in darker leaves bowered the gold orange glows.

CHAPTER V.

RAIN.

WATER poured into an open vessel is found to diminish in quantity in the course of a certain time, and after longer period, to have disappeared altogether; we then say that the water has evaporated, knowing very well that it has only changed its form, and has ascended into the air as vapour. Evaporation is favoured by heat; warm water in a saucer becomes diminished more quickly than cold; the little puddles on a road dry up much more rapidly on a warm summer's day than on a cold day in winter.

But the ascending watery vapour is not always visible; whether it be so or not depends upon the difference that exists between the temperatures of the evaporating body and the surrounding air. If a saucer of warm water is brought into a cold or only moderately warm room, the vapours become visible; but we do not see them when the air of the chamber is heated to the same degree of temperature as the water. In frosty weather, the evaporation from human beings and animals becomes visible; in warm weather it is not so, although in this case it is more considerable. When the lower stratum of the atmosphere becomes cooled down in the evening after a warm day of summer, the lakes and fields become covered with a steamy mist, that is to say, we see the ascending watery vapours, which are invisible during the day notwithstanding the greater evaporation. When the air over the sea is colder than the water, a sea-fog is produced.

When the watery vapours floating in the atmosphere are visible, we call them mist or clouds. All the difference between these two kinds of accumulation of vapour, depends upon their elevation above the earth's surface. In warm summer days, the morning mist frequently rises to a height, and becomes a cloud; and the mass of vapour upon a mountain, which from the valley looks like a cloud, is found on entering into it to be exactly like a mist. But when neither cloud nor mist are to be distinguished, even in the clearest weather, watery vapour exists in the atmosphere, as can readily be proved by causing it to cool down. When cold water is poured into a bottle on a warm day, this becomes dulled, that is to say, vapours are precipitated upon the outside of it, and these may even amount to drops; these vapours can clearly have been derived from nowhere else than the atmosphere, and thus they demonstrate that the air contains vapours, even when they are invisible. The same explanation applies to *dew*, which is simply the watery vapour which becomes visible through the nocturnal cooling of the lower strata of the atmosphere, and of the plants or other objects which exist in them. The conversion of the vapour into the form of drops, is caused by cooling, just in the same way. When strata of air of different temperatures are mingled, or come in contact, the vapours of the warm stratum change into drops, and fall to the earth as *rain*.

The surface of the earth with its plants and animals, on the one hand, and the atmosphere on the other, form a kind of distillation apparatus. Watery vapours rise unceasingly from oceans, lakes, rivers, morasses, plants, and animals; they accumulate into clouds in the air, subsequently become transformed into drops, and descend again to the surface of the earth as rain. On dry land the water penetrates into the earth, and comes to light again in springs, which collect into running streams; these give off vapour to a certain extent, and empty themselves into the ocean, whence the water is again evaporated; besides this, water is taken up by plants and animals, which likewise give off watery vapours to the atmosphere. In this way a continual circulation of water is kept up between the earth's surface and the atmosphere.

The amount of rain at any given place is calculated by means of a rain-guage. This is an open vessel of known diameter, exposed to the air so as to catch the rain-water; after every time it rains, the quantity which has fallen is noted, and these single quantities are added together to give the monthly and yearly amount of rain; a mean quantity is calculated from the measurements of several years. The quantity of rain is most simply given in vertical height; that is, by indicating the depth of water which would lie upon the ground at the end of the year or month, did not the rain-water evaporate or sink into the earth. The annual quantity of rain in Copenhagen, as stated in this way, amounts to about twenty-two inches.

Should we ask what natural circumstances exert especial influence over the quantity of rain, and in consequence upon the *distribution of rain* over the various parts of the earth's surface, experience tells us, in the first place, that under otherwise equal circumstances, it rains more near the sea than at a distance from it. The causes of this are readily perceived: in the first place, the sea sends up more watery vapour than the land; and in the second place, there is a greater alternation of temperature between the land and the sea, and, consequently, more frequent changes of the wind, than is the case between two portions of a continent where there are plains. Thus it rains more upon the British Islands, in Holland and on the north-west coast of France, than in Denmark or the north German plains; and again, more here than upon the plains of Poland or Prussia.

Another principal cause of the increased quantity of rain lies in the inequalities of the earth's surface. Mountains increase the amount of rain; it increases in proportion as we approach towards them, and the higher and steeper they are. The reason is obvious here also: the strata of air over the mountains are colder than those over the plains, and a constant reaction takes place between these different strata. Sometimes the warm air of the plain rises up the sides of the mountains or through the valleys, sometimes the masses of cold air flow down from the mountains into the plains; these strata, possessing different temperatures, meet above and below; cooling is thus caused, and the vapours are precipitated as rain. When we inquire into the amounts of rain upon the great plain which is bounded on the north by the Alps, and toward the south by the Apennines, we find that they increase towards the Alps. Southward of the Po, the annual amount of rain amounts on an average to twenty-six inches; northward of the river, to thirty-eight inches; immediately at the foot of the Alps, to sixty inches. There are particular places in the southern part of the plain where the quantity of rain amounts only to twenty-one inches, and isolated points in the Alps where it amounts to a hundred inches. We meet with similar conditions when we follow the Rhine or the Rhone upwards, or when we compare the quantities of rain in the mountains of Germany and France with those presented by the plains.

The influence of mountain-chains in the increase of rain is greater than that of the ocean; where, however, a range sinks down precipitously towards the sea, the increase of the rain is especially striking. The west and east sides of Scandinavia exhibit an example of this kind. The city of Bergen, the rains of which have become proverbial, has an annual amount of eighty-two inches; in Stockholm the quantity is only twenty-one, in Upsala eighteen inches. The mountains on the west side of England have almost twice as much rain as the more level east side; in the former the amount of rain in particular spots reaches above sixty inches, while in the latter it falls in certain places to seventeen or eighteen inches. The quantity of rain on the south side of the northern Apennines, which extend close down to the Mediterranean, is very considerable, and in particular places rises to a hundred inches.

The relation of the various winds to the rain is just as simply and readily explained. In Denmark, and generally speaking in most parts of Northern Europe, the west and south-west winds bring the rain, particularly when they alternate with north and east winds. These winds come from the ocean, which gives abundance of vapour, or from warmer countries where the evaporation is more considerable. When these currents of air, loaded with vapours, come in contact with the cold winds of the east and north, the vapour is converted into rain. In Copenhagen it rarely rains with any other wind than west or south-west; when the reverse occurs, it is soon after a change of the wind, and then we have a right to suppose that the vapours precipitated by the north or east winds, having been previously carried over by currents of air from the west and south, are afterwards brought back. When the east or the north wind has blown for a longer time, it does not rain until a change of wind occurs. In Prussia the north wind sometimes brings rain, since this comes from the Baltic; the south wind less frequently, because it comes from the dry continent. In North America the east wind is the principal source of rain; it comes from the Atlantic Ocean.

In order to comprehend the conditions of the rain of a country or any given place, it does not suffice to know how much rain falls annually; we must also know how this quantity is distributed through the seasons. It of course makes a great difference whether the same quantity of rain is distributed pretty equally through the seasons, or is accumulated into one season—the *rainy season*, in contrast to the remainder of the year, the *dry season*.

The frequency of the repetition of the rain is another important point in the examination of the condition of the rains of a region; for it makes a great difference in the climate whether the same amount of rain falls in many small showers or a few great rain-storms. The twenty-five inches of rain of Dublin are distributed over 208 rainy days, the twenty-two inches of Copenhagen over 134 rainy days.

It might be interesting to know the distribution of rain upon the surface of the whole globe, and to obtain a *résumé* of these conditions by a general rain-map; but the materials for this are too few and too much scattered. We shall therefore confine ourselves here to a part of the earth's surface—namely, Africa and Europe, from the equator to 60° N. L. In this space we meet with the following four zones, differing from each other in the conditions of their rains:

1. *The Zone of the Summer Rains*, from the equator to the 15° N. L.—Here, as almost everywhere in the countries within the tropics, the rain is limited to a particular season, and this at the time during which the sun stands over the northern hemisphere, and we, consequently, have summer. The amount of rain under these circumstances is very large, and, generally speaking, much more considerable than in the temperate zones. The rivers become swollen, overflow, and flood large tracts of country; the lakes become greatly enlarged, of which Lake Tschad, in the interior of Africa, affords an example. The rain-storms are much more violent than in the temperate climates.* The regularity of the rain is not confined solely to the annual distribution; it exists even in reference to the daily course. In the morning the air is clear; after a time the clouds begin to collect, and about ten or eleven o'clock it begins to rain. The rain continues through the afternoon; at sunset the atmosphere is again serene, and remains so through the night. This is repeated almost daily in the rainy season, with such regu-

* Cayenne, in South America, has given an instance of as much rain falling in half a day as, on the average, falls in half a year in Copenhagen.

larity, that in arranging parties of pleasure, people settle whether they are to be before or after the rain.

The rainy season does not occur simultaneously in the whole of the hot zone, but follows the sun as he recedes towards the north, so that it happens earlier at the equator than at a distance from it. The limit of this zone can be traced from west to east, from Senegal to Nubia; it lies between the 15° and 17° N. L.

2. The *Rainless Zone*, the *Desert Zone*, between 15° and 30° N. L. (N. Africa).—This is without rain the whole year, or only displays accidental rain-storms extremely rarely. Rain is one of the greatest rarities in Upper Egypt, Nubia, and Dongola. According to Pocock, it occurred only twice in eight years. The same is true, according to Rüppell, of Cordofan and the north of Sennaar; in like manner of Fezzan, between Bornou and the Mediterranean, where, according to Denham and Clapperton, five or six years may pass by without rain, as is also the case on the Desert of Sahara. Thus, this zone well deserves the name of the *rainless*.

3. *The Zone of the Winter Rains*, North Africa and the South of Europe, between 30° and 45° N. L.—The amount of rain in this zone increases towards the north; it is very small in Lower Egypt, small in the Barka plateau, and more or less so throughout the North African coast; towards the north, in Italy it increases considerably, and becomes especially large on the south side of the Northern Apennines. It is high in Portugal, but only low on the plateau of Spain, as on elevated plains generally.

The rains of this zone are either wholly restricted to the winter, as is the case in North Africa and the Canary Islands, or they also fall, but very sparingly, during the summer, as occurs in the South of Europe; but as we advance towards the north, the summer rains become more frequent, and the transition in this respect is gradual. Thus, the proportion of the summer rain to the whole annual amount in Sicily is only 36, in Rome 11, in Florence 14, out of 100.

4. *The Zone of the Constant Rains*, that is, of rains (including snow) in all seasons.—Ordinarily, the quantities of rain of the seasons do not deviate considerably from one another,

yet the summer and autumn rains are more abundant than those of the winter and spring. In the neighbourhood of the Atlantic Ocean, the autumn brings most rain; in the interior of the Continent, the summer.

The distribution of rains here described is founded upon observation, and therefore must be regarded as a fact, while the explanation of their conditions remains more or less uncertain.

The conditions of rains which are met with within the tropics, namely, the separation into a dry and a rainy season, are explained by Humboldt — apparently happily — in the following way: When the sun stands over the southern hemisphere (*i. e.*, when we have winter), there exists a great difference of temperature between the torrid and the northern temperate zone, between Africa up to some 20° on the one side, and North Africa and Europe on the other. This difference of temperature causes a strong influx of colder air towards the equator, and in the same manner as an influx of this kind takes place from the ocean on to a strongly heated continent, or, on a small scale, when the door is opened of a room, where the air is at a higher temperature than without; the colder air thus flowing in becomes warmed, and rises upwards in the torrid zone; and so long as that condition lasts, so long as the influx and ascent are not interfered with, the vapours in the air cannot fall as rain in the torrid zone itself. But when the sun stands over our hemisphere (*i. e.*, when we have summer), the air also becomes warmed over the temperate zone, and then there is not so great a distinction between the two zones; the influx decreases, and becomes, at the same time, less regular; calms and variable winds ensue—and then the vapours find the conditions in which they are precipitated as rain. And since the evaporation is very powerful in the torrid zone, so the amount of vapour is large, and consequently that of the rain.

The considerable amounts of vapour which ascend into the higher strata of the atmosphere, flow towards the north, to restore equilibrium; they cannot reach the lower strata of air in those parts of the temperature adjacent to the torrid zone, in which the influx takes place; this occurs in a higher latitude. Consequently, we find next to the zone of the ascending vapours, a zone of influx; and to the north of this, a zone where the vapours fall down upon the surface of the earth. But these zones change with the sun, just like the zone of the summer rains.

When the sun stands above the southern hemisphere (when we have winter), and the rainy season prevails to the south of the equator, there is in the northern hemisphere, about to the 15° N. L., a strong elevation of temperature and ascent of vapours, and no rain; between 15°—30°, a powerful current toward the equator (prevailing north and north-east winds), and in like manner no rain; but beyond 33° north the vapours fall, and thus the North of Africa and South Europe obtain their winter rains.*

During the summer, on the other hand, when the sun is over the northern hemisphere, the rainy season occurs between the equator and 15° N. L.; the vapours rise between 15°—30° (from the Desert but little, but so much the more from the Atlantic Ocean); the zone of influx is changed to 30°—45°, whence the north wind becomes prevalent over the Mediterranean and the countries surrounding it; and the rain does not fall until beyond 45° in Northern Europe.

We compared the evaporation and the rains with distillation. We have here a distillation on a vast scale; the retort from which the vapours arise lies in Africa, the receiver into which they flow is Europe; but the apparatus is moved about, so that the retort lies in winter in South Africa, the receiver in South Europe (probably also in North Europe); while in summer the retort is in North Africa, and the receiver in North Europe.

* See Von Buch's Physical Description of the Canary Islands.

CHAPTER VI.

THE ITALIAN MALARIA.

The climate of the beautiful land which, in the words of the poet, is embraced by the sea and the Alps, and parted by the Apennines, the pure, clear air, the mild winter, the warm and yet not scorching summer, the steady weather, make so strong an impression upon us, whether our knowledge of them be derived from our own experience or the report of others, that we often forget that this very climate, deservedly so highly praised, brings death and destruction to mankind in certain places, at particular periods of the year. As the great cities and the most frequented roads are generally far removed from such regions, a wrong idea is frequently conceived of the extent of the public calamities resulting from the *malaria*, as it is called, and one is sometimes tempted to regard as local that which is actually widely spread, thereby becoming very liable to fall into error in judging of the causes of the malaria. This is especially true, not unfrequently, of the opinions which have been formed respecting the Roman Campagna, where the unhealthy air, or narratives relating to it, fall within the sphere of experience of almost every traveller, while most of the other unhealthy regions remain unknown, or are only hastily traversed at a healthy season of the year.

A description of the geographical distribution of the malaria, of the places and times of its occurrence, will doubtless best lead to a knowledge of its nature and causes.

First of all, in reference to the distribution, it must be mentioned that the unhealthy air is naturally met with principally upon the coasts. But a closer examination shows that the vicinity of the sea is neither an exclusive condition of the unhealthy atmosphere, nor always produces it; for we find both that unhealthy air extends, in not a few places, from the coasts into the plains and valleys of the inland regions, and indeed occurs in parts altogether unconnected with the malaria of the coast-regions; and, on the other hand, that not a few regions of the sea-coast are protected from this ill.

Thus, the Genoese coast, from Nice to the gulf of Spezia, where the Apennines extend to the sea, is free from the malaria; but southwards, as far as Leghorn, where the mountain-chain is indeed steep, but where a flat, marshy tract of coast intervenes between it and the sea, the malaria occurs. Near Leghorn, and on the rows of hills lying to the south of it, the air is again healthy, but these are succeeded by the extensive Tuscan and Roman *Maremme*, abundantly notorious for their baneful atmosphere, and this zone passes immediately into the no less notorious Pontine Marshes. Somewhat further to the south, by the bay of Gaëta, where the mountains come close down to the sea, the air again becomes healthy; the succeeding tract of coast as far as the gulf of Baia is unhealthy, even as far as the grotto of Posilippo, near the bay of Naples. All the neighbourhood of the bay of Naples, on the contrary, is healthy. In the southern part of the gulf of Salerno we again come upon the noxious atmosphere, on the extensive coast-plains of the ruins of Pæstum; while a great portion of the Calabrian coast, where the mountains lie upon the sea, is healthy again; though we meet with the malaria once more in the environs of the gulf of Eufemia. Following the coast of the Adriatic sea, we can find similar alternations, only here the greatest portion of the coast is unhealthy; among the exceptions, Monte Gargano is especially noticed, rising as a steep, isolated promontory out of the sea. Sicily exhibits similar conditions.

Consequently, we may fairly conclude that the malaria appears principally in places where a flat tract of coast lies between the sea and the mountains. But this is not universally the case; the bay of Naples and the environs of Leghorn afford us examples of the contrary.

It has been remarked above, that the malaria passes, in certain places, from the coast into the plains and valleys. With regard to the plains, it is seen that this is the case in a high degree, and to a considerable extent, with the perfectly flat plain of Puglia; also with the Roman Campagna, which has an undulating surface; with the plain of Pæstum, that of Catania, southward of Etna, &c. In regard to the valleys, the Cesina and Ombrone valleys in Tuscany, and the Diano valley in Calabria, may be expressly named.

Observation of the circumstance that the malaria makes its appearance principally upon level coasts, low plains, and deep valleys, leads us to regard the *altitude* as an important factor in the investigation of the conditions which produce the malaria. The influence of this is extremely striking. In the mountain-ridge which runs parallel with the Pontine Marshes, where the air is infected, the malaria is not met with; whence a number of towns are seen here, while these are wanting in the plain. Refuge is taken in the Alban and Sabine mountains, during the warmest summer months, from the fevers of Rome. Above, on the Circeian promontory, the air is healthy; so it is, also, by the ruins of Theodoric's Palace, near Terracina; while it is noxious to the foot of each of these mountains. At Civita Vecchia the air is unhealthy; on the more elevated Tolfa it is good. Lago di Bolsena has the malaria; Montefiascone, on a neighbouring hill, has it not. Sometimes, however, especially in the Tuscan *Maremme*, the malaria ascends higher up, and it is even met with on the banks of the Lago di Perugia, 800 feet above the sea; it formerly occurred at the same height in the Val di Chiani, namely, before the river obtained an outlet. The most elevated place for the malaria known to me in Italy, is the mountain-lake, Lago Fucino, 2000 feet above the sea—a lake without an outlet (since Nero's Canal, which formed an outlet for the water into the river Liri, is choked up), consequently sometimes overflowing its banks, which, after the water has retreated, emit noxious vapours.

Looking next at the character of the soil, it is evident that the malaria occurs principally near morasses and stagnant lakes, and on rivers which have not a sufficient fall, or are prevented by dunes from running out into the sea. Thus we find it in the Pontine Marshes, the marshes near Viareggio, the morasses of Lentini southward of Etna, the Lagunes near Venice and Comacchio, the lowest part of the course of the Po where it divides into a number of branches; the rice-fields, with their stagnant water, in the valley of the Po; the morasses of Mantua, and the northern part of Lake Como, where the river Adda runs out. On the other hand, it cannot be denied that there are many regions where neither morasses nor other stagnant waters of any importance exist, and where, nevertheless, the malaria is very prevalent; we may name the Roman Campagna and the plain of Pæstum, where, indeed, a good deal of water accumulates in winter, which, in parts, cannot readily run off, but they are dry during the rainless summer; and this is still more true of the plain of Puglia, which is completely dried up in summer, and is extremely deficient in springs and water, whence it was called by Horace "*siticulosa*."

Coming to the question of the seasons, we find that the malaria prevails only in the warmest summer months. The period is longer or shorter according as the malaria of the region is stronger or weaker. June, July, August, and September are generally the most dangerous months. Since, therefore, in Italy, southward of the Apennines, these months are either rainless or have but little wet except in September, in which the rainy season commences, the malaria principally presents itself in the dry season, and ceases with the rainy season; yet it appears rather to increase just after the commencement of the rainy season, before the air has become cooled down.

The *time of day* must be considered as well as the season. It is universally recognised that the night is the most dangerous time; so that going out into the open air, or, more particularly, sleeping in it, is pretty certain to bring on an attack of the fever. The critical epochs are properly when dew is falling, therefore, at sunset and sunrise. It is, consequently, considered safest to remain within doors at these times, while it is regarded as less hazardous to be in the open air in the evening after sunset.

We will now proceed to the difficult and still imperfectly understood question of the causes of the malaria.

There are some who think that the cause of this evil is to be sought solely in the alternations of temperature, and in the colds caught thereby; and that when these are avoided by use of woollen clothes next the skin, and other means, the fever and the subsequent affections arising out of it, may be avoided. This opinion could scarcely merit acceptance. There are many regions where the alternations of temperature are greater than they are in those infested by the malaria. It is well known that the diurnal warming and nocturnal cooling are greater, the alternation of temperature, therefore, more considerable, in the interior of countries than on the coasts, as also that the sea-breezes prevailing here by day contribute to equalize the temperature. But the malaria occurs especially on these very coasts. Stress is laid generally upon the considerable alternations of temperature to which Rome and the Roman Campagna are exposed. It is true that they are greater here upon the extensive plains than immediately upon the sea, but they are smaller than in Turin, Milan, and Bologna, on the great plain of Lombardy, smaller than at Florence, in the broad, enclosed valley of the Arno, and yet all these places are healthy. That the danger can be kept at a distance by protecting oneself from catching cold, only shows that the body may have a different degree of susceptibility to the influence of the malaria. The monks of the orders which wear woollen garments, suffer like others from the malaria.

Others seek the cause in the *volcanic character of the soil*. They imagine that gases of various kinds rise out of the earth, and infest the atmosphere; these may be carbonic acid, sulphuretted hydrogen, or other kinds of gases. But well-grounded objections can be opposed to this view, which has many supporters. It is true that the earth is volcanic at Puzzuoli, in the Roman Campagna, and in the Tuscan and Roman *Maremme*. It is likewise certain that gases injurious to human beings are emitted in not a few places, though these are of limited extent, within these regions; thus in the Tuscan Maremme, near Volterra (*le Moje di Volterra*), near the Lagoni di Monte Cerboli, as they are called, where boracic acid is emitted from the ground, in combination with sulphuretted hydrogen, in many parts of the Campagna, &c. But, on the other hand, it is just as certain, that in many of the unhealthy coast tracts, and especially upon the great Puglian plain, not the slightest trace of volcanic phenomena or emissions of gas exist. Moreover, the air is healthy upon Vesuvius and Etna, which are active volcanoes, on Ischia and the Euganean hills, and other places, where the volcanic character still shows itself in warm springs and emissions of vapours and gases.

In that portion of the valley of the Tiber which runs parallel with the Apennines, the soil is volcanic on the western, calcareous on the eastern side, but the air is noxious on both sides. If the malaria were produced by emissions of poisonous air, animals also must be exposed to its injurious effects; we know that a very small quantity of sulphuretted hydrogen will kill a dog. But we find in the unhealthy regions wild swine and buffaloes, also sheep and goats, horned cattle, and horses. It is true, the tame animals are generally driven to more elevated regions during the unhealthy season, as from Puglia and the Roman Campagna; but this is done because the herbage becomes dried up there, and not because the atmosphere is hurtful to the animals; in many places there is no such change. Finally, it is not evident why the unhealthy air should be connected with a particular season of the year, if it were caused by subterranean emissions.

A third and at the same time the oldest opinion is, that the unhealthy atmosphere arises from the *decomposition of animal and vegetable substances*, which occurs when a considerable temperature acts upon stagnant or slowly-flowing water. It appears that this assumption is capable of affording an explanation of most of the phenomena. The Pontine marshes abound in water; the marshes near Viareggio, the Lentinian morasses, the country round the outlet of the Ombrone and Cesina, the lagunes of the Adriatic Sea, the embouchure of the Po, the Mantuan morasses, and the rice-fields in the valley of the Po, all offer examples of unhealthy atmosphere. The places of greater elevation, where the malaria shows itself, have likewise stagnant water; as the lakes of Perugia, of Bolsena, and Fucino. It is an old experience, that the noxious air arises on the coasts in those places particularly where the fresh and salt waters become intermingled, which is the case when the rivers or lakes have but a slight fall, so that the sea penetrates in at high water. It is also readily perceived, that the animals and plants of the fresh water are liable to destruction by sea-water, and, *vice versâ*, the marine animals and plants by fresh water; and that in this way a quantity of decaying organic matter becomes accumulated. The beneficial influence exhibited by drainage, and other measures preventing this mixture of fresh and salt-water, of which we shall speak presently, affords an argument in favour of this view. It is further supported by the circumstance that the unhealthy atmosphere is connected with that season in which a high temperature favours decomposition.

At the same time it cannot be denied that several phenomena are scarcely to be explained by the cause in question;

among others, the fact of the malaria presenting itself in the Roman Campagna, and especially the great Puglian plain, which are dry during the summer. Explanation of this by the aid of currents of air bringing the malaria of the Pontine marshes into the Campagna, and that of the Adriatic coasts to Puglia, will hardly solve the problem; for under this point of view, the same should be the case in several regions; for example, in the large, fertile, densely-populated plain about Naples, which likewise has the malaria in its neighbourhood. It will be better explained in the following way: that in these plains the noxious vapours do not rise until the pools of water are quite dried up, and the heat comes to act upon the organic bodies which lie at the bottom of them. It is ascertained by experience, that noxious air is produced in warm regions by artificially drying up the lakes. That the effects of the malaria increase after the first rains have fallen, is a confirmation of this explanation, since the organic bodies become more liable to decomposition when they are softened by the rain.

However, I by no means intend to assert that the last-mentioned cause is the only one; for from what has already been stated, it is not improbable that sulphuretted hydrogen does play an important part in many places (for example, about Volterra); but at all events, the decay of organic matters seems to be the most general cause.

Nevertheless, by saying that decaying organic matters diffuse unhealthy vapours in the atmosphere, and calling them *miasmata*, we get no complete or clear conception of the matter. Hitherto it has been vainly sought to lay hands upon these *miasmata*, as they are called. The distinguished Italian naturalist, Brocchi, had the courage to remain for four nights, in the month of September, near the church of St. Lorenzo *fuori le mura*, outside Rome, one of the most unhealthy places, which is forsaken at this season by the priests, while the country people living around are accustomed to go in at night to the public squares of Rome, to avoid the malaria in their dwellings. Brocchi collected the dew, by placing ice in glasses so as to cool down the air. In this way he obtained two pounds of water; but chemical analysis gave him no extraordinary results. A young, strong man, whom he had taken with him was seized with violent fever the first night, and after the experiment was completed, he himself, as he says, became abundantly aware what a foe the fever is.

With regard to the *effects* of the malaria upon man, the first is cold fever, but this passes readily and frequently into a more malignant form. The liver and the spleen also become affected. Those who are compelled to remain for a length of time in the unhealthy regions, are exposed to many effects destructive to health. These effects are seen in their pale, yellow faces, sunken features, dull eyes, swollen abdomens, and slouching gait. They form a striking contrast to the healthy, strong, active, light-hearted beings who frequently dwell but a few miles away.

It is probably to be chiefly attributed to the malaria, that in the otherwise fortunate and prosperous population of Tuscany, the mortality is greater and the duration of life shorter than in Denmark. In Tuscany, one in thirty-four or thirty-five dies annually; in Denmark, one in forty or forty-one. The average duration of life in Tuscany is thirty or thirty-one years; in Denmark, thirty-six years. In Rome, one in thirty-two dies annually. Thornwell states that 50,000 human beings die annually from the effects of malaria in Italy; but this can scarcely be founded on trustworthy data. The hospitals of Rome are filled with fever patients in the summer months. In one hospital, St. Spirito, there were 6000 fever patients in the summer of 1818 (an unfavourable year), and in one day, the 25th of July, 1130 lay there. In Leghorn, where the hospitals receive patients both from the *Maremme* in the south, and from the marshy districts in the north, the fever patients constitute one-sixth of the whole.

It is natural that mankind should flee from such dangerous dwelling-places, and that only necessity or the desire of gain can compel them to fix their abodes here. Hence these districts offer a striking contrast, in respect to population, to the elsewhere so universally thickly-populated regions of Italy. Lucca is well known to be one of the most populous and best cultivated regions of Europe, and the desert tracts of Viareggio are found close in the neighbourhood. While, in the extraordinarily fertile valley of the Arno, house is joined to house, and garden to garden, we may travel for miles over the neighbouring *Maremme* without seeing a house, without meeting a human being, perhaps excepting some few whose aspect bears ample testimony to the unhealthy character of the atmosphere. The contrast is greater than between the heaths and the inhabited districts of Jutland.

The deficiency of population must, of course, have great influence on the utilization of the land. Where, as in the *Maremme* and in parts of the Campagna, woods and copses are frequent, charcoal-burning is carried on. Here we see numerous fires, and long lines of mules laden with charcoal, which is sent to far-distant places. In the marshy districts near Ostia graze herds of black buffaloes in a half-wild condition. In the Roman Campagna vast herds of bulls and other horned cattle are kept, which are watched by mounted men, furnished with long poles—the riders of the Campagna, as they are called. In autumn, numerous flocks of sheep and goats migrate from the mountains of the Abruzzi to the plains of Puglia, to graze there during the winter; whereby, as in Spain, great obstacles are placed in the way of agriculture. The gathering of the cowherds, the owners, and the cattle merchants, brings a population of 20,000 persons into Foggia during the winter, while this town is almost deserted in the summer. Similar migrations take place also in the *Maremme;* the mountain herdsmen come down into the lower regions, with their cattle, in winter, and pay a small rent for the right of grazing. Agriculture often becomes difficult under these circumstances, yet it is carried on; usually, however, the land is applied to this purpose after having been used for grazing during a number of years. The great Roman Campagna is divided among only 250 owners, and these lease their property to great contractors, who live in Rome, and keep a manager and a few fixed servants. The whole of the field-work is carried on with hired people, who ordinarily come from a distance; they are poor mountaineers from the Abruzzi, Parma, and Modena; they get but a moderate amount of food, are badly clothed, and thus frequently fall an easy prey to sickness and death, when they go to rest under the open sky, after the efforts and fatigues of the day, at harvest-time in summer. In the valley of Cesina, the Grand-duke has divided the land into small holdings, and erected roomy and handsome buildings, but the speculators who bought them have let them again; and if we ask these tenants how they fare in summer, their answer is, that they go to the mountain-towns, and only leave a few servants behind. It is very evident, that tax-gatherers and soldiers sent into these districts must be regarded as lost, and that frequent changes must take place to prevent too great a sacrifice of life.

But has this unhealthy atmosphere been *always* the lot of Italy? Historical data afford an apparent contradiction in regard to this. On the one hand, it is certain that regions now uninhabited on account of the malaria, were populated in antiquity. According to Pliny, there were thirty-three cities under the dominion of the Volscians in the Pontine plain, which statement, however, is surely exaggerated. Rome extended, as the ruins show, through districts which now suffer from malaria. Many renowned cities lay in the modern *Maremme;* Ostia was at that time a great city. Villas were built on the gulf of Baia; the ruins of Pæstum show that a great city existed there in antiquity. The same is true of the Adriatic coasts, in places where the atmosphere is now unhealthy.

On the other hand, expressions are not wanting in the older authors, which testify that they were acquainted with the malaria and its effects. Cicero, in his treatise "*De Republicâ,*" says: "Romulus chose for the foundation of Rome a healthy spot in an infected region." Horace, in his well-known Epistle to Macænas, describes the month of August as that "which brings fever with it, makes parents tremble for the lives of their children, opens wills, and calls the undertakers into activity." Livy states, that in the time of the republic, five centuries after the foundation of the city, "the Roman soldiers demanded that they should be allowed to remain in Capua, instead of returning to the unhealthy and infertile environs of Rome." Cæsar, "*De Bello Civili,*" mentions the unhealthy atmosphere in Puglia and near Brundisium.

Cato, "*De Re Rusticâ,*" speaks of the importance of a healthy situation for an estate, and mentions that field-labours cannot be undertaken in summer in places where the atmosphere is unhealthy. Varro counsels those who possess an unhealthy estate, by all means to sell it, or, if they cannot find a purchaser, to leave it altogether. Columella, who lived near Tarentum, speaks of the injurious influence of the marsh-air upon human beings. Seneca speaks of the deserts of Puglia (*deserta Apuliæ*).

This contradiction can scarcely be explained in any other way than by assuming that the malaria prevailed in antiquity, yet was not so widely spread nor so active in its effects as at present. Even if we could assume—which, however, is extremely doubtful—that a greater strength of body, a simpler mode of life, and clothing more suited to the climate, were capable of diminishing the susceptibility to a certain extent, yet we certainly cannot presume that the malaria could be without influence upon the then closely-populated, but now unhealthy and desert tracts, especially since it seems settled by the facts above mentioned that the malaria was active in other places at that time.

It is a widely diffused opinion that the cultivation of the soil, and the increasing population of the country, afford defensive means against the malaria, and that it gains the upper hand when agriculture goes to decay, and the population diminishes; and it is imagined that the devastations caused by the invasions of foreign races have especially contributed to cause the great predominance of the malaria. We cannot well appeal directly to the inverse proportion of the violence of the malaria and the density of the population, without confounding the cause with the effect. But, on the other hand, it cannot be denied that the formation of stagnant pools, deficient drainage, and many natural consequences of the decay of agriculture, may contribute to increase the evil we are discussing. P. Savi calls attention to another circumstance—namely, that a broader seam has been gradually formed on the coast by the alluvium of the rivers, and that the sand-dunes have increased through the action of the sea, and obstructed the outflow of the water.

The Italian governments had much inducement to oppose this public calamity, and have made experiments against it at various times, but often with little success. Leo X. sacrificed many men whom he commanded to settle as colonists in the Campagna. Pope Pius commenced the drainage of the Pontine marshes. By digging canals, a considerable portion was laid dry, and not a little is at present under culture; but there are no dwellings there, and the labour is performed by hired people; for the air is still constantly unhealthy.

The experiments which the Grand-dukes of Tuscany made, in the last century, in the *Maremme*, by dividing the estates and introducing colonists, had not a successful result; the colonists died or removed. The experiments with the morasses between Viareggio and Leghorn were more successful. The unhealthy atmosphere was very prevalent here; it extended even to the gates of Leghorn. The town of Viareggio possessed, previously to 1733, only 330 inhabitants, poor fishermen and galley-slaves. The mortality was so great that one in fifteen died annually. But sluices were erected, which closed with the flood-tide and prevented the entrance of the sea-water, while they opened with the ebb so as to give an outlet to the fresh water. By these and several other contrivances the climate has been essentially improved. In 1823, Viareggio contained 4267 inhabitants; many families possessed summer-residences there, and used sea-baths. The environs also, and the wholly marshy strip of coast, have less noxious air at present, and it has vanished from Leghorn. Another successful experiment was made in the Val di Chiana. The river there had no outlet, the water stagnated, and the atmosphere was very unhealthy. Drainage was effected, in particular by means of the *colmate*, as they are called. The river is diverted to the sides, over the land, and allowed to deposit its mud; by this means the soil becomes elevated, and, consequently, an outflow becomes possible. Since that time, agriculture, population, and health, have made a gladdening progress in this valley.

Similar undertakings have lately been engaged in on a much greater scale. Great activity is displayed in the improvement of the *Maremme;* in particular, great works have been commenced in the marshy plain at the mouth of the river Ombrone. Here also endeavours have been made to elevate the land, and to effect a drainage of the river, and pains taken, by sluicing and other means, to prevent the intermixture of the sea with the fresh water. The effects are as yet doubtful, but since successful results have gradually presented themselves in other places, there is hope also for these new experiments.

Such conquests of land and people bring life and prosperity, and not death and poverty.

CHAPTER VII.

REPETITIONS OF NATURE IN THE VEGETABLE KINGDOM.

"NATURE is infinitely rich and varied, and the gifts which are showered down from her cornucopia cover the surface of the earth." This is a thought to which utterance is frequently given, and even a limited acquaintance with nature convinces us of its truth. Yet, notwithstanding this, we hear, especially among naturalists, the proposition "that Nature is sparing; that she never makes use of the *more* where the same thing may be done with the *less*." There are certain facts which seem to strengthen the last proposition, and I will direct attention to them in discussing the *repetitions of Nature* so far as refers to the *Vegetable Kingdom*.

It is very well known that the seed of any given plant produces another plant, which displays most exactly the external form, the internal structure, and the chemical composition of the parent-plant; on this depends the whole idea of the species. If the effect upon our imagination had not been weakened by the constant observation of this fact, it would appear to us one of the greatest miracles of nature. In the seed there exists not the slightest trace of all those parts of the often so complicated structure, the flower; these are formed much later, and yet is it certain that they are formed exactly in that way and in no other. We are able to go even further back: in the seed we see the germ, and in this traces of the root and terminal bud; but if we examine the seed in the flower, in its state of ovule, the germ appears to us, even under the highest magnifying powers, to be composed of a few minute vesicular cells; from these cells all those parts, and no others, must be gradually developed; while minute cells, exactly resembling them, will be developed, in another seed, into a plant perhaps differing from it as widely as the poles. How there can reside in these cellules a formative force, tending exactly in the direction thus determined, as though an ideal figure, gradually to be realised, floated before it,—this is to the most deeply-initiated naturalist a wonder which he can only marvel at and not comprehend.

But the marvellousness becomes still more increased when we reflect that this repetition of the forms takes place, not only from the parent-plant to its next successor, but through thousands of generations; for everything indicates that the forms have been maintained unaltered since the last great disturbance of the earth's surface.

Examples do occur, however, of deviation from the normal types of the species, produced by the agency of man; I mean, the *varieties* which have originated through cultivation in the course of time. The cereals, the fruit-trees, and ornamental plants, offer plenty of examples. We see the dahlia, the pink, and the auricula, vary in an extraordinary degree; yet this variation is strictly limited; through all the changes the typical or fundamental form is retained; a stock, vary as it may, never becomes a wallflower; a dahlia never an aster. Here, as in so many other cases, a sphere is given for human action, but fixed and definite boundaries are assigned to it.

The kind of repetition of which we have just spoken, occurs within the compass of the individual species; we might term this the *genetic repetition*, or the *repetition through descendants*.

In like manner as the peculiarities of the species are repeated in all individuals, those of the genus are repeated in all the species which it includes, those of the family in all the genera which belong to it; but we will not dwell longer upon this point, because, not only do the greatest deviations occur contemporaneously with the repetitions—for the species are, as it were, variations on the theme of the genus, those of the genus variations on the family—but because, under these circumstances, the genera, in particular, often exhibit within their limits so much transformation and gradation towards other families, that it not unfrequently becomes difficult to ascertain the primary form.

On the other hand, there is a different kind of repetition, which might, perhaps, be called the *systematic*, or *repetitions in the developmental series of plants*. For there exist in the vegetable as well as in the animal kingdom, series of forms in which the plant and the organs of the plant exhibit gradations of structure from the simple to the complex, and in which some groups have one particular organ, others different organs, especially developed; we can observe the transition from the grasses, with a simple structure of leaf and flower, to the palms, in which leaf, flower, and fruit, acquire a far greater development, and to the lilies, but above all, to the orchids, in which the flowers exhibit a still higher degree of development; while, however, the flower has thus acquired its most perfect development in the group of the Monocotyledons, Nature has commenced another group, namely, that of the Dicotyledons, which, as a whole, stands higher than the former; has proceeded, as it were, from a point lying some way back, from plants in which the leaves, flowers, and fruits, have a simple structure (conifers and catkin-bearing trees), and rises gradually to a more perfect stage of development. A parallelism thus arises between two primary groups, and thereby a kind of repetition of the same conditions in each.

The borage family (*Boraginaceæ* or *Asperifoliæ*), to which the forget-me-not belongs, is a very natural group. The plants belonging to it have a flower with a five-parted calyx and corolla, both regular, five equal stamens and four small, hard, one-seeded fruits, from the middle of which projects a single style. Nearly allied to these is the labiate family (*Labiatæ*); they have exactly the same fruit; the calyx and corolla are likewise five-parted, but three of the segments of the latter form a lower lip, the other two an upper lip, so that the corolla has become irregular; only four stamens exist, two of which are long and two short, but intermediate states show that this irregularity arises from the non-development of the fifth stamen, while two of the others are arrested at a certain point, so that they are shorter. In a third family, that of the potato (*Solanaceæ*), the flower is regular, calyx and corolla five-parted; five stamens are met with, just as in the borage family, but the fruit is essentially different, being a two-chambered capsule, or berry, with numerous seeds affixed upon two projecting placentas. Then, just as the regular flower of the borage family becomes changed into the irregular one of the labiate plants, the regular flower of the potato family becomes irregular in the snap-dragon family (*Scrophulariaceæ*), which possess exactly similar fruit, but have the corolla divided into two lips, while the stamens are two long and two short, precisely as in the labiate plants. Here, therefore, there is a parallelism in the development, a repetition of the transition from a regular to an irregular flower.

To a third kind of repetition I would apply the name of the *geographical*, or the *repetition according to climate*. Our northern Polar countries have a very peculiar flora; a quantity of dwarf perennial plants with large flowers, often of beautiful colours, partly belonging to genera which are unknown, or only play an inconsiderable part in temperate countries. But we find them again, either in the same or nearly allied species, upon the Alps, the Carpathians, the Pyrenees, the Apennines, and the Caucasus, when we ascend to the height of 6000 feet or upwards; nay, even in the most elevated regions of Peru and on the Himalayas we meet with some of them. When we ascend to a height of 3000 feet on the Apennines, the beech, which is sought in vain in the plains, becomes the prevailing tree, and with it appear the birch, the raspberry, the hazel, and a number of other North European plants, which greet the northern naturalist as friends from home. In the highlands of Mexico are found large forests of conifers; in those of Java, species of oak and chestnut. The temperate countries of the southern hemisphere, too, present the prospect of various forms of vegetation which are found in the temperate zone of the northern hemisphere, and are missing in the torrid zone; some species even exist both in Europe and in New Holland, South Africa, and the most southern part of South America, but ordinarily they are different species of the same genera. This repetition presents itself either as *substitution*,* when many species occur in both hemispheres, or as *representation*,* when one place possesses but one or a few species of the genus which is richer in another place; for example, one *Stapelia* is found in Europe and one in North Africa, while very many species occur in South Africa. Two species are met with in the Mediterranean of the genus *Mesembryanthemum*, which is very rich in South Africa.

We may also demonstrate an *historical repetition*. The stratified rocks contain remains of plants, the place of which

(* These terms do not appear to us well chosen. That of *substitution* should rather be applied to such cases as those of the *Ericaceæ* of the Cape of Good Hope, occupying similar conditions to the *Epacridaceæ* of Australia; the *Cacti* of Mexico substituted for the *Euphorbiæ* of tropical Africa, &c. *Representation* occurs in such cases as that of *Chamærops humilis* in Europe, and *Chamærops Palmetto* in North America—the corresponding but different conifers of Europe and North America, &c., &c.—ED.)

in the natural groups we are able to determine. The older coal formation is particularly rich in ferns, calamites (*Equisetaceæ*), and lepidodendra (*Lycopodiaceæ*); in the more recent coal formations *Cycadeæ* and conifers present themselves. Although scarcely any one of them belonged to species which exist at present, and it is improbable that they could have survived the great revolutions of nature, there are nevertheless many genera and families common to the ancient and modern worlds, and in this way many of our forms of vegetation are repetitions of those which existed at a time when man was not.

There is still another kind of repetition which I might call *habitual repetition*, or denominate *mimicry*, if this expression were not at variance with the subjection to law which exists throughout nature, but to comprehend which our powers are often insufficient. A few examples will explain what I mean by this.

We are all familiar with the cactus family, remarkable for their fleshy, often leafless stem, and the extraordinary variety of forms which they display; sometimes appearing as upright angular columns, sometimes as flattened and leaf-like, as globular, or cord-like bodies. But we meet with euphorbias with columnar, fleshy stems, exactly resembling the columnar *Cacteæ*, excepting that they contain milky juice; their flowers and fruit have not the least resemblance to those of the *Cacteæ*. Not only are the columnar *Cacteæ* aped in the group of euphorbias, this is the case also with the globular forms, and, moreover, various species of euphorbia correspond to the foliaceous *Cacteæ* (*Pereskiæ*). A climatic parallelism here exists, for the true home of the *Cacteæ* is in the dry, rainless regions of Mexico and Chili; the fleshy euphorbias occur in the arid districts of Africa, in the desert zone, in the Canaries, on the coast of Abyssinia, in South Africa, and in Arabia. Other groups of plants also become fleshy in these regions, as *Stapelia* and *Ceropegia* among the asclepiadaceous plants, and *Cacalia* among the *Compositæ*. But in the euphorbias, as also in some stapelias, the mimicry goes further than mere fleshiness. In the genus *Mutisia*, we have the remarkable sight of a compositous flower with the tendrils of a leguminous plant. In *Begonia fuchsioides*, the leaves are similar to those of a fuchsia, and very different from the other forms of leaf among the begonias, and the colour of the blossom likewise reminds us of the fuchias.

We have another most striking example in certain Brazilian plants, which, although possessed of perfectly developed flowers and fruits, mimic, as it were, in their leaves and stems, groups of plants of much lower rank. *Lacis fucoides* resembles certain sea-weeds so much, that it might be mistaken for one by a person who did not see the flowers. *Mniopsis scaturiginum* strikingly resembles a *Jungermannia*.

Another remarkable instance of the repetition of an inferior group of plants is met with in the root-flowers, as they are sometimes called (*Rhizantheæ*), plants with quite perfect flowers, which, however, bear a striking resemblance to the fungi in aspect, texture, and, to some extent, in internal structure. They grow as parasites on the roots of other plants; they are generally destitute of leaves, and possess merely scales, of some other colour than green, which take the place of these. *Rafflesia*, *Aphylleia*, and *Langsdorffia*, belong to this group.

In *Casuarina*, a large tree of the South Sea Islands, there is a remarkable repetition of the mode of branching of the *Equisetaceæ*.

Thus we meet with many instances of repetition in nature. Ought we, on that account, to call Nature sparing and niggardly? Just as little, in my opinion, as we could call her spendthrift, when looking exclusively to her great multiformity. Riches and poverty, parsimony and profusion, are human ideas; the laws of nature stand exalted high above these.

CHAPTER VIII.

ALPINE PLANTS.

We all know the mighty influence heat exerts over the vegetable kingdom; we are aware that it is the want of sufficient heat which arrests vegetable life with us in the winter, that it is the first warmth of spring which calls forth stem and leaves, the higher heat of summer which tempts the flowers out, and ripens the fruit and seeds; that it is the warmer climate which gives South Europe a richer vegetation than North Europe, and that the still warmer climate within the tropics produces the greatest abundance and variety of plants. Thus heat is manifestly the great awakener of vegetable life.

But plants are of very different natures; the degree of temperature which produces phenomena of vitality in one, is incapable of awakening them in another. At present we will devote our attention to those which are called into life by the lowest degrees of temperature—to those which, so to speak, gain the victory over the foes of vegetable life, over frost and snow, and which, therefore, in a climatal point of view, deserve to be called the first-born of Flora, even as those ferns of which we find remains in the coal-measures are the first-born in an historical point of view.

These vegetables, which the slightest degree of heat is capable of calling forth, have a peculiar stamp, and constitute a peculiar flora. We meet with them in the Polar countries of the north (even in the plains and on the coasts), in Northern Lapland, in the most northern parts of Siberia and North America, and on the islands which lie in the northern Icy Sea; we find this flora in regions where the snow covers the earth, where the lakes are frozen eight to ten months of the year, and where icebergs are drifted along the sea in the midst of summer.

We meet with the same flora again further south, when we ascend to a sufficient elevation upon a mountain. If we start for a ramble into the maritime Alps, from the Mediterranean coast of the south of France, we first meet with orange gardens, olive groves, and thickets of myrtle, laurel, and evergreen oaks, above which stone-pines, and here and there isolated date-palms, lift their crowns; at a greater height we leave this vegetation behind, we wander through woods of chestnut and oaks with deciduous leaves; still higher we meet with an old northern friend, the beech; and yet higher, the gloomy woods of pines, firs, and larches; finally, we leave these trees also, all arborescent growth ceases, low bushes accompany us for some distance further, but soon make room for small herbs; last of all, the everlasting snow, which covers the earth during the warmest summer months, sets a limit to the growth of vegetation. In this way, by ascending from the Mediterranean to the snow-line, and traversing the different zones of elevation upon one and the same mountain, we may in one single day behold as many different floras as if we travelled months long from the Mediterranean to the Arctic Ocean.

The zone which lies between the upper limit of the growth of trees (tree-limit) and the lower limit of the everlasting snow (snow-line) is called the Alpine zone, and the plants met with here are called *Alpine plants*. This flora has so remarkable a resemblance to the Polar flora that it must be combined with it. Not only are almost all the families and the greater part of the genera the same, but even a considerable number of species are common to both—a fact the more remarkable, since there lie between the Alps and the nearest Norwegian mountains, where this flora occurs again, extensive plains, or at most only mountains not rising high enough for these plants to flourish upon them.

The Polar flora, or, as we may also call it, the Alpine flora, is not merely met with in the higher regions of the Alps—the highest mountains of Europe,—it is found everywhere in Europe and the northern part of Asia and America, where mountain masses present themselves high enough to furnish a suitable climate to these plants in their more elevated districts. Hence we find this flora in the Pyrenees, in the Sierra Nevada, the Carpathians, and the Caucasus; in the Norwegian, Scotch, and Icelandic mountains; and traces of it are seen on the highest peaks of the Apennines and the Grecian chains; it is seen also in the Altai and other Asiatic mountains, and on the higher chains of North America.

What are the characteristic features of this flora?

The first characteristic mark is the absence of *trees;* even *bushes* are only found in the lower parts of the Alpine zone, and here the rhododendrons, or Alpine roses, play a prominent part, forming a dense scrub. The short summer, limited to two or three months, and the nocturnal frost which occurs even during the warmest months, make it readily conceivable that no plant can produce long shoots here; from the large, weighty masses of snow, and the violent winds upon these heights, it is clear that the young stems or shoots must be broken, and that, consequently, when stems or shoots do present themselves, they can rise only a few inches from the earth, or that, at all events, supposing them to acquire some length, they are compelled to creep along upon the earth or cliffs.

As a general rule, trees are the longest-lived plants. The opposite extreme is represented by the *summer-plants* (annuals) so frequent in our temperate climate—plants which grow up, flower, ripen their seed, and die, in the same year that they spring up from the seed. The annual plants are missed in the Alpine and Polar flora, just as the trees are; and this is readily explained. The summer is far too short to allow the whole course of life of a plant to be completed within it; if it ripened seed in a favourable year, it would fail in one less so, and the species would in such case readily be lost for ever.

Consequently, only *perennial herbs* and certain *small shrubs* are displayed in this flora; the stems are often subterraneous, and this alone, or a short stem above ground, is retained in the winter season. The growth in height being so much restricted, the development by lateral shoots is favoured, and thus many Alpine herbs exhibit bundles or tufts of short stems, which frequently form little cushions or turf-like patches upon the cliffs, with their leaves and flowers.

Proper mould is very seldom formed in this zone; the soil is either the naked cliff, where plants grow either in the crevices in which water collects and mosses prepare a place for the larger and more highly developed plants, or in drifted gravel and disintegrated rock, which is permeated by the descending snow-water, and which is constantly increased by fresh detritus being washed down. To enable a plant to grow under such conditions, long roots are necessary; and we see this to be the case in most Alpine plants, and especially in those which grow in the drift.

When we examine the stems of Alpine plants, and their leaves, another peculiarity strikes us; this is the absence of hairs and thorns. The Alpine plants are smooth, as it is very inaptly termed—unarmed. This shows how incorrect that opinion is, which regards the hairy covering of plants as a provision against cold; for if any kind of plant could require this, it would certainly be the Alpine vegetables. Looking generally at the matter, we perceive that moist soils bear smooth plants; dry soils, plants furnished with hairs and thorns; since, therefore, the soil in which Alpine plants grow, is kept constantly moist by the flowing down of melted snow, we see in this the reason of that peculiarity of Alpine plants.

While the stem above ground is so small in Alpine plants, the flowers are ordinarily very large in proportion to the whole plant. The snow has scarcely melted, it lies still close at hand, when the Alpine plant bears beautiful flowers; it is as though their development was hastened in order to take advantage of the unusually short summer, as though the whole force of growth was applied to the development of the flowers as rapidly as possible, and therefore, from the shortness of the stalks, partially buried in the ground, they appear to spring immediately out of the gravel. The considerable size of the flowers in proportion to the stem, is a very striking feature of Alpine vegetation; it is one of the differences distinctly evident in comparing an Alpine plant with one of the same genus inhabiting the plains.

Another characteristic feature of the Alpine plants is derived from the beautiful, clear, and unmixed colours displayed by their flowers—the purest snow-white (*Dryas*, various species of *Draba* and *Saxifrage*), the loveliest sky-blue (*Gentiana*, *Soldanella*, *Veronica*, *Campanula*, *Phyteuma*, and the dwarf forget-me-not, *Myosotis nana*, which far excels its well-known congeners of the plain in beauty), the most beautiful rose-colour (species of *Primula*, *Azalea*, *Silene acaulis*), a pure yellow (*Ranunculus*, *Potentilla*, *Viola biflora*, *Papaver*). When the flowers of the plains, especially those of the coasts, are compared with these mountain plants, it is remarkable how impure, how dirty, the former generally appear. At the same time spotted flowers, or a mixture of several colours in one flower, are more rare in Alpine plants.

While the Alpine flora offers a rich treat to the eye, through its large flowers, and their pure colours and lovely forms, they are, on the other hand, incapable of pleasing any of the other senses of man. With a few exceptions, which indeed refer only to plants occurring solely in the lower part of the zone, the flowers of Alpine plants are *scentless*. An increased degree of heat, generally also dryness of the soil and atmosphere, favour the development of those secretions which are volatilized from flowers, whence the south of Europe, for example, has far more sweet-scented plants than the north, and the number of odoriferous plants in general increases towards the equator; it is therefore readily to be comprehended that the Alpine plants, which grow in a constantly moist soil, at the lowest possible temperature, cannot be odoriferous.

It cannot be said, however, that Alpine plants are destitute of secretions, for these exist abundantly in the roots and stems of many; examples of bitter plants are particularly noticeable in the Alpine zone—for instance, the gentian family; and most of them yield a nutritious fodder for cattle. On the other hand, the Alpine flora displays no poisonous plants.

In no other part of the globe has nature been so transformed by man as in Europe, where cultivation has produced, in some regions in thousands of years, in others in centuries, such vast changes, that there are few districts in which the vegetable world can be seen in its original condition. Among these few, the Polar countries and the Alpine zone take the first place. No plough furrows, no spade turns up the earth, no grain, no garden plant is sown, no tree planted; man uses these regions for grazing alone, and in a manner which differs little from that in which it would occur if Nature were left wholly to herself.

The Alpine flora acquires an exalted interest from the strong contrast between the vegetation and that which surrounds it. The bare, steep cliffs, the vast, white snow-fields, and the bluish glaciers, are immediately in contact with elegant little plants decked with flowers of the purest colours. Loveliness is mated with majestic grandeur.

Here, in the north, we possess a flora resembling that of the Alps in several respects; this is our spring flora. Spring opens with herbs bearing brightly-coloured flowers; some, like the violets, primroses, anemones, and drabas, belong even to the characteristic genera of the Alpine flora. But the Alpine flora exhibits a spring followed by no summer or autumn, a spring which is quickly, and at once, lost in winter. This short but lovely spring renders the Alpine flora still more interesting; it is a splendid butterfly, living but a few weeks, after lying buried in earth as a chrysalis for many long months.

CHAPTER IX.

MOUNTAIN RAMBLES IN THE NORTH AND SOUTH.

NOT only has the mountaineer a preference for the mountains, explicable from the especial value every man attributes to his home, but the inhabitant of the plain who visits them finds something especially attractive in them. Not only does the child of the rocks feel the deep longing for these mute friends at home, but the stranger who has made their acquaintance also finds them often rising vividly in his memory and calling him to them. Although the circumstance that Nature has been less altered, and appears more in her original shape in mountain regions than anywhere else, certainly does contribute much to produce this effect, yet the chief cause cannot lie in this, for then a heath or a sandy desert ought to have the same effect. Rather must the chief cause be sought in the marked features which nature possesses in mountain regions. Just as a human countenance with striking features, even when these are not handsome, is readily seized and kept long in the recollection, while the rounded forms of an inexpressive face are easily passed over, and still more easily forgotten; so also does the aspect of nature in mountains, by the sharp contours and contrasted outlines of the earth's surface, stamp itself much more deeply in our memory than an uniform plain or an undulating hilly country. To this are added, the abundant variation which mountain scenery displays in the more detached, and frequently narrowly confined portions, and the great change which elevation produces in climate, and thereby also in the vegetable and animal kingdoms.

These remarks will perhaps be my justification for describing here a few mountain scenes which I have met with in the course of my travels.

In the summer of 1812 I visited the mountains of Norway, in company with the enthusiastic botanist, Christian Smith, who a few years later fell a martyr to the study of botany on the Congo river in Africa. We had rambled through the mountains of Upper Tellemark, so rich in natural scenery;

we had ascended the high, snow-covered, isolated Gousta; visited the foaming Riukanfoss, one of the largest waterfalls in Europe; and intended to travel over the wild mountain tract which lies between Tellemark and Hardanger.

It is a characteristic of all the Norwegian mountain-ranges, that, compared with others, they are very flat upon the top, and that the east side has a gradual inclination, while the west side falls down abruptly to the deeply-penetrating fiords. This character is marked here, perhaps, more strongly than anywhere else in the vast mass of mountains. Since the mountain-chain rises gently on the east side, the various zones of vegetation lie rather side by side than above one another. While in the Alps and other chains one ascends quickly from the zone of the deciduous woods to that of the Conifers, then into that of the Rhododendrons, and from thence into the zones of the Alpine plants and of the snow, thus having a variety which can be witnessed in the space of a few hours,—in the eastern parts of Norway one travels several days in the zone of the Conifers, several days more through that of the birch, and from there, equally long through the zone of the Alpine herbs and of the snow, before the ridge is attained. The entire extent from the eastern foot of the chain to the water-shed, amounts here to at least 112 miles.

We found ourselves then, in August, near the great lake Miösvandet, which lies 2700 feet above the sea, in the zone of the birch. The pine and fir had vanished. But few fields were seen around the farm-houses, for a harvest of ripe barley can seldom be reckoned upon. The life of the inhabitants stands quite in the transition from that of the agriculturist to that of the nomade. They have indeed fixed winter dwellings, but during the summer they ascend with their cattle into the mountains, to make use of the more elevated pastures. We left the cultivated land further and further behind us. The homesteads lay now half or whole days' journeys apart; all roads and paths disappeared; heaps of stones at wide intervals were here the wanderer's guide. He increases them by adding a stone as he passes by.

We sought in vain for a companion to guide us over the main ridge to Hardanger. With great trouble we succeeded in inducing a countryman from the last house in Tellemark to guide us to the *chalets*, which the Hardangers have on the east side of the water-shed; there we hoped to meet with further assistance.

We now ascended the zone of the Alpine shrubs, where all growth of timber has ceased; where, however, little low bushes and dwarf herbs, bearing large and brightly-coloured flowers, alternated with the naked cliffs and running streams. We here reached the first *chalet* of the Hardanger people, where the herd-girls, according to the custom of the district, came to meet us with a large, white-scoured milk-bowl, and the invitation, "Sit down, rest thyself, and drink!" In this little colony there were only girls; they were brought up early in the summer and fetched down in the autumn; the great plateau, the vast snow-fields, lay between them and their home, some forty miles away. They, therefore, did not venture to go over the mountain, and could not be our guides. Our companion from Tellemark could not travel further, but returned home. So far our position was unpleasant; but we found ourselves in the midst of the beautiful Alpine flora; as botanists, therefore, we did hesitate to remain, although we did not know when we should get on further, were not in a position to return, and therefore saw ourselves separated from all the world. The girls, who had found that we were not vagrants, cleaned out one of their milk-huts for us. This stone hut, but imperfectly protected from wind and rain, was our abode; a skin and a few coverlets our bed; barley bread, milk, cheese, and groats, our food. But the vegetation repaid us for all hardships; for, although we were surrounded by bare, treeless—in some cases, snow-covered rocks—particular places exhibited a very beautiful and rich vegetation. On one spot of about twenty square feet grew thirty different, bright-flowered Alpine herbs. These vigorous herbs afford rich nourishment to the cattle, which here spread themselves about the rocks, and return home spontaneously to be milked. When evening approached, cows, sheep, and goats, flocked in from the neighbouring rocks; they were called by name, by the girls ("silver-white," &c.), to be milked, and receive from their hands a gift of *salt*, which causes them to return at the proper time.

In the course of a few days, accident led a Hardanger peasant past our dwelling; his intention was to go on to another *chalet*, to fetch butter and cheese, and then to return to Soefiord, in Hardanger, so that he was ready to be our guide. The journey over the snowy ridge being too long for one day, he preferred to pass the night on the snow. But we chose to complete it in one stage, although we foresaw—as actually happened—that in spite of our setting out at earliest dawn, between three and four o'clock, we should not reach the shore of the fiord before midnight. This ramble, which we undertook a few days after, led us over the most barren rocky tracts and snow-fields. During the whole day we saw neither human beings nor domestic animals; only flocks of wild reindeer and ptarmigans inhabited these sterile districts, and not a tree or bush, nor even a blade of grass, presented itself. The snow completely covered the ground over large tracts; in other places it had partially melted, but lay in the hollows, forming gigantic bridges over the mountain torrents. Masses of vapour and clouds rolled over the rocks. The rough ground, the damp snow, tired the feet, and the shining surface of the snow dazzled the eyes. As we advanced, a high and widely-extended snow-covered ridge began to show itself in the west; this was the great "Folgefond," which lies beyond the fiord, but, from the narrowness of the latter, appeared to rise from the rocky plateau over which we were travelling. We did not descry the fiord itself until we approached the edge of the western slope, and immediately after, when we arrived at the declivity, we beheld one of the most remarkable pieces of natural scenery I have ever met with. Imagine our having gradually reached, by several days' ascent, a height of 4000 or 5000 feet, and now all at once standing at the top of a steep slope which stretches down to the level of the sea, while directly opposite rises another equally steep and still higher snowy ridge; so that the sea is here narrowed into a fiord or inlet, the breadth of which, at the bottom, amounts to only about a quarter of a league; it is really only a narrow deep cleft in the mass of rock. Woods present themselves somewhat further down, on the steep sides of the mountain, and quite at the bottom a very narrow border of bright green cultivated patches, dotted with wooden houses.

The sun was just about to set when we arrived at the edge of the slope; the descent was very difficult, but in the highest degree striking. After we had passed through the treeless zone, we descended through the birch woods, then through the pine forests, which were decorated with the showy blossoms of the foxglove, at the very foot the odour of fresh-mown hay was wafted to meet us, we arrived among fields of almost ripened corn, cherry-trees bowed by the weight of ripe fruit, and blooming rose-bushes. Pretty cottages, built of wood, stood close together, and one of them was opened to us. What a change, after wandering about for several weeks on the bare plateaux and over the snow-fields! The change seemed the more magical from our having made the descent in one of those half-dark summer nights which in Norway are still more beautiful than with us. It was a scene especially calculated to demonstrate clearly the influence of elevation upon climate and vegetation.

We will now change time and place, and pass from the cloud-wrapped mountains of Norway to the clear summer sky of Italy.

Observing from Rome, at the beginning of June, 1818, that the snow was disappearing from the summit of the Apennines, I prepared for an extended pedestrian excursion. My intention was to travel first northwards to Tuscany, and then to follow the chain of the Apennines, along its whole extent, to the southernmost point of Calabria; this plan I carried into execution. I undertook this ramble, which lasted eight or nine weeks, alone, an ass which I bought in Rome, to carry my baggage, being my only companion through the greater part of the journey.

After having traversed a portion of the west side of the Roman Apennines, ascending various of the elevated summits which lie in the proper main chain, I crossed the latter near Norcia, and found myself toward the end of June in St. Benedetto, on the coast of the Adriatic Sea, surrounded by olive, wine, and orange gardens, and fields whence the corn had already been harvested. From here I turned to the highest peak of the Apennines, which is appropriately called Gransasso d'Italia, and which lies not in the principal mass, but upon a lateral branch of Apennines stretching out toward the Adriatic Sea, between Teramo and Aquila.

As far as Teramo the journey lay still in the hilly zone, where the woods were principally formed of evergreen oaks, the thickets of myrtles and lentisks. But near Isola commenced a steep ascent to the base upon which Gransasso rests, and on the same day that I had left Teramo in the morning, and passed through Isola at noon, I found myself at evening high above in the zone of the beech. As one is here above the limit of corn-culture, and above the elevation at which fixed dwellings are met with, I was under the necessity of taking up my night quarters with some herdsmen, who here tended sheep, under the open sky; they had no huts, but passed the night by a fire, rolled in their sheepskins. Tired and thirsty, I asked for milk, but was denied it; not from ill-will, but because the herdsmen have the superstition that to give fresh milk to a stranger will bring harm upon their cattle. Of course it was of no use my assuring them that cattle-feeding flourishes in Switzerland and Norway, although the people come to meet the stranger with a bowl of milk. "*Costume del paese*" was the answer, and in this point my guide from Isola took part with his countrymen.

After a pretty cold night, at break of day I continue my ascent of the mountain. I soon passed the upper limit of the beech, and found myself at the immediate foot of Gransasso, upon the Arapietra (stone altar) as it is called, 5500 feet, a kind of terrace, and in the midst of the loveliest Alpine flora. Higher up, the mountain became continually steeper; on the south and east sides, Gransasso is so steep that it scarcely can be climbed; on the north side a ravine makes it more accessible, but this was covered with snow. By digging steps in the hard snow, it was possible to get nearly to the summit of the mountain, but one almost perpendicular cliff remained; this I could not ascend, but, measuring by the eye, I estimated it at about 150 feet above the point where I stood, and the whole height of the mountain, according to barometrical measurement, 8935 or almost 9000 feet above the sea. I returned to the north side, and passed the night in a village called Pietra Camela, from whence I next day crossed the chain upon which Gransasso rests; the elevation of the mountain-pass amounted to 7200 feet. On the north side much snow still lay for me to cross; the steep south side, on the contrary, was almost devöid of snow, and on this I arrived the same day at Aquila.

Bringing together in a brief view the differences of the mountain characteristics displayed in the two rambles here narrated, attention may be particularly directed to the following remarks.

The *condition of the atmosphere* certainly deserves the first place.

The west coast of Norway is well known from its misty, cloudy sky, and its constant rains; although the east side has a clearer air, this is not so much the case in the mountains, and especially the portion of them which lie nearest the west side. The summer, too, is very rainy. This almost constant rain and fog, these eternal clouds which envelope the mountains, of course prevent the forms of the mountains making themselves very prominent. Except in a few smiling moments, Nature exhibits grandeur indeed, but bears a certain gloomy stamp. Very different is it under the clear sky of Italy. Although clouds and rain are more frequent, even in summer, on the mountains than in the plains, the air is ordinarily clear, and therefore more transparent than in the mountainous countries of the north. The prospect thus becomes freer. The outlines of the mountains, under a more beautiful light, are sharper and purer.

The second point in which an important distinction is seen, is the *form of the mountain-chains*. I have already spoken of the great mountain plateaux in Norway; if we ascend either the crest of these expanses or the higher yet usually rounded summits of the mountains, we look over immeasurable waving surfaces, either displaying snow-fields or consisting of mere naked cliffs. The little portions overgrown with Alpine herbs are not large enough, and the plants themselves are too small, to contribute to the character of the landscape. The valleys of the east side lie too far away to be seen, and on the west the fiords are usually too narrow to be visible from the rocky peaks; the sea also is too far away, even when the fog does not veil the prospect. From the Apennines, which present no flat tracts of any considerable size up above, and where the peaks usually rise steeply upward, the prospect is on this account alone more extensive; for example, from Gransasso one looks down into the fertile valley on the north and south, nay, the coast-plains and the Adriatic Sea lie within the sphere of vision.

Snow is seen, even during summer, in both chains; but in the south it is, of course, only found at a greater height. The large snow-fields on the Hardanger chain do not lie higher than between 4000 and 5000 feet. Gransasso, which rises to 9000 feet, has masses of snow only on the north side in July, and in August and September scarcely any is to be found.

In both chains the zone of the pretty Alpine herbs adjoins the snow-line. In Norway the birch comes next; further down the pine and the fir are the most important forest-trees; the beech is unknown on the mountains of Norway, occurring first on the plains in the south of Norway (Laurvig), and sparingly in a few isolated spots in the diocese of Bergen. On the Apennines, on the contrary, the beech is the tree which ascends highest, and adjoins the zone of the Alpine herbs. This geographical distribution is the more remarkable when we compare it with that of the corn-culture. While the beech is met with only in the most southern part of Norway, barley is cultivated even in Lapland, not far from the North Cape; on the Apennines, on the contrary, the cultivation of corn has almost ceased before the zone of the beech is reached, and this goes several thousand feet higher. The cause doubtless lies in the peculiar dependence of corn-culture on the summer heat, while the beech is more affected by the heat of the whole year. In those northern regions the summer is much warmer than at that elevation on the Apennines which enjoys the same mean annual temperature.

In the more elevated regions the feeding of cattle is the most important occupation, in both chains; but, taken altogether, it is more considerable in the southern mountains of Norway than in the Apennines: in the former they bring not only sheep and goats, but also horned cattle up into the Alpine pastures; in the latter scarcely anything but sheep and goats are pastured. In the former, stone huts are built, and a complete Alpine husbandry pursued; in the latter, the herdsmen wander about with their sheep and goats, and sleep in skins under the open sky, or live in mud-hovels. In both places the herdsman's life is nomadic; in summer the cattle are driven up the mountains; but while in Norway the cows are kept by stall-feeding in the valleys during the winter, the sheep which have browzed during summer on the Alpine pastures of the Abruzzi, are driven to the great plains of

Puglia, where the climate is mild enough to allow them to remain in the open air through the winter.

If we extend our comparison to the inhabitants of the mountains, the advantage falls to the Northmen. With the Norwegian peasant, we see in the dwelling and in its furniture proofs of his activity; he has a taste for reading, and his life ensures strength and self-dependance. The herdsman of the Apennines is indolent, ignorant, and little open to cultivation. We must not, however, overlook here the influence which the political condition and religion exercise. The Norwegian mountaineer is a freeman, and owns his farm; the herdsman of the Apennines is the servant of a monastery, of a landholder, or of a tenant. The religion of the Northman allows him freedom of thought; the Italian herdsman is a bondsman also in this respect.

CHAPTER X.

ETNA.

In those places where the surface of the earth is greatly elevated, the inequality does not usually present itself as an isolated mountain, but as a combination of several—as a mass of mountains; sometimes a ridge, narrow in proportion to its length, with peaks upon the crest and sides of the chain; sometimes a group of mountains heaped together, usually upon a flat base; or finally, as a great Alpine country, with several ridges, lateral branches, central summits, promontories, and many peaks, one within another and side by side. In all these mountain masses we find valleys through which rivers flow, side-valleys, the smaller torrents of which terminate in the main streams, frequently terraces and elevated plateaux. These are the characters of the Alps, the Pyrenees, the mountains of Norway, the different mountain systems of Germany, and the Apennines.

Etna presents a very different appearance. Although of very considerable circumference and height, it is merely a *single mountain*, an isolated, conical projection from the earth's surface, without ridge, plateaux and terraces, even destitute of valleys and rivers. On this account, when we take into consideration its compass and elevation, it is the *only one of its kind in Europe*.

Its circumference amounts to more than ninety-six miles. The height is 11,300 feet; it is therefore much higher than any point in all Northern Europe, higher than the highest peak of the Apennines and of the Greek mountains, and equals the Pyrenees. Only the summit of the Alps and a couple of points in the Sierra Nevada surpass it in elevation.

Etna is entirely separate from the rest of the mountains of Sicily; to the south lies the plain of Catania; on the west and north are the rivers Giarretta and Alcantara; toward the east is the sea. The base of the mountain is of roundish form, but the extent from north to south is somewhat greater than from east to west. The highest point lies in the centre, and thus the entire mountain acquires the form of a cone. The sides are gentle declivities, except at the peak itself, which is a steep cone, terminating in a funnel-shaped excavation, the crater, the mouth of which is about two miles in diameter. Etna does not present a single valley: the great hollow on the east side, which bears the name of the *Valle di bue*, is formed of the sides of an ancient and enormously large crater.

But Etna has several hundred smaller craters, separate conical little mountains with funnel-shaped cavities. Through these have the enclosed volcanic vapours made their way out in the course of past time; but although certain of these craters are individually large, they are too small in proportion to the whole mass to interfere with the conical form of the mountain. Some lie at a small elevation; for example, Montirossi (from which came the lava-stream that laid waste Catania), at a height of 3000 feet.

The soil is everywhere volcanic; it consists, namely, of lava, volcanic sand, or volcanic ashes, or of masses of stone thrown out in the eruptions. The quantity of sand and ashes naturally increases in proportion as the craters are approached; and as they are more frequent, the higher one goes, the ashes also increase with the height; the uppermost part is almost covered with them.

Closely connected with the form of the mountain and the nature of its soil, is the characteristic peculiarity of Etna, that it is destitute of rivers, brooks, and springs. The rain-water, and that coming from the melting of the great beds of snow, flows down the steep sides, without being gathered into rivers, because there are no valleys there, and on the upper part no turf, which elsewhere contributes so essentially to collect the water; the loose ashes and the hard lava are equally ill calculated to favour the formation of springs. These occur only on the lowest parts of the mountain, although very sparingly, and at the base are a few small streams. The inhabitants are restricted, especially in the higher parts, to cistern water.

The isolated position and the contracted form of Etna especially fit it for exhibiting the great influence which elevation has over climate, and as a consequence, upon plants. In few places, perhaps in none in Europe, are the various zones of vegetation so evidently visible and so well defined as here, or can so readily be surveyed in one view. This has led its inhabitants, without their having the least conception of botanical geography, to divide the mountains into three very natural zones, into the *cultivated zone*, the *wooded zone*, and the *naked zone*.

In the *cultivated zone*, going up to a height of 2500 feet, we find extensive fields in which wheat and barley are cultivated, the former for the food of man, the latter for horses. The vine-culture is still more widely spread; the hot, dry summer, and the dark-coloured soil, especially fit this zone for it. In some places holes have been dug in the black volcanic ashes, and filled with mould, in which vines are planted; although the roots do not extend beyond the mould, the vines, surrounded by the black ashes, bear excellent grapes. The cultivation of olives is also considerable on the lowest parts of the slopes of Etna; of the almond and fig no less. Oranges only flourish where water is sufficiently abundant; thus Etna does not offer any great superabundance of this fruit. Cotton and saffron are also grown to some extent.

The cultivation of the soil and the population of this zone are so extensive, that indigenous vegetation is scarcely to be found; it is confined almost solely to the lava-streams which are too recent to afford a thick enough layer of mould. The plant which chiefly prevails, and is characteristic here, is the Indian fig, as it is called (*Opuntia vulgaris*), the succulent stems and shoots of which derive nourishment from the aqueous vapour of the atmosphere. This plant grows, therefore, on the dryest soils, and flourishing so luxuriantly there, its fallen shoots and roots soon form a layer of vegetable mould, adapted for the growth of other plants. Besides this important advantage, it is applied to various uses by the inhabitants; with its entangled shoots and bundles of spines, they form an excellent and almost impenetrable hedge, while the juicy fruit afford a cooling refreshment during the hot summer, and hence are eaten in great quantities.

The second region is the *zone of woods*, extending from 2500 to 6000 feet. The orange-tree, the cotton, and the olive, are lost; almond and fig-trees, as well as vines, gradually disappear. Corn and wine are indeed still grown here, but the woods gradually assume the greatest share of the soil, and the felling of timber and grazing are the chief occupations here. In the more elevated villages, wheat is no longer cultivated, but its place is taken by rye, which is here called German corn, probably because it has been introduced from Germany. The woods in the lower part of the zone are principally composed of oaks with deciduous leaves, and chestnuts. Here are found the chestnut-trees so celebrated for the circumference of their trunks, among which the "Castagno di cento cavalli," the circumference of which at the root amounts to 180 feet, is especially renowned. The height of this tree being very small in proportion to the circumference of its trunk, it looks at a distance like a group of trees, and not like a single one. When approached, the tree still presents five trunks, standing close together, but their diverse directions, and the traces of the exterior of the main-trunk existing here and there between them, indicate that they were formerly connected and formed one great trunk, which is in great part covered with earth. But the very fact that the main stem has been destroyed, makes it doubtful whether several trunks did not exist originally, blended together. Yet other trunks are found in the neighbourhood, not indeed so large, but of very considerable circumference, and so well preserved that it can be seen that they are not composed of several trunks. Among others, the "Castagno di St. Agata" is seventy feet, and the "Castagno della Nave" sixty-four feet at the root, and fifty-seven feet at a distance of four feet above the root.

The upper part of the zone of woods is chiefly covered by beeches (which are not met with below 3000 feet), a species of fir (*Pinus laricio*), and birches. There is no corn-culture here, and very few or no villages are seen. This part of the zone is turned to account by feeding swine upon the mast, and goats in the pastures; the wood is also felled for timber. A species of broom (*Genista etnensis*), forming a small tree or tall shrub, is universal throughout this zone, and characteristic of it.

When we pass the tree-limit in the Alps, the Pyrenees, and the Norwegian mountains, we come upon the beautiful Alpine flora already described; little shrubs or low herbs, with comparatively large, elegant flowers of bright colours, and exhibiting great variety of form and colour. This Alpine flora is wholly deficient on Etna, although the elevation is quite sufficient to produce an equally cold climate. The vegetation above the tree-limit is extremely poor, in the highest degree uniform, and there is not a trace of the forms or characteristic features presented by the Alpine flora. This zone also is divisible into two. The lower is still a little verdant; the prevailing plants are the tragacanth shrub (*Astragalus siculus*), which forms little round cushions in the lava and ashes, welcome to the traveller tired of climbing were they not beset with countless spines; then the berberry bush, which is here quite dwarfed, and covered with sharp thorns; and finally the juniper.

In the upper portion, from 7500 feet to the summit, these shrubs have vanished; the ashes and lava are almost bare; scarcely ten species are found altogether, and of these, two are principally seen scattered among the ashes, namely, our common tansy (*Tanacetum vulgare*) and a grounsel (*Senecio chrysanthemifolius*). It is not difficult to explain why the upper part of Etna has so poor a vegetation, and is entirely destitute of the Alpine flora: the atmosphere does not act so readily upon the solid lava and hard ashes as on other rocks, which it converts into the drift, so fertile in the Alps; then again, every fresh eruption prevents, by new lava-streams and new showers of ashes, this transformation of the soil, and at the same time destroys the plants that are beginning to appear; finally we have to add, the great deficiency of springs and brooks.

Etna has a different aspect at different seasons and under different circumstances. This, perhaps, deserves to be more minutely explained, and I shall take leave to present a few little traits which I witnessed in my journeys over this remarkable mountain.

I saw Etna in its *winter character* at the beginning of March, 1830. Three-fourths of the mountain, namely, the whole of the naked and almost the whole of the wooded zones, lay beneath an unbroken covering of snow, while at the base all the fields were clothed in the brightest green of spring; peas, beans, and flax, were already in full blossom, the flowers of the almond had fallen, and given place to the leaves, and the fig-leaves were beginning to unfold; the meadows were decorated with hyacinths, narcissuses, crocuses, anemones, and countless other flowers. Etna stood there as an enormous cone of snow, with its base encircled by a gigantic wreath of flowers.

It was towards the conclusion of August and beginning of September, 1818, that I first visited Ètna. The mountain was then in its *summer garb*. The snow had entirely disappeared, except patches in little hollows of the very highest part, and these were only visible at the very spots themselves. The forests looked green and fresh, but the cultivated zone displayed a withered, dead aspect. The almost rainless summer, the excessive heat, had dried up almost all the grass and herbs here; only the evergreen shrubs and trees remained with their hard, shining leaves, together with the cactus (*Opuntia*) and agaves, which could bear the drought on account of the abundant stores of sap. In the lowest zone the botanist's occupation was gone; I therefore hastened toward the wooded zone, with the view of investigating this and the naked zone. I was obliged to renounce all idea of measuring altitudes this time, since my barometer had been broken in Calabria, and another which I had obtained in Calabria proved useless when I arrived at the wooded zone. The weather was, and had been throughout the past month, clear, dry, and warm. But scarcely had I advanced beyond the limits of the woods, when clouds began to gather around the peak, and before I had reached the "English House," as it is called, a little building of lava, directly at the foot of the highest crater, it was enveloped in the densest fog, and rain began to fall. I had made up my mind to take up my quarters in this uninhabited house, which lies 9200 feet above the sea, and is buried under the snow during eight or nine months of the year; two mules had carried up my baggage, and in addition water and fuel, for of these necessaries, which do not fail in other mountains, not a sign exists here. The weather became worse and worse; thunder, lightning, and storm raged; the rain poured down, it hailed and snowed, and the thermometer sank to 38° Fahr., while on the same day the temperature had risen to 78° Fahr. in Catania, at the foot of the mountain. I was here alone with my guide, for two days, in the most elevated dwelling in all Europe; I could be almost certain that no other human being passed the night in the same stratum of air. Kept within the walls of the house by the weather, the time might have seemed long enough, but the naturalist has always the good fortune to find occupation everywhere. It struck me to make a thermometrical observation every half hour, so as to find out the course of the temperature during twenty-four hours at so great an elevation; and at the same time, as it had been agreed to observe it several times in Catania, to learn the difference between the temperature at the sea-level and at a point elevated more than 9000 feet above it. On the third day the weather cleared up, it became bright, and I was enabled to ascend the highest crater, which forms the summit of Etna.

The prospect from the peak of Etna has something quite peculiar about it, arising from the fact that the mountain is completely isolated and conical; no peak, ridge, or terrace, interferes with the view, and it is almost as if one floated in the air in a balloon. Land and sea lie beneath one, as on a map; with perhaps the exception of the western quarter, one can see all over Sicily; if Etna stood in the centre instead of the coast, the whole island, although it occupies a surface of 600 square geographical miles, together with a portion of the adjoining sea would be overlooked; as it is, one sees beyond the north coast alone, and over this the Lipari islands, which lie there as if one could grasp them in one's hand; the southern point of Sicily is also seen; towards the east the Straits look like a narrow stream, on the opposite side of which is Calabria, the mountains of which rise 6000 feet, and yet one sees the sea beyond them. The great shadow which Etna throws is very remarkable; in the morning, when the sun has risen, lighting up the Straits and the east side of Etna, the west side of the mountain and that part of Sicily lying west of it are still in obscurity.

At that time Etna was in the most perfect *rest*, the crater was closed, and only slight clouds of smoke arose from it. In the following year I had an opportunity of seeing the *volcano in activity*.

While the eruptions of Vesuvius succeed one another quickly, sometimes stronger, sometimes weaker in degree, those of Etna are much more rare; but when they do happen, they are the more violent. No eruption had occurred since 1811; I felt myself particularly fortunate, therefore, that when I again visited this mountain in May, 1819, an eruption had commenced the day before my arrival. I hurried at once up the mountain during the night, and reached before daybreak a point, Montagnola, about 9000 feet above the sea, which was above the new crater. Here the most glorious opportunity presented itself to me of seeing the flames from which the smoke arose, and from which the glowing stones were hurled; somewhat below was the outflow of the lava, and as there was a precipitous fall towards the *Valle di bue* close by, the lava-stream formed a cascade at least several hundred feet deep. In the valley below, or more correctly in the gorge, it spread out and flowed like a broad river of fire a mile long; the woods set on fire by the lava burned in bright flames, the rye-fields were already destroyed by the lava flowing down, and the inhabitants of the nearest villages were anxiously calculating which way the stream would probably take. But it soon stopped; and this, as I convinced myself a few days after, when I visited its base, by the lava masses becoming heaped upon one another, and thus forming a dam for the stream itself.

While I was watching this eruption, and endeavouring to approach the crater as closely as was advisable, the sun rose. The sun's light struggled with the so-varied lights of the crater-fire, the burning lava, and the blazing woods. At length the sun triumphed; the colour of the fire of the crater became greyish, that of the lava changed to a white smoke; all around was covered with snow. This combination of fire and snow, and this contrast and contest of the different illuminations, was one of the most interesting natural phenomena I ever witnessed.

Eight days later I visited the principal crater. The English House and the principal part of the naked zone were covered with snow; at the summit I measured the height of the mountain, while the earth trembled under my feet. The new crater had grown into a considerable hill in the course of eight days, through the stones and ashes thrown out.

When I sailed from Messina to Naples, in the beginning of July, five weeks afterwards, the crater was still burning; and as Stromboli was in flames at the same time, I had two burning volcanoes before me at once.

CHAPTER XI.

RAMBLES IN THE KARST.

The great Alpine chain which bounds Italy like a gigantic wall upon the north, separates at its eastern portion into three principal branches, the southernmost of which extends in the direction from north-west to south-east, as far as the northern bays of the Adriatic, and joins further to the south-east the Dinaric Alps, which run along the east side of this sea. That portion of this south-eastern branch of the Alps which lies nearest to Trieste, namely, the greater part between Gorz, Trieste, Fiume, and Mount Nanus, is called the Karst. During an eight-weeks' stay in Trieste, I made many rambles among these mountains, and I will here endeavour to convey the image which they impressed upon me of the natural conditions of this region.

Most of those striking features which characterise the great mountain masses of the Alps vanish in the Karst. Here we find no summits rising 12,000 or 15,000 feet above the sea, covered with eternal snow, forming a zone 4000 and 7000 feet high, from which blue glaciers stretch their arms along the flanks and into the valleys; the most elevated summits of this eastern portion attain in general only 4000 or 6000 feet; few rise above the snow-line, and no glaciers extend down from them. We also miss here the sharp crests of the Alps, the steep declivities, and the deeply-excavated valleys, which form regular longitudinal and cross grooves; this portion of the Alps approaches to a plateau in form, being broad, and, in comparison with the rest of the Alps, flat; the most elevated portion presents an undulating and exceedingly irregular surface, from which rise several peaks and crests, and over which go passes; these are not, therefore, as is usual in the Alps, formed by two closely-adjoining cross-valleys. The condition of the water-courses is closely connected with this. On the south the chain comes so close to the sea that no proper river can be formed here, and although we do find streams in the interior, tributaries of the river Isonzo, lying on the west, their course is irregular; and, moreover, several rivers are met with which have no outlet at all, or at all events no visible one, to the sea, in some cases flowing into inland lakes equally devoid of outlet, as the Zircknitz lake, in others, lost in subterranean reservoirs.

In regard to the character of the rocks also, the Karst mountains differ from most parts of the Alps; instead of exhibiting a great variation of the structure, the Karst is composed of an uniform grey limestone, wearying to the eye. Numerous funnel-shaped hollows are met with on the surface of this limestone, not unlike volcanic craters in form; but their composition sufficiently testifies that no volcanic eruptions have taken place here. Both in the funnel-shaped hollows and on the level or undulating surface, we find innumerable masses of fragments of limestone, of irregular form, very often perforated with holes; sometimes large, sometimes small; sometimes spread out in strata, and sometimes piled up in heaps, which are not unlike those of the burnt lime around lime-kilns. These heaps and beds of broken limestone often render rambles in these regions very fatiguing, and, unlike the promontories and cliffs of the Alps, they yield no compensation by producing picturesque views.

This limestone is full of grottoes or caves, remarkable for their size and depth. Like many limestone caverns in Germany, they are lined with stalactites, which present a great variety of forms, looking like gigantic cones of ice—columns and galleries, in which the imagination, especially as the caverns are commonly illuminated only by the aid of torches, sees altars, palaces, temples, &c. The Corneal is undoubtedly the most beautiful of these grottoes. The visitor descends into one of those deep, funnel-shaped recesses so frequent in the Karst; at the bottom is found a narrow entrance to the cavern, but it soon rises, and you enter a large vault supported by columns; soon you pass over a colossal bridge, formed by nature, beneath which a subterraneous river is heard flowing, or a subterranean lake is seen; then you arrive at a projecting mass of rock, from which you look down into a pit, the bottom of which lies beyond the reach of the torchlight. According to my barometrical measurement, the greatest depth of this grotto is 400 feet lower than the entrance. The Adelsberg and Magdalen grottoes, both near Adelsberg, are of similar character; in the first are found bones of the cavern bear (one of the beasts of prey of the ancient world);

the last is especially remarkable from the Proteus (*Hypochthon*) being found in the great lakes lying at the bottom of the grotto—a remarkable animal never beholding daylight, the eyes of which are little developed and hidden by a membrane, and which, although a four-footed reptile, breathes all its life by gills, and has a rose-coloured body, so transparent that the colours of its viscera show through. In these grottoes also are found some peculiar insects, spiders and crustaceans, which are blind and of very pale colours —white, yellowish, or light brown.

The grotto of St. Canzian is of somewhat different nature; while most of the others have a low entrance, and require to be lighted by torches, this has a very large opening, and in spite of the great size of the grotto, is completely illuminated by the daylight. Quite at the back a small orifice is found into which the daylight shines, and at the bottom the pretty large river Rekka runs with great velocity into the grotto. Up, 500 feet above, on the mountain, which is completely hollowed out by the grotto, lies the village of St. Canzian. Behind the grotto lies a funnel-shaped hollow several hundred feet deep; by descending with great labour into this, another sight is obtained of the river Rekka, flowing out from the back of the grotto. Here it forms a cascade, and after running a little distance along the ground, again hides itself beneath it, and, apparently, never becomes visible again. Some, however, think that it is the Rekka which emerges from the mountains as a short coast river, under the name of the Timavo, at a distance of about thirty miles; this is navigable by small boats when it passes out from the cliffs. Near Planina, a river flows into the mountain in the same way, and in like manner another near Schloss Lueg, which lies in an open cavern. The Zircknitz lake exhibits another remarkable connexion between superficial and subterraneous waters, and has been renowned for centuries as a great natural curiosity. This lake, which is about five miles long, two and a half wide, and fifteen feet deep, sometimes loses all or nearly all its water, and then, after some time, regains it, frequently pretty quickly. It is said of this lake, that one can hunt, fish, and reap upon the same ground. When full of water it abounds in fish; when dry, one may hunt hares over it; and it is sometimes sown with buckwheat or oats. The lake appears, especially at one side, to stand in connexion with subterranean reservoirs of water, and the increase or decrease in them seems undoubtedly to affect the quantity of water in the lake. Recent observations appear to show that the rise and fall of the lake goes hand in hand with amount of rain of the seasons and of the year; and this corroborates the opinion that these subterraneous reservoirs of water, considerable as they are, derive their origin from the superficial water, which flows down into the subterraneous lakes or rivers through the calcareous fragments of the surface, through the crevices of the cliffs, and through the mouths of the caverns. This penetration of the superficial water down into subterraneous accumulations, in combination with the sparing amount of rain which is a characteristic feature of the climate of the south-eastern parts of Europe, causes the great deficiency of springs and wells in the Karst; whence the inhabitants, as in Dalmatia, are for the most part dependant on rain-water collected in cisterns; and in this we meet with another great difference from the rest of the Alps, so rich in springs and brooks.

The absence of rain and moisture, together with the coating of broken limestone over the surface, are certainly the most important causes of the very poor vegetation of the Karst. Northward of Nanus, between Adelsberg and Zircknitz, as well as on the northern declivity of the chains generally, fir-woods flourish, and on Nanus, beeches; but the proper Karst, between Nanus and the sea, excepting solitary hollows and other isolated spots, where a few oaks and hornbeams appear, is destitute of wood. But the Karst is not only without woods, it is almost devoid of plants; only here and there a juniper-bush, some little herb or a grass, springs from the heaps of limestone. This gives a totally different character from that of the Alps; for these are remarkable for their forests and luxuriant meadows. Hence it will be readily concluded that the land is little fitted for corn-culture, and suited only for cattle-feeding; here and there only have little patches been ploughed up in the hollows, in which a crop of wheat or oats is painfully coaxed out of the thin layer of soil, or in more favourable situations vines planted. Grass for sheep is met with sparingly here and there. The mountain-chain is consequently only thinly populated; the villages consist of miserable huts; dirt and poverty prevail among the ragged natives, and beggars are met with everywhere. The inhabitants, Illyrians of Sclavonian race, are at the same time a depressed people; they are ruled by foreigners, who do not understand their language or their customs.

The Karst and a large portion of Carniola thus exhibit the picture of barrenness, drought, sterility, and absence of life. To see anything beautiful, one must descend into the earth, where the brilliant torchlighted pictures transport the beholder into fairy land.

Yet the inhabitant of the Karst can see the beauties of nature in full splendour above ground; he need only wander to the border of the precipitous slopes of the mountain-chain, for then there lies at his feet the proud Adriatic Sea, overarched by the clear Italian sky, and on the slopes themselves the fig and laurel grow wild, with a crowd of other plants characteristic of the Italian climate. The olive, the exclusive property of Southern Europe, widely extends its grey covering, the vines form arcades, the almonds in spring spread a rosy carpet over the gardens, and the Triestans have built innumerable villas to shield them from the burning heats of summer.

But although we are in Italy here, we soon observe not only the vicinity of the Alps in general, but above all that of the Eastern Alps, which, being lower, allow the passage of the cold winds which come from the great plains of Eastern Europe and Western Asia. The mountain-wall which separates South from North Europe is interrupted in two places by depressions—in France between the Pyrenees and the Cevennes, between them and the Alps, and here at the Karst. Through the former come the milder western gales, but here the cold and dry east winds, which sometimes blow with violence, under the name of *borra*. When this *borra* prevails, the ships cannot lie in the harbours, and it often does great mischief by land and water. Hence we seek in vain for oranges, which are cultivated at the Lago di Garda and Lago Maggiore; and the olive is only secure from frost to the west of Trieste, where the steep Karst itself affords a shelter against the wind; in the valley running in toward the east of Trieste, where the wind has full play, all the olive-trees were frozen in the winter of 1788-9, from which cause very few are met with there now. In the first half of April, I witnessed a storm which appeared to me like a hurricane, but it was only called a *borrin* (a diminutive of *borra*). It brought such cold with it, that the thermometer sank almost to the freezing point; water froze in the ships in the harbour, the environs of Trieste were covered with snow, and buds of the vines looked as if scorched. The almond did not blow before April. The deciduous trees did not come into leaf until the middle of the month; on the 23rd of April snow fell there, but melted directly. On the 1st of May, the Triestans celebrated the appearance of spring by a visit to the neighbouring Boschetto.

CHAPTER XII.

CAPRI AND ISCHIA.

The Bay of Naples presents one of the most beautiful pictures of natural scenery in our quarter of the globe. Under that clear sky which falls to the lot of the countries of the Mediterranean, the sea, which, like the atmosphere here, assumes a deep blue colour, runs into the land in a bay rounded in its general form, but broken by promontories. At the bottom of the bay lies the isolated, conical Vesuvius, 4000 feet high, and incessantly smoking; along the south side stretch the mountains of Castellamare, among which Monte St. Angelo rises to 4700 feet, displaying forests of the northern beech, and on the upper portion a few sub-Alpine plants, while for some months of the year it is covered with snow. The north side of the bay is bounded by much lower volcanic hills, surrounding Naples on one side.

Before the mouth of the bay, like two portal columns to the beautiful temple of Nature, lie on either side the islands of Capri and Ischia, which by their height and well-marked forms essentially contribute to remove the uniformity which the prospect over an unbroken sea-view to the west would otherwise display. Separately or together, according to the different points of view selected on the coast, these islands in some degree limit the field of vision.

As seen from the shores of the Bay of Naples, these two islands present a remarkable difference in their outlines. One, Ischia, looks like a conical mountain falling off gradually, with its base considerably extended towards the east; the other, Capri, displays very sharp, angular forms, and is divided by a fissure in the middle into two portions of unequal height. These varying outlines are most intimately connected with the geological characters of the islands. Ischia is wholly volcanic, Capri is formed of limestone cliffs.

This difference becomes more accurately comprehended when the islands themselves are visited. The principal mass of Ischia is formed by the mountain Epomeo, 2500 feet above the sea. This is no longer among the active volcanoes, the last eruption having taken place about 550 years ago (1301); but the latest lava-stream still lies almost bare, vegetation beginning only here and there with a thin coating of the greyish-white lichen *Stereocaulon paschale.* But although Epomeo no longer pours out lava, nor does its peak smoke, there still remain several indications of volcanic action upon the island. Warm springs present themselves in many places, and form the well-known medicinal baths; in several places warm vapours rise out of the earth—the *fumaroles*, as they are called, at which there is danger of burning the hand when it is thrust into the earth. The buildings bear perceptible traces of numerous earthquakes. Not a single valley is found on the island; but the mountain is full of narrow, deep, and long fissures, which one can enter at the foot of the mountain; they resemble narrow lanes between infinitely high walls, which become continually higher, and the fissures consequently darker, the further one goes in. It has a rather depressing effect when you penetrate in this way sometimes a mile into the mountain, the light from above constantly diminishing, the bleat of the goats and the song of the herdsmen constantly growing weaker.

Capri, on the other hand, as already mentioned, is composed of limestone. It is formed of two principal cliffs, the western, which rises as Monte Solare to nearly 2000 feet above the sea, and the southern, on the summit of which the ruins of the palace of Tiberius lie at about 1000 feet; both portions rise extremely abruptly from the sea, and the landing-place is therefore in the fissure between them, where one meets steep cliffs at once on each side. The inaccessibility of the island has been known in history from the time of Tiberius to the last war. The access to the west side of the island where the town of Anacapri lies, is effected by a flight of several hundred steps hewn out of the rock, which runs down into the sea. The uppermost step of the flight lies nearly 1000 feet above the surface of the sea.

The limestone mountains of Capri exhibit no clefts like those of Ischia; but instead of these, the caverns so frequent in other limestone rocks. These are particularly abundant on the sea-coast, and as the sea penetrates into them, they can be rowed into in boats. The Azuro, or blue grotto, is remarkable among these caverns. The entrance to it is so low that it is inaccessible at high water, and it is usually necessary to lie down in the boat at other times in order to pass in, while the grotto itself is large, lofty, and vaulted. The dome presents to the eye a beautiful sky-blue colour.

Not only do these two islands present very great differences in respect to outline and composition, the contrast holds in their *vegetation*. The distinction is seen most clearly in the cultivated plants. The loose soil afforded by the volcanic ashes is, in Ischia as in other districts, especially adapted for the culture of the vine; while the hard cliffs of Capri, like the limestone hills of many countries of the Mediterranean, are particularly fitted for the growth of the olive. Hence Ischia, excepting the higher portions, which are either bare or overgrown with low chestnut thickets, may be regarded as one great *vine-hill;* Capri, on the other hand, with the exception of the wildest parts, which do not admit of cultivation, and a few isolated patches devoted to corn-growing, is a great *olive-hill.* A wonderfully beautiful aspect is displayed by the east side of Epomeo, which forms a semicircle divided into terraces, either when the vines are unfolding their young leaves in spring, or when they are covered with ripe grapes and parti-coloured leaves in autumn. The olives on Capri, with their grey leaves, have not such a beautiful appearance, but the greater variety of the forms of the rock compensates this deficiency.

Both islands, and particularly the densely-populated Ischia, are cultivated to such a degree that it is difficult to recognise the characteristic features of the indigenous vegetation. But it appears to me that Ischia affords far fewer rare plants than Capri.

Ischia, however, exhibits a remarkable exception to this, and at the same time a phenomenon worthy of notice in reference to the history of vegetation. In two of those smoking places above mentioned, the Fumarola di Frasso and the Fumarola di Cacciotto, grow two plants which are not found elsewhere in the kingdom of Naples; namely, the sedge *Cyperus polystachius* and the fern *Pteris longifolia;* they grow in the midst of the ascending vapours, and in earth so hot that it burns the hand when an attempt is made to dig up the roots.

The Neapolitan botanist, Tenore, who made this discovery, transplanted these two plants into the Botanical Garden at Naples, but they did not bear the winter there. Tenore considered them as tropical plants, growing in Ischia in a hothouse formed by nature, and he at once built the bold hypothesis that these two plants belonged to the earlier period of the earth's existence, when Europe possessed palms, elephants, and the rhinoceros; and that they had survived the revolutions of the globe which have intervened. This hypothesis can scarcely be accepted, for many reasons; and the enigmatical character of the certainly difficultly explicable appearance of these two plants is lost when we call to mind that *Cyperus polystachius* occurs on the north coast of Africa, and *Pteris longifolia* in Sicily; for I found this fern near Syracuse, therefore much nearer than the stations previously known. But the question still remains, whether these two plants originated upon the island of Ischia at the same time they did in other parts of the globe, or have been subsequently conveyed to that island? When a species of plant occurs in common, and in both places widely diffused, in very distant regions—for example, in Lapland and in the Alps, Europe and New Holland, or Europe and Mexico—and is not found in the intermediate countries, it is assumed with most probability that it primarily originated in both places. On the other hand, I think that one must rather have recourse to migration for the explanation, if the distance from the nearest locality is not overwhelmingly great, and the plant has otherwise a very extensive area of diffusion; conditions which here exist. Whether the migration has taken place by the aid of birds, or accidentally through human agency, I will not venture to determine.

We have a similar instance in Hungary. In a lake formed from warm springs is found the Lotus plant, which belongs to the flora of Egypt and other warm countries. It differs a little, it is true, from the Egyptian form, and hence recent writers have assumed it to be a distinct species—*Nymphæa thermalis*. But in any case, we have here the example of a form of plant which occurs with unimportant modification, under especially favourable circumstances, in a country of much colder climate, and which could not maintain itself without these special local conditions. Perhaps we may add here, that a species of moss, *Zygodon torquatus*, Lieb. (*Grimmia torquata*, Hornschuch), which occurs without fruit in Herjedal in Sweden, is stated by Professor Steenstrup to occur with fruit about the volcanic springs of Iceland.

CHAPTER XIII.

NATURE IN THE SOUTH SEA ISLANDS.

The South Sea, or Pacific Ocean, is the largest connected mass of water upon the surface of the globe. It is bounded on the east by America; on the west by Asia and New Holland. Taking into consideration the many large islands which occupy the space between Asia and New Holland, it is permissible to regard the seas separating these last two portions of the globe as mere interruptions of continuity, and to view these two regions, together with the islands lying between them, as a single vast continent. Then, since this continent and America approach so near together in the north that merely a narrow opening—Behring's Straits—remains, while they are separated so widely from each other in the south (the southern point of Van Diemen's Land and Cape Horn), the Pacific Ocean appears like a gigantic bay penetrating from the South Polar Ocean in between the two continents.

These two continents exhibit very different characters where they border the ocean. If we except the most northern part of North America, from which projects the peninsula of Alaschka, continued by an arc of islands which reach almost to Kamtschatka—as also the islands which adjoin the coast, and the most southern part of South America, where rows of islands lie almost in contact with the coast—the remaining portion of the west coast of this continent is without islands; the lofty mountain masses lie almost everywhere close upon the sea. Upon the opposite side of the South Sea, on the contrary, we find, throughout, a series of large islands, like bulwarks or dykes for the coasts, which in general exhibit no high mountains here. We shall not reckon these rows of islands, these bulwarks for the continent, as part of the South Sea Islands, since they differ very much from the rest in direction, in size, and in their whole character. In this way we exclude from the South Sea Islands, the Kuriles, the Japanese Islands, the Philippines, New Guinea, New Ireland, New Britain, the Solomon's Islands, the New Hebrides, and New Caledonians; indeed, even the islands of New Zealand are most correctly regarded as a prolongation of this great dyke.

Therefore, excluding these bulwark-islands, and likewise the above-mentioned line of Aleutian Islands, the South Sea Islands are included between the two tropics; only little solitary islands, like Easter Island, go a little beyond these, about to the twenty-seventh degree. The whole of these islands may be considered a special quarter of the globe, and called Oceania.

On no other part of the earth's surface are so many islands collected together; the number exceeds many thousands; in fact, they are uncounted and innumerable, like the stars of heaven. But they are all very small. The largest, which considerably exceeds the rest in circumference—Owyhee, or Owai—is only a little larger than Corsica. This is an essentially characteristic feature of this part of the globe; we are convinced of this very readily when we look at the other large groups of islands—such as the West Indies, the Asiatic group of islands, and the Greek Islands.

When we reflect what differences present themselves, in Europe even, between the continent and the peninsulas, between large and small islands; what influence this has upon climate and plants, upon the habits and intercourse of the people, in spite of all the parts lying so near together,—we easily perceive how the circumstance that Oceania is composed of countless spots of land, sprinkled, as it were, over an extensive sea, must give a very peculiar stamp to this part of the globe. On no other part of the surface of the earth, of any considerable extent, are the land, and consequently the climate, the vegetation, animal life, and the inhabitants, exposed in a similar way to the influence of the ocean. The inhabitants are, so to express it, seamen on board rafts.

At first sight it might appear as if the South Sea Islands were scattered in the ocean without trace of arrangement. A closer examination, however, shows us, in the first place, that they lie much nearer to Asia and New Holland, and adjoin the bulwark closely; while there is a considerable distance between these insular groups and America. That a fixed rule holds here, is seen from scarcely any solitary scattered islands being found in this interspace. It is in the next place evident, that the islands collectively form a curve from north to south-east, from the northern Marians to Easter Island; and that about the middle of this bow the Sandwich Islands lie considerably detached from the rest. In detail also, we remark some regularity in the distribution; we can separate certain groups and rows, albeit not by sharply-defined limits. On the north of the equator, the islands are arranged more in rows, which sometimes run north and south, as in the Marians, sometimes west and east, as in the Carolines, or north-west and south-east, like the Sandwich and Lord Mulgrave's Islands; the groups of islands which lie in the southern hemisphere are arranged rather in roundish groups, as the Fegees, the Friendly and Society Islands, and the Low Islands. But outside these lie several detached islands in small groups, which cannot easily be reckoned to those main groups, especially in the remote parts, as Pitcairn's and Easter Island.

With regard to elevation above the sea, the South Sea Islands exhibit great variation; some are very low, and rise but a few feet above the water, in fact, they are partly or entirely overflowed by high tides; others are mountainous, and rise steeply to considerable altitudes. Mowna Roa, in Owyhee, is 12,000 or 13,000 feet high. When we reflect that this island, as already mentioned, is not much larger than Corsica, this height becomes the more remarkable.

In the geological characters of the South Sea Islands, the *coral formations* play an important part; and among them the *Atols*, as they are called (lagoon islands, Matus), deserve our first attention. These are very small islands, consisting of a narrow strip of land forming a ring, or of parts of a ring, round an internal lake (lagoon). The ring is either quite complete or it presents one or more openings, it is frequently longish instead of circular, and the whole island rises very little from the sea—six or twelve, or at most thirty feet higher upon the windward than upon the lee side; it is formed exclusively of corals and fragments of corals; the breadth of the ring amounts to 1000 or 2000 feet, in part flooded at high water. The lagoon is not very deep, and becomes gradually filled up by the fragments which are thrown up by the sea. When the ring is completed, and has attained a certain height, the lagoon becomes a fresh-water lake. The Atols are most prevalent in a zone from the Carolinas by

Mulgrave's Islands to the Low Islands, that is, from north-west to south-east, and they constitute the greatest part of Oceania.

The second kind of coral-structures present themselves as *coral-reefs*, which lie at some distance from islands of various geological structure, but they follow the outline of the coast. These reefs are very narrow, annular, and low, essentially resembling the Atols in structure, especially when the island which is surrounded in this way is small. The water in the channel between the island and the reefs is rarely completely shut in, a variable number of entrances to it generally occurring. The depth does not exceed fifty fathoms, while on the outside of the reef it is not uncommon for no bottom to be found. The Society Islands, the Fegees, and a few smaller groups, exhibit these reefs.

Lastly, the coral-formations occur as *coral-banks*, which rest immediately upon the coast of large or small islands, when the coast sinks gradually to the sea or is surrounded by shallow water. The Sandwich, the Society Islands, the Marians, and a few other smaller groups, present this structure.

The coral islands are formed in the first instance beneath the surface of the sea, by the growth of coral animals—little slimy creatures which are connected together, and grow out in branches like plants, or in other forms.

According to Forster's theory, which for a long period was universally received, the coral islands were supposed to have grown up gradually from the greatest depths; but this opinion is now discarded, it having been shown that the coral animals are only found living at a less depth, and that they flourish best immediately beneath the disturbed surface of the sea, not, however, where they are laid bare at ebb tide, for in such places they die. Steffens, and with him most geologists, assumed that they were elevated submarine volcanic craters, which had their upper border clothed with corals; but none of the Atols are more than a few feet in height, and it is not to be assumed that all craters would be of equal height. The most recent theory is Darwin's, according to which the three kinds of coral-formations above described come into a natural common relation. He supposes a slow sinking to take place. An island surrounded by coral-formations (*coral-banks*) sinks, and as this takes place, the coral grows up to the surface of the sea, the most vigorous growth taking place on the outside, where the most abundant nutriment is found. An island then remains in the middle, around this is water, and this is enclosed by a ring of coral-structures; in this way an island surrounded by a *coral-reef* is formed. By further sinking, the central island finally sinks beneath the surface of the sea, the lagoon is formed in the middle, the border is the coral-formation, and in this way an *Atol* is produced.

The islands which are surrounded by coral-reefs, and those which have coral-banks around them, are of different geological character. Most of them are volcanic (lava, basalt, trachyte), a few are still in volcanic activity, as tho Sandwich Islands and Tufoa among the Friendly Isles.

There are, indeed, few regions of the earth which have so favourable a climate as the South Sea Islands. As they lie within the tropics, the climate is warm, but the heat is not oppressive, for the predominant ocean causes a cooling, and is thus a powerful equalizer. The mean temperature of the various points of Oceania falls between 75°—77° Fahr. From observations in the Sandwich Islands, the highest degree of temperature is 89° Fahr., the lowest 59° Fahr. above the freezing-point, and the difference between the warmest and coldest month is only 9°. Consequently, there exists here not only an eternal summer, but a constantly cool and pleasant summer. The insupportable heat suffered in the desert-zone of Africa, and the coast regions of Peru and Chili, is here unknown. Generally speaking, there is no want of moisture and rain, and most of the islands have one rainy season, the summer. Moisture is especially present on the volcanic mountainous islands, for the currents of air loaded with vapour are arrested and cooled down by the mountains, and the vapours then fall as rain; only a few of the lower islands, which, so to express it, cannot give themselves rain in this way, and which lie outside the zone of the regular rainy season—for example, Easter Island, south of the tropic—suffer from drought.

A cause contributing much to render the climate of the South Sea Islands constant, is, that they lie within the zone of the trade-winds, of the constant east wind, which is north-east northward of the equator, south-east to the south of it, and which so much facilitates the sea-voyage from America, but compels those who wish to sail in the opposite direction, to seek a higher latitude. It must be observed, however, that in the neighbourhood of the limits of the zone of the trade-winds, and in the southern hemisphere a little within the tropics, the trade-wind is interrupted at a certain season by opposite winds; here, consequently, the so-called monsoons occur; and even within the zone of the trade-winds interruptions of the rainy season occur.

In consequence of the trade-winds, the mountainous islands have a weather and a lee side; on the latter there prevails in part calms, which in the higher islands extend even many miles into the sea, in part the alternation in the twenty-four hours of land-winds during the night and sea-winds during the day. In the dwellings of the natives the doors are usually turned towards those alternating winds, and they thus obtain an agreeable coolness; these dwellings, which mostly consist of great roofs resting upon short posts, are on the whole well suited to the purpose, and many travellers describe it as extremely pleasant to repose on mats or mattresses in the sun in the day, or during the night.

This climate is as healthy as it is agreeable; here nothing is known of the deadly diseases of Java or Guinea; nothing of the climatal fevers of the West Indies. Man lives in the fresh sea-air as on board a ship, but without the confined atmosphere of the ship's cabin, and without the other disagreeables, want of exercise, want of fresh vegetables and water, which accompany a sea-voyage.

When a high degree of temperature is combined with abundant moisture, we usually see a luxuriant and richly-varied vegetation. Such is met with in the Asiatic Islands, in New Holland, Brazil, and in several tropical climates. But this is not the case in the South Sea Islands. On the volcanic islands, it is true, there is a superabundance of plants, and large plants, but the number of species is small and the variety consequently little. While we are acquainted with more than 5000 species from Brazil, we know scarcely as many hundreds from the South Sea Islands. To this is added, that few vegetable forms are peculiar. The forms which present themselves are Asiatic or Australian, particularly the former; but not American, even on the islands which lie nearer to America than to Asia.

We have already alluded to the probable causes of the South Sea Islands having so poor a flora, in spite of their excellent climate; namely, that the islands have probably originated since the time at which Nature ceased to produce new forms, which is true of the coral and probably of the volcanic islands; further, because the islands are so small and lie so much scattered, which opposes a considerable hindrance to the migration of plants, both from the continent to the islands and from one island to another. The comparatively large number of ferns and Lycopodiaceæ is remarkable; they constitute one-fourth of the species.

We cannot speak of all the characteristic wild plants, but we will name some of them. The cocoa-nut palm, the tall trunks of which render many of the low islands visible, forms forests, and affords the inhabitants fuel and timber, the nourishing nut, cocoa-nut milk, and oil. *Pandanus odoratissimus*, with its stems undivided while young, and branched and curved in the older stages, with its leaves arranged in spiral lines, its pleasant-smelling flowers and large heads of fruit, which furnish a not very superior food. *Casuarina equisetifolia*, a large tree, distinguished by its jointed, leafless branches, resembling the *Equisetum*, or "horse-tail." The inhabitants regard it as a funereal tree, as the Europeans do the cypress. On the Sandwich Islands especially occurs the sandal-wood tree, the wood of which is carried to China to be used for smoking.

Among the cultivated plants, the bread-fruit tree deserves especial mention—a large tree forty feet high, with leaves resembling those of the fig, and with large fruit, which through their mealy nature are very nutritious, and when cooked are said to taste like the finest wheaten bread. The plantain or the banana, with their large leaves and their likewise nutritious fruits. The Taro, the tubers of which, like the potato, contain abundance of fecula, and are eaten boiled or roasted like them; the cultivation of this, requiring so much pains, because it must be kept under water at one time of the year—a process effected in the Sandwich Islands by means of canals—is an evidence of the industry of the inhabitants. The Batatas, or sweet potato, and the yam, the tubers of which are of similar nature. The Tee-tree, which is regarded as a symbol of falsehood and lying, because its leaves are sometimes red and sometimes green, and the root of which is used for the distillation of a spirituous liquor. A kind of sugar-cane. Ava, a kind of pepper (*Piper methysticum*), from which a strong intoxicating liquid is prepared, which is said to be very congenial to the taste of the priests and some of the chiefs. The paper-mulberry, the fibre of which is used so industriously by the inhabitants for clothing and all kinds of textile fabrics.

If Oceania is poor in species of plants, it is still more so in land animals. The only land Mammalia found by the first Europeans who visited these islands, were the pig, the dog, and the rat—animals which might have been conveyed thither, either with or against the will of the inhabitants; and even these were not found in all the islands. Some few mammals may perhaps have escaped notice, since the more recent naturalists who have visited these islands, mention the mouse, also a couple of species of bat and a small Rodent; but in any case there is great poverty in mammals. The other domestic animals which the Europeans carried with them were therefore entirely new to the inhabitants; hence, the horse, for instance, they called a pig for riding. There also appears to be a striking want of insects. The number of birds is greater. Marine animals, on the contrary, such as seals, fish, turtles, crabs, mollusks, &c., are superabundant.

The absence of mammals, and of all domestic animals except the pig, exercises so much influence on the economy of the people, that it certainly deserves mention as a characteristic feature of Oceania.

Common language, common customs and mode of life, agreement of features and the other physical characters, unite all the inhabitants of the South Sea into one race. The inhabitants of the Sandwich Islands understand not only those of Tahiti, but even the New Zealanders, and mere dialects of one fundamental language are spoken throughout these islands. The characteristic customs, the *tatooing* and the *taboo*, the placing of the dead in a kind of open tomb (*morais*), ornaments and decorations, the use of the double-canoe, the culture of the same useful vegetables, are, with inconsiderable modifications, common to the most distant islands.

It is universally agreed that the inhabitants of Oceania are a fine and well-made race of people, differing less from the European, Arabic, and Indian, than from the other races. Their prevailing colour is far from what we can call black; even among the lower classes of people, who are constantly exposed to the sun and air, it is scarcely more than yellowish or brownish; among the higher ranks, especially in the female sex and in new-born children, it is scarcely darker than in the South Europeans. The hair is not woolly as in the negro, but smooth or lank; the eyes are large, and not oblique and small, as in the Mongolian race; the nose is separated from the cheeks and upper lip, the lips are not thick, as in the negro, and the limbs are well proportioned.

I have mentioned the tatooing. This remarkable custom, diffused throughout Oceania, consists in decorating the body by cutting or pricking lines or figures in the skin. This operation is performed by artists educated expressly for it; it is done with the wing-bones of the tropic bird, the end being carved into many points like a kind of comb; with these points the skin is pierced until a wound is made, into which is rubbed charcoal or the stinging-nut, as it is called (*Aleurites triloba*). The operation lasts several weeks, and very frequently additional figures are made afterwards. These figures are executed by the better artists with much regularity, symmetry and accuracy; indeed, not unfrequently even with taste; since, however, these artists require to be well paid with one or more fat hogs (the great wealth of the Tahitians), the less affluent are obliged to use the services of bunglers, and the poor go altogether without these decorations. It is readily perceived, that, looking at it as a decoration, the tatooing is to the Oceanians what clothes are to us; at a distance these marks have actually a remarkable resemblance to clothes; long streaks down the legs give the appearance of striped pantaloons; the decorations on the arm resemble an elegantly stitched glove; upon the leg, a stocking, &c. The lines are drawn upon the body so as to give the appearance of a very slender figure, so that even the *corset* is in a certain way known here. More depends upon a good tailor here than with us, for a man wears the coat all his life. Fashion, evidently, can have no influence, at all events, upon the same person.

The custom of the taboo is this: particular objects are declared to be sacred; so that they must neither be touched nor used, either by anybody or by certain persons. Not only objects which belong to religion may be selected for this, but many other things. For example, at the birth of a child a bread-fruit tree may be planted; it is taboo for every one else except the child. Pork is taboo for women, with some exceptions, however; the head of a human being is taboo; no one may place his hand upon it, or walk over the head of a person sleeping, &c.

Corpses are strongly rubbed with cocoa-nut oil, and, enveloped in a quantity of cloth, are laid upon stages in the open air. They are thus converted into a kind of mummies. The places where they are deposited are called *Moraïs*.

I have asserted already, that the natural position of the South Sea Islands makes the inhabitants born seamen. It is no wonder, therefore, that they are excellent swimmers. Travellers assure us, that when one sees what a length of time during the day, all, men, women and children, remain in the water, and what multifarious occupations they there engage in, one is tempted to regard them as a kind of amphibious animal, which can live as well in water as on land. This love of remaining in the water is so strong, that in the Sandwich Islands, where the higher native women now wear silk dresses, European bonnets, and shoes, it sometimes happens that they forget their new mode of life, and, changing suddenly from smart ladies into sea-nymphs, swim round the ships. When the Europeans first visited the South Sea Islands, they found in most of them a tolerably advanced civilisation. In many there existed a government, agriculture—in some, as already mentioned, with artificial irrigation—and a not inconsiderable degree of industry as well as taste, exhibited in their clothes, canoes, and beautifully ornamented utensils. They also possessed bards. But the civilisation, and still more the religious and moral conceptions, had a direction entirely different from the European.

But the inhabitants of Oceania, as they were when first visited by Europeans—indeed, as they were fifty years ago—are found now only in little-frequented islands. All has completely changed in Oceania in a short space of time. The inhabitants now dress in the European fashion, and have adopted European customs; tatooing declines greatly; a double-canoe is now a rarity in Tahiti. In the Sandwich Islands, where Cook was killed by the savages about seventy years ago, are now seen European dwellings, warehouses, billiard-rooms, taverns, and sentinels in uniform; they are annually visited by several hundred European and American ships, and fifty vessels may be seen there at once. When it was wished to give Captain Beechey a specimen of the national songs and dances, it was requisite to fetch dancers and bards from a distant island; schools and churches have taken the places of *morais* and idols. Were the islands not so scattered and so numerous, the time might not perhaps have been distant when it would have been necessary to study the national manners and customs of the inhabitants of Oceania in museums of antiquities, as we now do those of our own heathen times.

The Oceanians display great pleasure in adopting European civilization; indeed, this delight sometimes borders on enthusiasm. When the inhabitants of the Sandwich Islands remarked that, by the aid of writing, it was possible to communicate thought to those at a distance, they were so taken by the idea that everybody, great and small, hastened with his copy-book to the schools, and took them by storm; similar scenes occurred at the establishment of the first printing-press at Eimeo.

Tameamea, who made himself ruler over all the Sandwich Islands, was a Peter the Great for his nation; he made every effort to diffuse European civilization; built ships himself, established a militia, and commenced an independent trade in sandal-wood with China, which, however, did not succeed.

There is something very pleasing in seeing how civilization, and, simultaneously with it, Christianity, diffuses its advantages over many parts of the globe, and what giant strides this progress sometimes makes. But the pleasure arising from this is often disturbed for the philanthropist by an admixture of melancholy considerations; for the progress of civilization takes place, in most cases, by the Europeans or their successors displacing the older races, who perish as by a slow consumption. The same fate which the Guanches met in the Canary Islands, in all probability awaits the native races of North America, the savage tribes of Brazil, the aborigines of New Holland, the northern tribes of Siberia, and the Kamtschatdales. In human eyes it appears more desirable that the noble scion should be grafted on the wild stock, and not that the latter should be cut down to make place for the former. Oceania affords a remarkable and brilliant example of such a grafting. Perhaps it is here as in plants, the stock on which the scion is grafted must be of allied nature.

CHAPTER XIV.

THE TROLLHÄTTA FALL.

The importance and the character of a waterfall are principally determined by three things, namely, the quantity of water, the depth of the fall, and the angle which it forms with the horizon. The last two are easily ascertained by direct measurement; it is more difficult to determine the quantity of water. It is altered with the seasons and years, and cannot be ascertained from the breadth of the fall, for this does not depend solely on the quantity of water, but also, and indeed principally, upon the form of the earth's surface; if this be such that the flow of water is compressed between cliffs, the breadth may be much less than in another fall which possesses a far smaller quantity of water. In the absence of actual measurements, therefore, we have to draw conclusions respecting the amount of water from the size of the streams or lakes which flow into the waterfall.

We are able, consequently, to obtain a fair idea of the quantity of water at Trollhätta, by directing our attention to the circumference of Lake Venner, which empties its waters into the Cattegat through the Götha-Elv, which forms the fall; its size almost equals that of all Zealand, whence the old northern Sagas related that Gefion plucked this island out of the place where the Venner lies, and removed it to the entrance of the Baltic. Lake Venner is fed by a number of large and small streams, but chiefly by Klar-Elv, which rises more than 200 miles off in the mountain-lake of Faemund. The elevation of Lake Venner above the sea amounts to about 250 feet; so great, therefore, is the fall from this inland lake to the coast, at a distance of about forty-six miles; 112 feet of this occur at the Trollhätta, not however in one fall, but in several small ones, which succeed one another so closely that the Elv has not anywhere a quiet current. Highest of all lies the Gullö fall, so called from the inaccessible, fir-covered, rocky islet of Gullö, which lies in the middle of the fall; next follow the Toppö and Stampestrom, and the Höllen falls; lastly, quite at the bottom, the Flöttberg-strom, with a slight fall. While the separate portions, taken singly, afford a wonderfully beautiful scene, the entire fall also may be very well seen at once from the neighbouring heights. The cliffs which partly enclose the fall, partly project from it, and the fir-woods upon these cliffs, essentially contribute to heighten the beauty of the enormous masses of water rushing perpendicularly down, the vast white-foamed waves coursing each other with arrow-like swiftness, and the clouds of vapour which envelope them.

Europe has many waterfalls that surpass the Trollhätta in height; not a few, indeed, several times as high, such as the Marboré fall, near Gavernie in the Pyrenees, which is formed from a gathering of ten or twelve watercourses, one of which makes a leap of some 1300 feet at a bound; Staub-bach, again, in the valley of Lauterbrunnen, the height of which amounts to more than 900 feet; but these falls are formed by little mountain-brooks falling over steep cliffs, and are either partially or wholly dissipated into spray before they reach the bottom of the fall; these little streaks of silver gliding down the often perpendicular cliffs, have indeed their beauties, especially when the sun shines upon them and forms rainbows on the rocky sides, but from the smaller amount of water, they are destitute of the grandeur of the Trollhätta fall. Hansteen has made us acquainted with the Börring fall, in the bishopric of Bergen; its height amounts to 900 feet, and the quantity of water is undoubtedly greater than in those just now mentioned, but hardly very considerable, since the west side of Norway displays but very small streams compared with those which emerge on the east side of the great mountain-chain. There is a very beautiful waterfall at Terni, in the Papal States, the Caduta della Marmore. The river Velino, which rises about fifty miles to the south, having caused great mischief in the surrounding districts, it was diverted by digging a canal through the limestone rocks; this river, compressed into a narrow bed, forms the fall, rushing down from a height of 300 or 400 feet perpendicularly into a very narrow valley. From an orange-grove in the bottom of the valley there is a picturesque view of this waterfall, surrounded by a luxuriant Italian vegetation. The Riukan-fall (the *reeking* fall), in Upper Tellemark, is among the waterfalls which combine a very considerable height with a tolerably large quantity of water. The mountain-lake, Miöswasser, which is twenty-five or thirty miles long, and has an average breadth of more than two miles, empties itself into the Maane-Elv, and this forms the waterfall; at the very top it runs in two very oblique divisions, and below these the water drops almost perpendicularly about 800 feet into a deep abyss, which is so filled with watery vapour that the bottom of the abyss cannot be seen from its upper edge; the water flows away through a narrow fissure in the rocks. Consequently no convenient point exists from whence a view of the fall can be obtained; it is indeed possible to descend to the foot of the fall, but there the beholder is too close to the fall, and since the cliffs are steep and wet, the descent cannot be accomplished without danger. This waterfall surpasses the Trollhätta in height, but is far inferior in quantity of water.

Next to the Trollhätta, in regard to height and quantity of water, come undoubtedly the celebrated Norwegian Sarpen, and the Swiss falls of the Rhine. Sarpen receives not only the Klar-Elv, but the streams of the high mountain-chains of Norway, more than 200 miles to the north, namely, the united waters of Laugen and Glommen (Guldbrandalen and Osterdalen), which flow, in their way, through the great lakes Miös and Oire; but in spite of this, the quantity of water is much inferior to that of the Venner and the Götha-Elv. The height, sixty feet, is also only about half that of the Trollhätta. The Rhine fall at Laufen, in the neighbourhood of Schaffhausen, is about the same height as Sarpen, namely 50 or 70 feet; the quantity of water, also, coming from the High Alps and the Lake of Constance is about the same as at the last-named waterfall.

It appears, therefore, that if we except those falls which are of inconsiderable height, the Trollhätta must be considered as surpassing all others in Europe in quantity of water. But great as the giant is, he must yield to a mightier when we turn our eyes to other parts of the globe.

The Niagara falls, in North America, are formed by the waters of the vast Lakes Superior, Huron, Michigan, and Erie, before the stream empties itself into Lake Ontario, which communicates with the sea through the river St. Lawrence. The size of these lakes amounts to nearly two-thirds of that of the Baltic, and is more than forty times as large as Lake Venner. It is to be supposed that the amount of water at Niagara and at Trollhätta stand in a similar proportion to each other; and while, therefore, the Swedish waterfall is a giant in comparison with the other European falls, it remains a dwarf beside the North American. In height, also, the Niagara has the advantage, for the fall amounts to 140 or 160 feet.

The Trollhätta is not only one of the most remarkable natural phenomena in Europe; it affords testimony of the force of the human mind, and above all, of science in conflict with nature.

Lakes and rivers are important means of communication, but waterfalls prevent it. Thus Trollhätta interrupted the water-communication which would otherwise have existed between the great upland of the Venner and the coast, and thence with other countries. This obstacle was only most imperfectly overcome by the vessels stopping above and below the fall, unloading the merchandize, conveying overland and re-shipping it. But science gave counsel, and public authority followed the advice. A portion of the water of the river was diverted to the side, above the fall, in a canal partly hewn through the rock, and through a lake lying near, but here it met a steep precipice. From below, the masts of the vessels are seen projecting high above the cliff; but art proves able to bring them down. In the hard rock, more than seventy feet high, a deep canal has been cut, in which five locks are placed close together, and below the cliff are three more. When a vessel is to be let down, the upper gate of the highest lock is opened; the water flows in gradually until it reaches the same height in the lock as it has above, and the vessel can now sail in. The upper gate is then closed, the gate of the next lock opened, and the water flows from the first lock into the second, the vessel sinking slowly till the water is level in both locks, and thus the vessel reaches the second, which is then closed above, and this operation is repeated with all the locks, so as to bring the vessel down to the foot of the waterfall. The same operation, in a reversed order, lifts the vessel up to the top of the precipice: the lowest gate of the lowest lock being opened to let the water out, it comes to a level with the river; when the vessel has entered, the front gate is closed, and the back one opened, and the same process is repeated until the summit is reached.

Natural science has also facilitated communication in another respect here. With sailing vessels the passage is necessarily very slow along the winding river, and the delay is further prolonged by the passage through the locks; but steam power is especially adapted for the navigation of rivers. The number of steam-boats between Gothenburg and the inland is continually increasing.

But the naturalist has not only to combat nature. He must maintain another conflict, even as science has other cares; he must take the field against human prejudices, a conflict which is often more difficult and more lasting than the former. Trollhätta reminds me of this conflict. Here, where the cliffs, rivers, and pine-forests of Norway and Sweden border closely on the plains and beech-groves of Denmark, I see in memory a great gathering of naturalists collected around a frugal but hearty table in a neat wooden building. (The meeting of the northern naturalists at Gothenburg, July, 1839.) They have come hither from the various regions of Scandinavia; they are sons of three races, which have carried on bloody strife for centuries, between whom for centuries misunderstanding, mistrust, and rancour, originating in and nourished by national prejudices, have prevailed. But I see them sitting here intermingled, I hear them speak in the same tongue, albeit in different dialects; they offer the right-hand truly; men growing in years form brotherhoods, and converse together with the familiar "thou;" pleasure and satisfaction beam in every countenance. It is evident that a great common thought animates the whole assembly at this moment: a longing fills the soul, a longing for the coming condition of things, when the strife, the mistrust of nations shall have ceased, and when this strife and these prejudices shall be regarded with the same eye as that with which we now look back upon the wars of town against town, castle against castle, and house against house, so general during the middle ages.

CHAPTER XV.

THE PART PLAYED BY FORESTS IN NATURE AND IN HUMAN LIFE.

NEXT to the irregularities of the earth's surface and the distribution of land and water, the principal feature contributing to mark the physiognomy of countries, is the vegetation. Among the plants again it is the taller, arborescent kinds which by their magnitude play the chief part in characterising the land. A collection of tall arborescent plants, with trunks embranched below, we call a forest, while the terms "bush" and "heath" are applied to assemblages of low woody plants or bushes. The bush is only distinguished from the tree by its sending up a number of stems from the root; or, more properly speaking, by the stem dividing into several branches close to the root. But Nature affords manifold transitions between trees and bushes, and trees may be artificially changed into bushes (limes, hornbeam), and bushes into trees (the whitethorn). A wood, too, is not always an assemblage of trees; it may be a single tree. The banyan-tree (*Ficus indica*) of India has the peculiarity of sending down branches to the earth, where they strike root and grow into new trunks, which maintain their connexion with the parent. According to Forbes, there exists near the river Nerbuddah, in India, a wood formed of a single tree; in this there are 350 large and more than 3000 small stems, all connected together, and covering an area of 2000 feet. An army of 7000 men has rested beneath its shade. The mangrove (*Rhizophora*) exhibits something similar, a plant playing an important part in the coast-swamps of tropical countries; this also sends down branches, which again give off stems, and in this way form an intricate wood, well fitted for the abode of crocodiles and snakes.

Certain climatal conditions are requisite for the growth of trees; there exist portions of the earth's surface which are destitute of woods, chiefly on account of the cold. The *tree-limit* illustrates this.

When we investigate this limit in the Northern Polar countries, we find that it is met with in the most northern region of Scandinavia, about 70° or 71° N. L. (it is formed by the birch; the Scotch fir and Norway spruce extend only to 67° and 69°); here, however, trees grow only in the fiords, not close upon the sea, and from hence the tree-limit recedes both towards the east, and, still more, towards the west. Iceland, the Feröe Islands, and Greenland, are destitute of woods, although the south extremity of the last-named country lies in the latitude of 60°, and the most southern part of the others at 63½° and 61½°. On the west coast of America the tree-limit recedes still further to the south, for in Labrador the trees do not go further north than 58°. But the line which marks the tree-limit advances in the interior of North America; for Franklin found a pine (*Pinus alba*) on the Coppermine river at 68°—69°, in spite of the excessive cold; in Siberia, a larch (*Larix sibirica*) advances far to the north, in spite of the low degree of cold, for it is met with up to 68°. On the other hand, the tree-limit recedes greatly in Eastern Siberia; still more in Kamtschatka, where the growth of trees ceases at about 58°; on the north-west coast of America it extends somewhat further up. Thus the line of the tree-limit has two polar curves and two equatorial curves, but, remarkably enough, these stand in contrast to the curves of the lines of heat, for exactly there where the mean temperature is lowest, do the trees go furthest towards the north (in the interior of both countries), and where the mean temperature is highest (on the two seas) the line recedes towards the south. Therefore, it is evidently not the mean temperature which determines the occurrence of trees, but partly the summer heat, which is ordinarily somewhat higher in the interior of continents than on the coasts, —partly the more changeable climate and more violent storms which occur in the coast countries,—and finally, partly the saline particles in the currents of air, which act injuriously upon the vegetation of trees.

In the southern hemisphere the trees extend as far towards the south pole as the continents; trees are, indeed, absent from the extreme point of Cape Horn, but Tierra del Fuego has forests of large beeches. The islands lying in the vast ocean to the south of the continents are destitute of wood.

Not only does the vicinity of the pole set a limit to the growth of trees, the height of mountains has the same effect.

There is a tree-limit also in the vertical direction. Thus the growth of trees ceases at an elevation of 500 feet in Lapland (the birch); at 3500 feet (also the birch) in the south of Norway; in the Alps, at 6000 feet (the larch and dwarf fir); and on the Andes, at about 12,000 feet.

But, besides the Polar countries and the higher zones of mountains, there are vast tracts of the earth's surface within the tree-limits which are devoid of woods. Among these may especially be cited:

1. *The Desert Zone of Africa,* from Atlas and the Mediterranean Sea to the highlands southward of the upper part of the course of the Niger and Lake Tschad, 15°; from the Atlantic Ocean to the Red Sea; for Egypt and Nubia also belong to this; nay, the whole of Arabia may be included, the greater part of Persia, and the north-western provinces of India—namely, the lower part of the course of the Indus: an enormous tract, perhaps not inferior in extent to the whole of Europe.

2. *The Salt Steppes,* eastward, northward, and westward of the Caspian Sea and Lake Aral; they extend even into the southern part of European Russia, which is likewise without woods.

3. *Mongolia and Tibet,* where partly the elevation and partly the character of the soil likewise cause a total absence of woods.

4. *The vast Prairies of the Missouri and the Mississippi.* The savannahs of Florida are also among the unwooded parts of North America.

5. The great plateaux in the *northern provinces of Mexico.*

6. The steppes or *Llanos,* as they are called, on the Orinoco.

7. The enormous bare plains of the region of the river Plata, the *Pampas,* which extend from the Cordilleras of Chili to the Atlantic Ocean, from the mountain-chains of Brazil to the Straits of Magelhaen; for the whole of Patagonia is devoid of wood.

In the frontispiece-map are represented the wooded portions of the earth, but it is self-evident that many smaller unwooded portions exist within the limits of these regions (for example, the west coast of Jutland, the elevated region of Spain, &c.)

We shall, perhaps, best obtain a general view of the different characters of the woods, by examining the zones indicated on the map:

1. *The Zone of the Conifers.*—The coniferous trees are in general characterised by their slender trunks, which in some species of the north-west coast of America, attain a height of 200 and 250 feet, and by the narrow, dry, needle-shaped leaves, which are evergreen, with the exception of the larch, so that they maintain the appearance of vegetation throughout the year, in a zone where all traces of other vegetation vanish in winter. The thickly rising trunks do not readily admit of the growth of other trees in the forests where Conifers prevail; but the birch is mingled with them not unfrequently, The vegetation beneath the Conifers is very stunted, which is especially the case in the fir-woods; the dense shade and the ordinarily not very fertile soil which the Conifers prefer, and the fallen leaves, are certainly to be regarded as the principal causes. Yet we find some of the Ericaceous family (*Rhododendra, Pyrolæ,* &c.), and a few fungi, on the soil of the coniferous woods; the beard-like lichens (*Usneaæ*) hang from the branches of these trees. In Northern Europe these coniferous trees form the forests: the Scotch fir, the Norway spruce, and the larch (the yew-tree occurs sparingly, not forming woods). Northern Asia in like manner produces but few species in its great wooded zone. Great uniformity consequently prevails in the northern countries of the old continent. The coniferous woods of North America display a far greater multiformity, for already thirty or forty species of them are known.

2. *The Zone of the Amentaceous, or Catkin-bearing trees.*—While the Conifers have a tendency to rise high without exhibiting a corresponding circumference, the Amentaceous trees spread out their ordinarily more diffuse branches very far to the sides. The leaves are usually broad and tender, so that both they and the branches and twigs are more mobile in the wind, which gives them a charm wanting in the rigid Conifers. But the leaves fall, and leave the trunk naked during the winter. The trunks themselves here usually acquire a greater thickness than those of the Conifers (for example, in the oak, beech, chestnut, and plane). They agree with the Conifers in the flowers being small, uncoloured, and destitute of beauty. The variety is greater here than in the

Conifers, but in this respect again North America has the advantage, especially through its numerous kinds of oak. The deciduous trees suffer the presence of many plants beneath their expanded arms; in particular, we meet with a beautiful spring flora, before the leaves have unfolded. Conifers occur in the zone of the Catkin-bearing trees, as do, in like manner, the latter in the zone of the Conifers; but the division is here drawn according to the prevailing trees.

In the warmer part of the temperate zone, in Europe and North Africa, is seen the transition from the zone of the Catkin-bearing trees to the tropical zone. Here, various of these trees retain their leaves through the winter, as the ilex and cork oak; families of plants which appear only as herbs in the colder zone, here show themselves as tall shrubs or trees, as the leguminous plants and mallows; and tropical families, such as those of the laurels and palms, have a few representatives here. The variety becomes greater, and beautiful blossoms decorate a portion of the trees. A similar condition is seen in the southern districts of North America, where the magnolias appear, with their broad, shining leaves and large splendid flowers, and the gleditschias and robinias, with their feathered leaves and elegant blossoms.

3. *The Zone of the Multiform Woods.*—The especial characteristic of this zone, the greater portion of which lies within the tropics, is the extraordinary variety of the trees. While our woods are composed of one or of a few kinds, in the torrid zone they are formed of several hundred species of trees; thus a single region on the mountains of Java displays a hundred species of fig, besides many other trees. While in the temperate zone firs or pines, beeches or chestnuts, meet the eye unceasingly over great tracts of country, in the torrid zone palms and mimosas, to select two examples out of many, present new specific forms at a very short distance. But this very variety renders it difficult to give a summary, even merely of the principal forms. I will name only the following:—The palms, with their lofty, undivided trunks, with leaves, flowers, and fruits at the summit, and usually rising high above the leafy trees; the mimosas, and other leguminous trees, with very compound leaves, and frequently splendid blossoms (*Amherstia nobilis*); the mallow tribe, with their thick trunks (*Baobab*), with broad, usually divided

leaves, and large, handsome flowers (*Carolinea*); trees of the family of the Euphorbia, which contain milky juice, sometimes poisonous, sometimes, as an *Euphorbia balsamifera*, drinkable like the milk of animals; trees of the fig family, with large shining leaves, also with milky juice. Trees of the laurel family, with leathery, glossy leaves, and aromatic products; the arborescent ferns, with their lovely, finely-divided foliage at the summit; the Cycads, with large leaves, often subdivided on each side like the teeth of a comb, crowning the tesselated trunk.

The tropical forests are characterised in the next place by the size of the individuals, for although examples occur in the temperate zone of very lofty trees, for instance, species of fir, taken altogether, the trees of the torrid zone are higher than those of the temperate zone; further, by their large persistent leaves (in the Catingas forests of Brazil, they are deciduous), by large flowers and fruits (*Lodoicea maldivica*). Moreover, abundance of *climbing plants* is among the characteristic features of the tropical forests. These (the *Lianes*, as they are called; for example, species of *Cissus*, *Banisteria*, *Bignonia*, *Passiflora*, &c.), themselves arborescent, twine round the trunks, and frequently acquire such a mastery as to choke them, and at length wind round bare, dead cylinders. They often seem to have compressed the trunks like snakes, which arises from the bark and wood having grown up over these climbers; frequently they hang like garlands from one trunk to another, or (for example, the Rotangs, *Calameæ*, Spanish cane) they twine to a length of several hundred feet, like a cord from tree to tree; and since the trunks of these trees stand very close together, it is only possible to make a way through such a forest, by hewing a path. The number of *parasitical* plants is another characteristic of tropical forests, in part true parasites, which send their roots into other stems, and derive nourishment from their sap, like the species of *Loranthus*,—in part false parasites, which grow upon the branches and trunks of trees, but emit air-roots, and are nourished by the moisture they absorb through these from the atmosphere, and by that which they find in the cavities of the trunks. Among these the principal are the extraordinarily numerous family of the

Orchids, remarkable for their magnificent, peculiarly formed flowers; also the *Pothos* family, with broad, often hand-shaped leaves, and flowers upon thick, fleshy clubs; the pepper-plants, and the climbing ferns. These various forms frequently clothe a tree in such a manner, that it may be said to bear a flower-garden, where hundreds of different plants form a medley, in which even the practised eye has difficulty in referring each organ to its proper plant. In tropical forests the bamboo-canes are also met with—those woody grasses, which by their drooping shoots and bright-green leaves form a contrast to the usually dark leaves and widely spread branches of the tropical trees.

In the tropical forests, therefore, we find a much greater abundance, a much greater mass of plants, than outside the tropics. The high degree of temperature and the great moisture produce a rapid variation, and the decomposed vegetable matters are heaped in layer upon layer on the soil of the forest. This picture is especially applicable to the primæval fruits, as they are called, in Brazil, Java, and several other regions, where heat and moisture call forth the greatest fulness of vegetation.

But if we ascend to a considerable elevation in the torrid zone, the forests change with the altered climate; the forms of the temperate zone, and at the same time the want of variety and abundance, are again found. On the mountains of Mexico are found many oaks and coniferous trees. At a considerable elevation in Java grow many oaks and several chestnuts; and on the heights of the Himalayas are seen several Conifers, and other extra-tropical forms.

4. *The Zone of the Rigid-leaved Woods.*—Turning to the southern hemisphere outside the tropic, we meet, especially in New Holland and Van Diemen's Land, with a most peculiar character of the woods. In the two countries last named there exists an extraordinary number of kinds of trees, and yet in spite of this the greatest uniformity, because the trees belong to certain principal forms, the species of which differ little from each other, and because almost all have in common certain peculiarities in the leaves; these, namely, are dry, leathery, very often evergreen, of a bluish or greyish green colour, and in trees stand vertically upon the shoots. From

this it may readily be concluded, that the woods afford less shade, and possess a dry, dead aspect, although the trees frequently bear beautiful flowers.

That which characterizes New Holland, holds good also of South Africa. Wherever woods do appear (for in some parts they are infrequent), they are chiefly composed of Proteaceæ and Ericaceæ, with rigid leaves. It is otherwise in the temperate part of South America. On the east side, as already observed, there are no woods; but on the west, in Chili, the tropical forms extend southward of the tropic, and in the southern regions and in Tierra del Fuego, they gradually give place to forms resembling the European, for example, beeches.

When we investigate the influence of forests upon the atmosphere, we find the most evident signs of it in the torrid zone. The forests increase the rain and moisture, and produce springs and running streams. Tracts destitute of woods become very strongly heated, the air above them ascends perpendicularly, and thus prevents the clouds from sinking; and the constant winds (trade-winds or monsoons), when they can blow uninterruptedly over large surfaces, do not allow the transition of vapours into the form of drops. In the forests, on the contrary, the clothed soil does not become so heated, and, besides, the evaporation from the trees favours cooling; therefore, when the currents of air loaded with vapour reach the forests, they meet with that which condenses them, and change into rains. Since, moreover, the evaporation of the earth goes on more slowly beneath the trees, and since these also evaporate very copiously in a hot climate, the atmosphere in these forests has a high degree of humidity, this great humidity at the same time producing many springs and streams.

Since, then, the forests actually exert this influence in an important degree, and it is deficient when they are absent, sad effects have been experienced in many places which have been robbed of their rain, moisture, springs, and streams, so important to vegetation, by the destruction of the forests. When the Canary Islands were discovered, they were thickly overgrown with wood; since these have been gradually almost entirely eradicated, the climate has become very dry, nay, in in some islands—for example, Fuerta Ventura, to such a degree, that the inhabitants are sometimes obliged to flee to other islands to avoid perishing from thirst. A similar aridity of the climate, produced by the destruction of the forests, has been observed in the Cape de Verd Islands, various of the Antilles, and several other places.

In reference to the temperate climates, too, it has been asserted that forests favour rain and moisture, and that a dryness of climate is produced by their extirpation. Many forest-guardians and statesmen have on this account violently opposed too great a consumption of the forests. But it seems to me that the fear which many cherish on this account, is without sufficient ground, and that such an influence, if not totally deniable, is but very slight in all the forests of temperate climates.

If we compare the distribution of rain in Europe (the only part of the globe upon which we possess a sufficient number of observations), we see that the mountains and the ocean are the two great causes which influence the quantity of rain and the humidity, and these causes promote them. As we ascend from the plains towards the mountains, the quantity of rain increases considerably, especially on the side of the mountain which lies exposed to the rainy point of the compass (the south-west in most places in Europe). The quantity of rain increases in like manner, albeit in a slighter degree, toward the ocean; where these two influences (mountain and ocean) are combined, the quantity of rain sometimes rises to four or five times the usual amount, as on the west coasts of Norway and Britain, the coast of Portugal, and the south side of the Alps, especially next the Adriatic Sea. On the other hand, we cannot trace any notable influence of the forests. Places which lie in the well-wooded north of Germany, have not a greater amount of rain than those in districts devoid of forests, and are inferior in regard to the quantity of rain to the naked plains of Holland. Stockholm and Upsal, lying in such a richly wooded region, have a smaller quantity of rain than Copenhagen, &c.

In the next place, the slight influence of forests in this respect is proved by the comparison of the measurements of rain at various periods in districts where the forests have been cleared away. Great lamentation has been made in Denmark concerning the decrease of the forests, caused partly through the subdivision of landed property, partly through the unhappy condition of the country people during the wars of 1807-1814, which drove them to the felling of the wood as a means of saving themselves from destruction; it has been supposed that this diminution of the forests has lessened the rain and the quantity of water. But observations of the rain in Copenhagen of the last third of the last century gave about twenty Paris inches; observations in the present century, twenty-two Paris inches. In London the quantity of rain has remained unaltered since the middle of the last century, in spite of the increasing cultivation of the land diminishing the woods. The same is true of Paris; indeed, observations of the conclusion of the 17th and commencement of the 18th centuries seem even to indicate that the quantity of rain was less at that time than at present, and yet the forests of France suffered greatly towards the conclusion of the last and the commencement of this century, through the sale of domains and church property, and through the division of large estates, especially during the revolution. At Viviers, in the south of France, the amount of rain has increased in the period from 1777 to 1818 from thirty-one to thirty-seven inches, in spite of the large forests in the neighbourhood having been almost wholly destroyed. The same holds good in Italy; while the state economists are actively opposing the extirpation of the forests in the Alps of Lombardy, the quantity of rain has remained unchanged in Milan, or even increased a little, in the seventy years from 1764 to 1831.

It is easily comprehensible, however, that forests of the temperate zone cannot possess the same influences as those within the tropics, for neither the heating nor cooling are so strong; and for Europe in particular, the true sources of rain are the prevailing westerly gales from the Atlantic Ocean, and the masses of vapour which these bring from the wide ocean are so great, that those which rise from the damp soil in the small area of the forests and from the trees themselves, can be reckoned as nothing compared with them. To this must be added, the variability of the wind, and the conflict between the vapour-loaded, warm south-west and the cold north-east, providing constant opportunities for the change of the vapours into the form of drops.

What has been said of the humidity holds good also of the temperature. In the torrid zone, the forests, as a rule, act in diminishing the heat; in the temperate zone this influence is lost, or only slight, for no striking difference can be observed between the temperature of forest regions and unwooded tracts; and taken as a whole, the temperature has remained unchanged in Europe during the last centuries, while the forests have been much reduced in size. The ideas of the rigid climate of Germany and France, in the time of the Romans, on account of the greater extent of the forests, are certainly exaggerated, and have arisen from the unfavourable light in which the South Europeans regard the climate of Northern Europe. The theoretical opinion that the climate of North America has been rendered milder by the felling of its forests, does not appear to be confirmed by experience.

It cannot be denied that the forests influence the condition of the winds; but this effect is ordinarily confined to small tracts. On open plains the winds have freer play than in wooded regions. A forest lying to the north may, in Europe, shelter the immediate vicinity from the cold northerly winds, and thus soften the climate; a forest situated on the south may keep off the warm and damp winds; a plain in Northern Europe is less exposed to the injurious effects of the maritime winds, when it is protected by a forest lying between it and the sea. In the torrid zone a forest may intercept the cooling and wholesome sea-breezes; then the inner country, especially if swampy, becomes unhealthy. This is the case with the great mangrove woods in Guinea and Java, and with the primæval forests on the flooded banks of the river Amazon.

No other class of animals is connected so closely with the vegetable kingdom as insects; very many of them are not only destined to feed upon vegetables, but even upon certain definite species or genera of plants. From this it will readily be concluded that forests are of great importance to insects. Myriads of these little animals live upon and in the trunks of trees, upon their leaves, flowers, fruits, and upon their parasitical plants; myriads of others live upon the vegetable feeders; countless musquitoes, and other blood-sucking insects, swarm in the dense primæval forests, and render a sojourn in them almost insupportable. In the temperate zones the number of insects is smaller, but nevertheless large enough, so that particular species of insects sometimes destroy great tracts of forest; for example, those which bore into the trunks of the coniferous trees, or eat off their buds, as the species of *Bostrichus*, in the Hartz, and the *Bombyx Monacha*.

Next in importance in the forests to the insect world is the feathered tribe. The climbing-birds, especially fitted by the structure of their feet to live upon trees, are particularly numerous among the winged inhabitants of the forests; in the torrid zone the great tribe of parrots are the chief of those which make their dwelling in the woods, scarcely ever descending to the ground, numerous in individuals, and filling the forests with their disagreeable cries; in the forests of the temperate zone, the woodpeckers are the chief of the climbers which inhabit the woods, the grubs which they find in the trunks of the trees forming their food; but very many of the family of song-birds have their home here.

The class of reptiles is less abundant and less connected with the forests, but in the torrid zone a great number of snakes have their abode in them, and in the swampy forests of the coasts are found abundance both of snakes and crocodiles, with other lizards.

Just as the birds have a peculiar forest-family in the parrots, the Mammalia have one in the monkeys, the numerous species and individuals of which are so well adapted for a life in the woods; the structure of their bodies and their food bind them to the trees to such a degree that they seldom or never leave them. Among the other mammals, some of the beasts of prey and animals of the deer-family are especial inhabitants of forests.

Turning our attention, lastly, to the human race, we see that nations in the lowest stage of development are sometimes closely connected with the forests. In the colder lands, where the trees ordinarily bear no edible, or at least no well-flavoured or nourishing fruits, it is the game which chiefly furnishes the inhabitants with food and clothing; these races then appear chiefly as hunters, such as the aborigines of North America. In the torrid zone, on the contrary, races in the same stage of culture live principally upon the fruits of the trees or the pith of the trunks, like some of the tribes of Brazil, some of the inhabitants of the Indian Archipelago, and several races of negroes. South America even affords an example of a race who, almost like monkeys, live upon the trees; whose existence, in fact, is to a great extent bound to a certain species of tree. There are the Guarauni, at the mouth of the Orinoco, who live by and upon the Mauritia palm. While the ground is flooded, mats woven from the leaf-stalks of those palms are suspended between the trunks; these mats are covered with clay, so that fires can be made upon them, and here the Guarauni sleep, and pass a great portion of their lives. The trunk furnishes a fecula; the juice, a palm-wine; and the fruits are well-flavoured, mealy at first, and afterwards sweet.

Nomadic races, on the other hand, generally avoid forests; extensive grazing plains, fertile valleys, or the slopes of mountains, affording rich pasture-land, are the best fitted for the migratory life which they lead, and for the support of their domestic animals.

As soon as a race rises to agriculture, it becomes hostile to the forests. The trees are in the way of the spade and plough, and the wood gives less booty than the field, the garden, or the vineyard. The forest, therefore, falls beneath the axe, fire consumes the fallen trunks and branches, and the ashes manure the soil, giving for some years an extraordinarily rich harvest, especially in the dense tropical primæval forests. When, after the lapse of some years, the fertility decreases, a new portion of the wood is felled and burnt, and thus man proceeds unsparingly with the destruction of the forests; sometimes the conflagration spreads further than was intended, and the destruction is thus increased. This is the course pursued by the peasants of Norway and Sweden, as also by the colonists of North America, of Brazil, Mexico, the Cape, Java, and in every place where agriculture first appears, or commences its first constant and uninterrupted extension.

With the increase of population this destruction of the forests is continued, for it brings with it increased consumption of the products of the forest; wood is required for houses, furniture, wagons, and other implements, for bridges, posts, for fences, fuel for cooking, and where the climate is cold, for warming the dwellings.

The consumption of wood increases further with industry, with navigation and trade. Mining operations require timber, both for the works and for fuel to smelt the metals and ores; artizans and manufacturers use large quantities of the products of forests; dams against rivers and seas require their share, but, above all, navigation. The trunks of millions of trees are used up in ships and masts, in order to connect the highlands and inland districts with the coasts, and the coasts with each other, even beyond the ocean.

In this way civilisation comes into hostile contact with the forests, and thus, under like circumstances, the country in which civilisation is oldest, possesses the fewest woods. Hence forests are more sparingly met with in the countries of the Mediterranean than northward of the Alps, and more sparingly in the centre than in the north of Europe, so far as the climate is not an obstacle to the growth of timber.

Have not, then, our descendants to expect a great deficiency of timber—a deficiency which may readily become disastrous? Many public economists and philanthropists have assumed this to be the case, and many do still assume it; they depict the future destitution of timber in the darkest colours, they loudly complain of the felling of wood, and they demand that governments should prevent in time the ruinous consequences, by limiting the free use of wooded estates.

Yet even as I have striven to demonstrate the groundlessness of the idea of the danger which is feared of alteration of climate, by the diminution of the forests in temperate countries, I hope also to be able in some measure to scatter the dark cloud which so many imagine they see hanging over future generations in regard to the product of forests. That which is true of so many other inconveniences following in the train of civilisation, holds also with this. It has its cure, in a great measure, in itself.

In the first place, it is clear that as wood becomes more scarce, and thereby dearer, other materials come into use in its stead. While in Norway, Sweden, and the north of Russia, houses are built of wood alone, they are built of stone and wood in Central Europe, and almost entirely of stone in the south of Europe. While in the north the fields are fenced with wooden posts, living hedges or stone walls are used in Central Europe; while gardens are surrounded by palings with us, walls are used in the south of Europe The wooden bridges and timber dams of the north are changed for stone bridges and quays of masonry in the south. For the want of other fuel, the South European uses the trees on which he trains his vines, or the old olive-trees. Bridges, ships, nay, even houses, are built of iron. Coal and peat, when these are at hand or can be procured, take the place of firewood when this becomes too dear.

Secondly, it is clear that as wood gradually becomes dearer, it is used more sparingly. In Norway and Sweden firewood and timber are lavished in a way which is unknown in Denmark; if we compare the consumption of firewood in the country with that in towns, we are tempted to accuse the rural population of wastefulness. And yet there is no doubt that even in the towns we could save fuel by well-contrived stoves and heating apparatus, without losing heat.

Thirdly, it is certain that increase of civilization widens the market; if timber is absent in one country, it is fetched from another; the more facile means of intercommunication lower the price. The greatest commercial and maritime State fetches its timber and its masts from Scandinavia, from the countries of the Baltic; nay, even from the other side of the Atlantic.

Fourthly, the increasing price which the decreasing extent of the forests involves, becomes an inducement to preserve them, to maintain them, and at least to raise new woods in those places where the soil is not adapted for agriculture. Instead of allowing domestic animals to graze in the woods and destroy the young growth, the woods are fenced in and the cattle kept out. Wild animals are kept in zoological gardens. The forests are treated according to a scientific plan; trees are felled according to a definite rule, and young plantations are provided. The diminution of the forests has called into existence the entire science and practice of forestry in Europe.

During the war-time of 1807-1814, it was greatly feared in Denmark that fuel would fail; and it is certain that many woods were felled both during the war and in the immediately succeeding period, since the country people, reduced to poverty by the forestalling, were compelled to seek relief in the sale of their woods. Nevertheless these destructions of forests do not appear to have had the effect that was feared. In the earliest years of this century, before the war commenced, a fathom of firewood cost, in Copenhagen, about 1*l*. 5s. 6d.; at present it costs, on an average, 1*l*. to 1*l*. 1s. 6d., although there is at present a duty which did not then exist. The wood of an unfelled tree cost, before that era, 13s. 6d. in Zealand, which is also above the present ordinary price. The forests are indeed diminished, but they are protected and better treated, and firewood is more sparingly used than formerly. The State has therefore gained, and no one has been a loser by the change.

CHAPTER XVI.

THE GEOGRAPHY OF THE BREAD-PLANTS.

WE call those bread-plants which contain in one or more parts of the structure a sufficient abundance of starch to furnish an essential article of food to man. The starch, or fecula, is that material which constitutes the principal mass of bread, although other substances usually occurring with it, gluten and vegetable albumen, play an important part in regard to nutrition in a stricter sense, especially to the formation of muscle.

Starch consists of whitish transparent granules, composed of thin layers, and of various forms and sizes, which lie inside the cells of plants, and are coloured blue by a solution of iodine, while the membrane of the cell usually remain uncoloured. In the potato, which has uncommonly large granules, they acquire a diameter of $\frac{1}{20}$ of a line.

The starch, or mealy substance, occurs sometimes in the *cotyledons*, that is, the leaf-like parts which enclose the germ before the seed is developed, for example, in beans, peas, nuts, walnuts, chestnuts, horse-chestnuts, &c.; sometimes in the *albuminous mass*, the part which encloses the entire germ, within the coats of the seed, for example in the various kinds of grain, the buckwheat, and the cocoa-nut;* sometimes in the *envelope of the seed* (the fruit), for example, in the bread-fruit, the banana, the date, and the St. John's bread; sometimes in the interior of the *stem* (as sago), for example, in several palms, Cycads, and ferns; lastly, sometimes in *tubers*, which may be portions of the root or of subterraneous stems, for example, yams, cassava, salep, sweet potatoes, potatoes, Jerusalem artichokes, &c. Starchy matter does not occur in the leaves and flowers, at least not in such quantity as to be capable of affording a bread-stuff.

There are countries with such unfavourable climatal conditions that they cannot produce any bread-plant, among others, the North Polar lands. Here dried fish principally takes the place of bread, and, combined with fresh fish and marine mammals, constitutes almost the sole food. We can

(* An error a; fixed oil takes the place of the *starch* in the cocoa-nut.—ED.)

imagine a line separating these regions from the bread-countries, and this line may be called the *Bread-line*. This does not by any means run parallel with the circles of latitude, but makes considerable curves toward the pole and equator.

The *Bread-line* extends furthest north in Scandinavia, for in Finmark we meet, only within the fiords, it is true, with barley and potatoes up to the 70° N. L.; from here it sinks both to the east and west. It is well known that neither Iceland nor Greenland possess bread-plants, although the south coast of the former lies in 63½°, and that of the latter in 60° N. L.; and that in the Feroë Islands, although lying between 61⅓° and 62½°, there exists but an inconsiderable cultivation of barley. On the east side of North America, the Bread-line sinks still further to the south, for Newfoundland and Labrador have no bread-plants, and the limit can scarcely be put here higher than 50°, consequently much further south than in Denmark, where the plains abound in corn. It extends a little further north on the western coast of North America, which, as is well known, possesses a warmer climate than the east side; the few data which we find here, render the determination of the north limit rather uncertain; it can scarcely be placed higher than 57° or 58°. Turning from Scandinavia towards the east, we find a depression of the Bread-line, even in European Russia, here coming by 67° northward of Archangel; the curve is considerable in Asiatic Russia, at Ob the north limit of bread comes to 60°, at Jenesei to 58°, at Lena 57½°, and in Kamtschatka, which has only a slight cultivation of corn in the most southern part, it sinks to 51°, thus about to the same latitude as on the east coast of North America. The Bread-line has thus two polar and two equatorial curves, the former corresponding to the western, the latter to the eastern sides of the continents. Toward the south pole, there exists so little land, and this is so sparingly cultivated, that the Bread-line cannot be drawn with certainty there. Everything indicates that the curvatures are much slighter.

The portion of the solid surface of the globe which lies within the Bread-limits, may be divided into several zones according to the *prevailing* bread-plant, but it is better to define them separately for the different longitudinal zones.

In the western part of the old world (Europe and Africa), we can distinguish six zones, succeeding one another from north to south; but it must be observed here that these limits are by no means so sharply defined in nature as on the map, and that the predominant bread-plant of one zone occurs frequently also, although subordinate, in the others.

1. *The Zone of Barley, Oats,* and the Potato, includes that part of Scandinavia which borders on the Bread-line; that is to say, Finmark, Nordland, and the higher districts of the Scandinavian mountains, the Feroë Islands, the Shetlands, the most northern part of Scotland and Ireland. Bread is made of barley or oats, or of a mixture of the two; potatoes constitute an important food. The north and south limits of this zone may be determined according to the varying distances from the sea.

North boundary, 62°—70°—67° N. L.
South boundary, 57°*—65°—60° N. L.

2. *The Zone of Rye* occupies the greater part of Europe north of the Alps, but with the exception of the west side, for in England and France wheat is the predominant bread-stuff, and the zone of wheat thus immediately adjoins here that of barley and oats. In the zone of rye, buckwheat, beans, and peas, are also important farinaceous food; in the east, moreover, the millet is considerably used. The cultivation of wheat and the use of wheaten bread increase in this zone as we proceed southward. The boundaries of the Zone of Rye may be placed at the east side of Europe at about:

North boundary, 65°—60° N. L.
South boundary, 50°—48° N. L.

It must be observed, however, that the Zone of Rye is found in the centre of Europe and southward of 50°, on account of the elevation of the countries. Barley is chiefly used for beer in this zone, which is destitute of the vine; oats are used for the food of horses.

3. *The Zone of Wheat* extends from the above-mentioned boundary of the Zone of Rye (in the west, of the Barley and Oats Zone) to the African desert; consequently, from west to east in Europe and the north of Africa.

North boundary, 57°—50°—48° N. L.
South boundary, 30° N. L.

* In Scotland; in Ireland, 52°.

This zone, therefore, includes, besides Great Britain and France, the whole of Southern Europe and the north of Africa. In this zone, in the middle of the northern boundary (50°), maize already plays a not unimportant part, and from 45° rice also; but they are usually confined to certain regions, and subordinate to the wheat. Beans, lentils, and several pulses, as well as millet, and in some districts (especially Egypt) durra, are of some importance as articles of food. Barley is not used for beer here, but chiefly for the food of horses and mules. In the mountain regions of this zone rye sometimes appears predominant; in some parts chestnuts form the principal farinaceous food.

4. *The Zone of the Date* adjoins the African deserts between 30° and 15° N. L. The greater part is destitute of bread-plants; dates, however, constitute the principal food in the oases. But wheat and several other kinds of grain are also cultivated here.

North boundary, 30° N. L.
South boundary, 15° N. L.

5. *The Tropical Zone.*—Rice and maize are the grains chiefly used here, but other bread-plants play an important part, especially yams, mandioc (cassava), and the plantain. It includes both the west and east coasts of Africa, from the deserts to the southern tropic; the interior is little known, but so far as it is, the same appears to hold good, excepting in the case of Abyssinia, where the conditions are somewhat altered, on account of the elevation.

North boundary, 15° N. L.
South boundary, 23° S. L.

6. *The Southern Zone of Wheat.*—In the south of Africa, especially in the Cape Colony, the European grains again make their appearance; wheat is predominant.

North boundary, 23° S. L.
South boundary, 35° S. L.

For the *eastern portion of the Old World* (Asia), as well as for *New Holland*, the following zones may be laid down, but they are greatly modified by the great Asiatic mountain regions.

1. *The Zone of Barley, Oats, and Rye*, which goes from the Bread-line to about 50° in the west, and to 40° in the east of Asia. Besides the grains named, buckwheat and potatoes, especially the former, are cultivated to a considerable extent.

North boundary, 60°—51° N. L.
South boundary, 50°—40° N. L.

2. *The Zone of Wheat in the west and Rice in the east.*—In the west of Asia, between 50° N. L. and the tropic, wheat prevails. In the east, on the other hand, the cultivation of rice extends to the south limit of the preceding zone; wheat, indeed, occurs also, but not in sufficient extent to form a zone. In the middle of the continent there is but little agriculture in the dry and sterile plateaux and mountains. The limits therefore are:

	The Zone of Wheat.	The Zone of Rice.
North boundary,	50°.	40° N. L.
South boundary,	23° N. L.	

3. *The Tropical Zone.*—The predominant bread-stuff is rice; but the yam, plantain, and cocoa-nut, also bear an important share; and with regard to the Archipelago between Asia and New Holland (Polynesia), the sago-plants, the bread-fruit tree and the cocoa-nut palm divide the predominance with rice.

North boundary, 23° N. L.
South boundary, 23° S. L.

4. *The Southern Zone of Wheat* occurs only in the European colonies, in New Holland and Van Dieman's Land, where also the other European grains are cultivated.

North boundary, 23° S. L.
South boundary, 44° S. L.

For the *Islands of the South Sea* (Oceania).

1. *The Zone of the Bread-fruit and Cocoa-nut Palm* includes the islands within the tropics. Taro (*Colocasia esculenta*) is also general here.

North boundary, 23° N. L.
South boundary, 23° S. L.

2. The inhabitants of *New Zealand* have hitherto used only *Fern-stems* as sources of farinaceous food.

North boundary, 34° S. L.
South boundary, 48° S. L.

In regard to *America*, the zones may be found in the following manner:

1. *The Zone of Rye, Barley, and Oats*, as well as Potatoes. No special zone of Rye can be distinguished here.

	Western.	Eastern.
North boundary,	58°.	50° N. L.
South boundary,	50°.	45° N. L.

2. *The Zone of Wheat.*—Although, taken altogether, wheat predominates here, maize occurs very frequently from 45°, and in Carolina rice even takes the place of wheat.

North boundary, 50°—45° N. L.
South boundary, 30° N. L.

3. *The Tropical Zone.*—The predominant grain is maize, but the yam, sweet potato, cassava, and plantain, play a very important part, to which may be added arrow-root (*Maranta arundinacea*), chayote (*Sechium edule*), &c.; in Brazil, rice is universal.

North boundary, 30° N. L.
South boundary, 23° S. L.

4. *The Southern Zone of Wheat and other European grains.*

North boundary, 23° S. L.
South boundary, 45° S. L.

The difference of geographical latitude is not the only means of establishing boundary-lines and zones for the bread-plants; the elevation above the sea is another agent, and in some cases in the warmer countries those zones which the latitude gives, change according to the elevation.

In the centre, and partially in the south of Europe, the zone of wheat is resolved at a certain height into that of rye, barley, and oats, and the last-named grains also disappear at a greater elevation.

On the Himalayas the cultivation of rice extends to a height of about 3000 feet, it then gives place to wheat, which forms a zone between 3000 and 10,000 feet; higher up, between 10,000 and 12,000 or 13,000 feet, barley and oats are still grown. Barley attains this great elevation, especially on the north side, in Thibet.

In the tropical regions of America, the zone of the plantain and mandioc, extends to 3000 feet, of maize to 6000 feet. After these, wheat and the other grains form a zone between 6000 or 9000 feet; in the upper part of Peru these grains extend even to 10,000 feet, and particular places to 12,000 or 13,000 feet. In Peru and Mexico potatoes are cultivated up to 10,000 feet; and in Peru, quinoa, to a still greater elevation above the sea.

If we wish to reduce the most important bread-plants into two principal classes, *tropical* and *extra-tropical*, the first class must contain the rice, plantain, yam, sweet potato, chayote, arrow-root, cassava, bread-fruit, sago, cocoa-nut, taro, and date; the second will include wheat, rye, barley, oats, buckwheat and potatoes; maize is common to both. In regard to frequent occurrence, and to the number of human beings which the various bread-plants support, the rice, among the grains, undoubtedly holds the first rank, then follow wheat and maize, and lastly rye, barley, and oats. Among the other bread-plants the plantain, yam, bread-fruit, and potato, play the most important part.

The bread-plants exhibit a great difference in respect to fruitfulness.

A comparison even of the different kinds of grain shows that the tropical yield more nourishment than the extra-tropical. While wheat yields on an average five or six fold in Northern Europe, and eight or ten fold in Southern Europe, and the rest of the European grains about in the same proportion, maize yields in temperate climates eighty or a hundred fold, in the torrid zone three or four hundred fold, and rice a hundred fold. But the yield is more variable in these two grains than in the former; if drought ensues, the maize fails, and if the rainy season does not make its appearance, the rice is ruined. Hence great famine is frequent in India and China, especially since rice is so often the sole food in these regions.

The plantain yields 133 times as much food as wheat on the same area. Hence a small garden around the native's hut is sufficient to feed a family. Within a year after it is planted it bears ripe fruit; if the stem is then cut off, new ones spring forth, which bear in three months.

A cocoa-nut tree yields, on an average, thirty nuts a year, which is a considerable product, when we take into consideration the size of the nuts and the abundance of nutritious substance. The bread-fruit tree yields fresh fruit for eight or nine months of the year; during the rest of the time, bread baked from the fruits, prepared like dough, is eaten; it is estimated that three trees are sufficient to feed one human being. Cook expressed himself in the following terms: "If an inhabitant of the South Sea has planted ten bread-fruit trees during his life, he has fulfilled his duty towards his family as completely as a farmer among us, who has every year ploughed and sown, reaped and threshed; nay, he has not only provided bread for his own lifetime, but left his children a capital in the trees."

It is still easier to provide bread in the eastern islands of the Asiatic Archipelago, where sago grows wild in the woods. When the native has satisfied himself, by boring a hole in the trunk, that the pith is ripe, the trunk is cut down and divided into several pieces, the pith is scraped out, mixed with water, and strained, and there is sago-meal perfectly ready for use. A tree commonly yields 300lbs., and may afford 500lbs. or 600lbs. Thus a man goes into the woods and cuts his bread, as we hew our firewood.

But the facility for obtaining bread seems to stand in inverse proportion to civilisation. Other causes certainly exist, especially the differences of national character, determining the degree of civilisation in most of those regions where nature is so bountiful; but the superabundance of nature herself undoubtedly contributes to lessen the energy of man. Strife against nature, when not too hard, advances civilisation. Labour is the mother of enlightenment. History has not preserved the record of those who first used the bread-plants, who first planted them; for history could not come into existence until mankind had satisfied the first necessities. The early history of the bread-plants is enveloped in obscurity, in the form of traditions and myths, according to which the gods themselves descended on to the earth to confer the great gift upon mankind. In India it was

; in Egypt, Isis; in Greece, Demeter; in Italy, Ceres, ve corn to the natives, and taught them to cultivate ne ancient Peruvians had similar traditions respecting ; and so late as the advent of the Europeans, this native to America, was cultivated round the Temple of un, at a great elevation above the sea; and the grain istributed among the people, who believed thereby to e a fortunate harvest.

is a remarkable fact that we are still in uncertainty her the different kinds of grain still grow wild in the vorld, and if so, in what region this occurs. Even the ors of antiquity were at variance as to whence wheat barley, the chiefly-used grain at that time, had been ved, and in the various statements less regard seems to been paid to actual facts, than to the fertility of the tries, and the desire to secure for the native land of the er the honour of having furnished so great a gift to man-

The same uncertainty still prevails respecting these kinds of grain, and the same is true of oats and rye. It supposed that the rye had been found wild upon the casus, but later observations have shown that this wild t is different from the cultivated, particularly in having central stem of the ear so brittle that it cannot be hed. A wild rye is also found in Sicily, but this too characteristics by which it differs from the cultivated

When plants are met with, in a wild condition, ly like our kinds of grain, it is usually in places which been cultivated at a former period, and thence it is able that they are only outcasts, and not wild aborigines. we do not know whether the parent plants of our ern grains have totally vanished, or have become so ed by cultivation in the course of time that we cannot nise them in the species to which they actually do owe origin. The same seems to hold of maize in America. grain was already diffused over South and North ica when the New World was discovered, and the nents which have recently been made respecting its rence as a wild plant, in Paraguay, for instance, leave same doubt as to whether it is not merely an outcast cultivation, which we meet with in respect to the grains Old World. Rice seems, indeed, to have its home in

India, whether, however, the statement of the Danish missionary, Klein, that he has found it wild there, is sufficient testimony, for similar reasons remains doubtful. Most of the accounts which we had of potatoes growing wild in Chili, Peru, and Mexico, have since proved to be unfounded, for it has been discovered that these referred to other species of the numerous genus to which the potato belongs.

On the other hand, the date-palm grows wild in Africa and Arabia; the cocoa-nut in India, Ceylon, and the whole of Polynesia and Oceania; the sago-palm in the East Indian Archipelago; but all these occur in a more confined region of distribution than is occupied by the plants as now cultivated. The bread-fruit tree, which occurs in the Indian Archipelago, and the buckwheat, which is found wild in Siberia, near the Chinese border, may also be included among the bread-plants, which are known to occur still in a wild condition. The most important bread-plants of the present and the past might be represented on different maps, just as we have maps of ancient and modern geography. Comparisons of them would show the migrations of the bread-plants, and interchange of them between the various countries and quarters of the globe.

In the *countries of the Mediterranean* (Italy, Greece, Northern Africa, and Western Asia) *wheat* and *barley* were in antiquity the ordinary, very widely-diffused grains. We find mention of them in the oldest writings, in the Bible, and by Homer and Herodotus; we find representations of them in monuments of the earliest times. Millet was also known then, but played then, as now, a subordinate part. They had not rice at that time; it was known only as an Indian plant; the American grain, maize, was of course unknown at that time; of rye (which even now is little cultivated there) no certain traces found.

Central and Northern Europe had very little corn-culture at that time; and in the same way as *barley* and *oats* now furnish bread in the northernmost parts of Scandinavia and Scotland, according to Pliny, the ancient Germans lived upon oat-groats; the inhabitants of the north probably possessed no better bread-stuff. Rye seems to have come into Northern Europe at the time of the migrations of races from the Caucasian countries, without having entered the lands of the Mediterranean; and wheat appears to have migrated at a later period from the south to the north of Europe, chiefly by way of France.

In *Africa*, south of Atlas, the date-palm prevailed then as it does now. *Durra*, which is now extensively diffused in North Africa, has been derived either from Nubia or Western Asia.

India, as we see from the writings of antiquity, had then, as now, *rice* for the principal article of food; the plantain grew there likewise, probably also the yam.

It must be assumed that *sago* grew then in the *Indian Archipelago*, since it occurs wild there at present.

Before the discovery of *America*, the principal material for bread in this part of the globe was *maize*, also *cassava*, possibly *yams* (a different species from the Indian), and *potatoes* and *quinoa* upon the mountains. The vast national migrations from Asia towards Europe, which took place in the middle ages, appeared to have merely caused one change, the penetration of rye into Northern Europe, and its gradual displacement of the oat.

The great conquests of the Arabs in North Africa, Spain, Sicily, and other lands of the Mediterranean, brought rice from India, first to Egypt, and afterwards to the south of Europe; they brought also the plantain from India to Western Asia, Egypt, and Barbary; by them was the durra, or, as they called it, the Moorish millet, diffused over the countries of the Mediterranean, especially North Africa and Portugal.

The discovery of the road to India, southward of Africa, caused a far greater revolution, but above all the discovery of America.

Maize was introduced from America, and became diffused with extraordinary rapidity over all the Mediterranean countries, some parts of Central Europe, nay, it even found its way to China and Japan, and into the interior of Africa. The potato became known much more slowly through Northern Europe and Northern Asia. Cassava was brought from America to the tropical regions of Africa and Asia.

In return for these great gifts, America obtained the supposed European grains, which the colonists diffused and continue to diffuse in North America, the temperate parts of South America, and over those elevated regions within the tropics which have a temperate climate.

Brazil, Carolina, and other regions, thus obtained rice, which at present constitutes so important an article of cultivation there. America also acquired the plantain; some, however, believe that one species of plantain is a native of America.

The European colonists also conveyed wheat and other European grains to the Cape Colony, and, after the colonisation of New Holland and Van Dieman's Land, to the temperate regions there.

In respect to changes on a smaller scale, it is remarkable how rye has been gradually displaced by wheat in the north of Europe, just as at an earlier period the former displaced oats. In the period 1651-1675, the wheat exported from Dantzic bore to the rye which was exported thence the proportion of one to three; in the period 1801-1825, the proportion was exactly reversed, namely, three to one. In the year 1758 it was calculated that not quite two-thirds of the population of England and Wales lived upon wheat; the rest upon rye, barley, and oats. At present not one-eighth live upon the last. In the year 1727, a small wheat-field near Edinburgh was regarded as a rarity in Scotland; since 1780 the product of wheat in Scotland has increased tenfold. At that time wheaten bread was seen only at the tables of the richer classes; at present, not only on that of the middle classes, but that of poorer people of the towns, and, in fact, of the country. In Denmark also the cultivation and the use of wheat has increased; and indeed a time may come when the use of rye and that of wheat will stand in a totally different proportion from the present; nay, it is even probable that Denmark will, at a remote future period, pass from the zone of rye into that of wheat.

It would be interesting to have a complete summary of the *production of bread-plants*, and of the *trade* carried on with them; but from want of sufficient statistical data, I must confine myself to a few *observations* respecting the *production* of, and trade in corn.

While in antiquity, Sicily and all Barbary were the great granaries, these must now be chiefly sought in Northern Europe.

The plains lying to the south and south-east of the Baltic are especially adapted for the cultivation of grain, by the constitution of the soil and the comparatively warm and dry summer. Hence the most important granaries for a great portion of Europe are here. One of the most important cities on the Baltic for the export of corn is Dantzic. Lying at the mouth of the Weichsel, which, with its tributaries, especially the Berg, flows through fertile corn-plains, the city receives the grain by water communication, in flat-bottomed boats. According to an average of twenty-five years, 1801-1825, 535,000 tons—namely, 400,000 tons of wheat and 135,000 tons of rye—were exported annually; but in the three years 1829-1831, 559,000 tons of wheat and 117,000 tons of rye, making together 676,000 tons. In particular years, when the conjunctures were favourable, especially when the English corn-market was open, the export of corn has amounted to 1,000,000 tons.*

The other important points for the export of grain, on the Baltic, are Memel, Königsberg, Stettin, Riga, and St. Petersburgh.

According to an average of six years (1830 and 1836-1840), the total export of corn from Russia amounts to 4,500,000 tons; if we deduct from this about half a million for Archangel, one million for Odessa, and half a million for the other export towns on the Black Sea, the export from Riga and St. Petersburgh amounts to about 2,500,000 tons. The export from Königsberg, Memel, Stettin, and Rostock, I do not know accurately, but they may be set at 1,000,000 or 1,500,000 tons. Consequently 4,000,000 or 4,500,000 tons are exported from the countries on the south and south-east of the Baltic. Although Archangel lies in the White Sea and near to the northern boundary of the cultivation of corn, it has still a considerable export, which amounted to 400,000 tons, according to an average of the years 1827-1832. The river Dwina connects this city with a large tract of country rich in grain. Here, however, as might be expected, the export consists almost wholly of rye and oats.

The export of corn from Denmark is very considerable.

* As the commercial intercourse of the last few years cannot, for many reasons, be considered as natural, we have used in this, as in several succeeding essays, the results of earlier years.

According to statistical tables, the average of twenty years (1820-1839) gives a surplus of 1,354,808 tons, exported from the entire kingdom of Denmark;* in the year 1839 the surplus amounted even to 1,850,357 tons. The export of corn in ground and baked condition has increased of late years; in the four years 1820-1823, only 3406 tons of wheat-flour were exported, and no bread; in the four years 1836-1839, on the contrary, 62,646 tons of wheat-flour, and 38,271 of bread.

The export from the ports of the Baltic, from Archangel, and from Denmark, provide for the deficiency of grain in the Scandinavian peninsula, especially in Norway. A portion goes to England, some to Holland, Belgium, and France, some even to South America.

The second great granary of Europe lies in the south-west of Russia, which is inclined towards the Black Sea, and traversed by the rivers Dnieper and Dniester; in particular, Volhynia and the formerly Polish provinces. Odessa is the most important place of export for this great production of grain; on an average more than a million tons of wheat are annually exported; but only a small quantity of other kinds of grain. The wheat of the Black Sea goes to Turkey, Greece, Italy, and Spain, and moreover to England also.

A third corn country of importance is Egypt, whence wheat is in like manner conveyed chiefly to the ports of Southern Europe.

Those portions of North America which lie within the corn-limits, also export grain. Canada sends wheat to England; the United States of North America export wheat and maize, principally in the shape of flour, especially to the West Indies and South America, the most important places of export being New York, Philadelphia, New Orleans, and Baltimore. Carolina furnishes much rice to Europe and South America.

Brazil exports rice; and Southern Chili, as also the Cape Colonies, wheat.

A mutually important rice-trade subsists between the two Indian peninsulas, China and the Indian Archipelago.

In several countries the false politico-economical dogmas,

* Buckwheat, peas, vetches, rape and linseed, which are included in the tables among the grains, are deducted here.

as regards the corn-trade, have been gradually discarded, according to which it was considered advisable sometimes to forbid the export of grain, sometimes to allow it, and to alter the tax upon foreign corn according to circumstances. Political economists have drawn attention to the evils of that system. Manufacturers and other industrial classes were compelled to pay an extravagant price for the first necessaries of life; the sale of manufactured goods and colonial wares was diminished, because foreign agricultural nations were not allowed to give their corn in exchange; and through the great instability of the corn-trade which necessarily resulted from the system, both the provision for the country was rendered less secure, and the price of foreign corn raised much higher than it would be under a steady market, on which producers and merchants could calculate.

CHAPTER XVII.

THE GEOGRAPHICAL DISTRIBUTION OF THE MOST IMPORTANT ORNAMENTAL PLANTS.

An answer to the inquiry where the most important ornamental plants have their home, to what regions we especially owe the brilliant flowers and elegant plants which decorate our gardens, our rooms, and our conservatories, must be of some interest, more particularly when we reflect that these questions stand in connexion with the general history of civilisation.

Northern Europe, where the art of gardening has risen to a greater height, and horticulture is more extensively diffused than elsewhere, does not, from the unstable, usually damp climate and severe winter, afford a great abundance of wild plants distinguished by splendour of colour or elegance of form; and since, at the same time, foreign objects are usually more attractive than those which we have at home, no great number of our cultivated flowers and ornamental plants have been derived from our own meadows, fields, or woods. A few, however, have found their way into the flower-bed, as the daisy, the violet, the pansy, the lily-of-the-valley, the rocket, the forget-me-not, the primrose, the hepatica, and the maiden pink. The snow-ball (*Viburnum opulus*), which occurs frequently in our woods, has become a favourite shrub in our gardens, from the peculiarity that all the corollas of its inflorescence may become barren, so as to form the pretty white globular bunches, known by the name of snow-balls. Many of our native plants certainly deserve a place in gardens; some of our more showy Boragineous plants, and the beautiful Orchids, might claim especial attention; unfortunately, however, the latter are difficult of cultivation.

The countries which surround the Mediterranean, and form a naturally enclosed basin, have a climate essentially different from that of Northern Europe, and their flora is very different. Winter is particularly mild here, in the southern parts wholly free from frost and snow; while the summer weather is very constant, and at the same time, in the south, almost without rain; the atmosphere is also very clear. A great number of trees retain their leaves in winter, many bulbous plants decorate the fields and meadows, particularly in spring, and numerous aromatic plants, especially of the family of the Labiatæ, fill the air with sweet odours during the dry summer. It was natural that as the taste for floriculture became gradually awakened in the Northern European countries, attention should be turned chiefly to the South, where the intellectual cultivation of mankind was so old, and where horticulture rose to a higher pitch, even in the middle ages, than northward of the Alps. Hence we have, in fact, obtained the greater part of our commonly cultivated ornamental plants from the basin of the Mediterranean. From there have come so many of our summer plants, which are capable of flourishing in our climate, from the fact that their life is limited to the summer, and the cold of winter has no opportunity of affecting them, such as the summer stocks, the mignonette, the adonis, the major convolvulus, the Venus's looking-glass; from there we have obtained a number of bulbous and tuberous plants, the whole vital force of which is concentrated during a portion of the year in the bulb or tuber, and which can therefore lie, during the cold season, in a winter sleep, as it were, during which we keep the bulb or tuber out of the ground. Among these may be named the species of hyacinth and narcissus, crocus and tulip. We, moreover, owe to this part of the globe various perennial plants, which are kept in the house in winter,* and planted out in the summer, such as the wallflower and winter stock; certain shrubby plants which, although they belong to a milder climate, are capable of bearing our winter, such as the lavender and box; and lastly, certain trees, shrubs, and herbs, which grow in orangeries, such as the bay-laurel, the orange and lemon trees, the cypress, the myrtle, the oleander, and the rosemary.

When we ascend to a certain height on the *Alps*, and other mountain-chains which separate Northern from Southern Europe, we meet with the lovely and most characteristic Alpine flora, which affords neither trees nor shrubs, but only

(* It must be borne in mind throughout this essay that the author writes in Denmark. The plants referred to, however, are so well known, that after this note there can scarcely be any misconception.—ED.)

dwarf perennial herbs, with comparatively large flowers of beautiful and pure colours. Few of the flowers of this flora are found in our gardens, and the cause of this is chiefly to be sought in the circumstance that it is so difficult, in the lowlands, to contrive the external conditions under which these plants are met with in their native habitats. For there they are covered with snow for eight or nine months of the year; the air is transparent, yet the summer temperature is low; the soil is composed of the gravel formed by the disintegrated rocks of the Alps, permeated by the snow-water which flows down from the higher peaks. Nevertheless we owe to the Alps our most beautiful spring plants, the auricula, the soldanella, the gentians, &c. Lower down than the Alpine herbs, in the subalpine regions, grow the rhododendrons, and still lower the aconites and the laburnums.

The *Polar flora*, or vegetation of the most northern parts of Europe, agrees very closely with the Alpine flora. For reasons similar to those mentioned in reference to the latter, but few plants of the Polar flora have been included among our garden flowers; *Papaver nudicaule* may be named as an example of them.

Although *Siberia* has a severe climate, this country, from the clear atmosphere which prevails in the interior of large continents, and the comparatively high summer temperature, affords a number of plants with flowers of a considerable size and of the liveliest colours. From there we have the *Papaver bracteatum, Pæonia albiflora, Delphinium grandiflorum, Viola altaica*, &c.

In *China*, and *Japan*, which agrees with it in regard to the country and the people, floriculture has existed from the highest antiquity, and has been brought to a high degree of perfection, although in some respects it has degenerated into trifling. The most important plants which we owe to these countries, are the camellias, the China aster, the hydrangea, the Indian and Chinese chrysanthemums, the China primrose, *Kerria japonica*, the Chinese lilac, &c. As the climate is there considerably warmer than with us, the greater portion of the plants have to be kept in houses.

From the tropical climate of *India*, it follows that we can in general obtain from this luxuriantly gifted country but few plants for our gardens, most of them being suited only for our hot-houses. Among the universally diffused Indian ornamental plants may be mentioned, the balsam, the oleander, and two species of *Canna*. The highlands of India, whence, from its temperate climate, one might expect a number of plants suited to our climate, and which would succeed out of doors with us, have only been recently opened; but already our gardens are decked by many beautiful plants from there, such as *Potentilla formosa* and *atrosanguinea*.

Persia has been renowned from the most ancient times for its flower-gardens; we owe to it the crown imperial, the peach, and the two species of lilac.

The vegetation of *New Holland*, like the animal life of that country, has a highly peculiar character; since, however, the great continent has only recently been investigated botanically, it is only of late that plants from there have become objects of cultivation in European gardens. The greatest number are met with in the English gardens, and they have been diffused thence over the other countries of Europe. The climatal conditions in which these plants are naturally situated, render them only cultivable in conservatories with us. Among the Australian plants, we find especially the trees and shrubs of the myrtle-family, with dry, evergreen leaves (*Eucalyptus*, *Melaleuca*, *Metrosideros*, *Leptospermum*, &c.), then a peculiar group of the genus Acacia, which have a peculiar aspect from the absence of leaves, the place of which is supplied by broad, flat leaf-stalks; moreover, the large family of the Proteaceæ, of which no examples occur wild in Europe, containing trees with dry, leathery, persistent leaves; and the genus *Epacris*, which includes heath-like shrubs.

The *Southern part of Africa* is perhaps the richest region of the earth in regard to vegetation; most of the genera are there extremely rich in species, and much splendour of colour and beauty of form are met with in the flowers. It is the proper home of the succulent plants; there we find the numerous genus *Stapelia*, with strange, juicy stems, the not less rich genus *Mesembryanthemum*, with handsome flowers; species of *Aloe*, *Crassula*, and *Rochea;* further, a great abundance of Liliaceous plants, of the genera *Ixia*, *Gladiolus*, *Agapanthus*, &c.; the many heaths; the genus *Pelargonium*, with manifold species and varieties, and the group of Proteaceæ, which are also met with there as prevailing trees and shrubs.

The climatal similarity between *North America* and Europe gives rise to the conjecture that a great number of the plants of that part of the globe must also be capable of flourishing in the open air with us. We have, in fact, obtained many plants from them, especially trees and bushes for our pleasure-grounds. Among the trees may be named various species of oak and Conifers; the tulip-tree, the acacia, as it is called (*Robinia pseudacacia*, the locust-tree), and the red-flowered robinias; among the shrubs, the genera *Spiræa*, *Kalmia*, *Azalea*, *Calycanthus floridus*, various Compositæ, such as *Rudbeckia*, *Aster*, *Solidago*, and *Coreopsis*.

As the highlands of *Mexico* lie 6000 feet above the sea, the climate is temperate. Hence various Mexican plants bear our climate, at least our summer. Among these are the genera *Pentstemon*, *Zinnia*, *Tagetes*, and the superb *Tigridia*. The dahlia, which was unknown in Europe in the last century, is now one of the most important ornamental plants.

Tropical South America, like Mexico, has only since a recent period furnished Europe with ornamental plants. From thence chiefly we have obtained the Cactus family, which presents itself in such extremely varied and strange forms, like angular columns, snake-like bodies, jointed, flattened, or cylindrical stems, or globular melon-shaped masses, very often bearing splendid flowers. To this part of the world, also, we owe the passion-flower, and various kinds of Amaryllis.

Peru and *Chili*, also, have only recently opened to us their floral treasures. As the highlands have a temperate climate, various plants from these will flourish in our open borders; others require to be kept in houses. To this flora belong the sunflower, *Tropæolum*, *Fuchsia*, *Schizanthus*, *Calceolaria*, and *Salpiglossis*.

California, again, and the countries of the river Columbia, have of late years given us various plants which thrive in the open air, such as several species of *Gilia*, *Collomia*, *Lupinus*, *Pentstemon*, the beautiful *Ribes sanguineum*, and several species of pine remarkable for the height they attain.

When we survey the geographical distribution of the ornamental plants, it becomes evident, that while similarity or approximation of the climate to ours plays, indeed, an important part, especially in regard to the plants thriving in the open air, at the same time geographical discovery, and earlier or later colonisation and civilisation of distant parts of the globe, have great influence. This is particularly seen when we pay attention at the same time to the periods at which the various plants have been introduced into European gardens. The oldest of our ornamental plants have been obtained from the northern and southern parts of Europe. The sphere was afterwards extended to the Chinese, Indian, and South African plants; next to the North American; then to the Australian, Mexican, and Peruvian; and, lastly, to those of Brazil, Chili, and California.

In this manner have the different parts of the earth's surface gradually opened their treasures to us. Variety has constantly increased in our gardens, which have constantly approached nearer to a collection of the most beautiful objects which earth produces in the vegetable kingdom.

Formerly, the introduction of ornamental plants was accidental. Diplomatists, merchants, or travellers, who had a taste for horticulture, sent or brought home one or other beautiful plant. Subsequently, travelling botanists undertook this task, especially when they were accompanied by a gardener who could attend to the collection, and to the preservation of what was obtained, for which the observers themselves scarcely had time. In recent times, since horticulture has so increased, and gardeners have possessed scientific education, they have been the chief persons who have undertaken travels with this intent, and they have essentially contributed to multiply the number of ornamental plants in our parterres and pleasure-grounds. Among these there is scarcely one who has done greater service in this respect than the Scotchman, David Douglas. He travelled for the English Horticultural Society, especially in the United States and on the north-west coast of North America, particularly on the Columbia river, whence he introduced, in greater number than any one else, trees, shrubs, and herbs capable of sustaining cold, partly sending, partly bringing them home with him, namely, 53 arborescent and 145 herbaceous plants, making in all, 198. The greater portion of these were wholly new, and since they were able to bear the climate of Europe, they have become extraordinarily diffused, both in the gardens of Great Britain and of the Continent, and they are seldom absent from the smallest. The many new species of *Pentstemon*, *Lupinus*, *Œnothera*, *Gilia*, and *Collomia*, especially deserve mention, and next to them the new and beautiful species of *Ribes*, as well as several kinds of *Pinus*.

After he had done so much in America, he travelled to the Sandwich Islands; but here he fell a sacrifice to his zeal, and perished in a melancholy manner, falling into a pit which had been dug by the natives to catch wild cattle, where a bull, which had already fallen in, attacked and killed him. He was then thirty-six years of age. When we consider the influence the cultivation of flowers exercises in a moral point of view, we may fairly say that this man sacrificed his life as honourably in his calling, as a man who falls on the field of battle. The care of flowers and the cultivation of plants do not merely contribute to the maintenance of health, they soften the passions, and elevate the taste above the affairs of every-day life. In the home around which we see a well-kept garden, internal order almost always prevails; and when there is a flower-stand outside, there is almost always a book-shelf within. He who sacrifices his life in contributing to advance such influences among thousands, confers greater benefit upon the world in general than those who fall by the bullet, and often advance merely ambition and covetousness.

CHAPTER XVIII.

THE COFFEE-TREE.

As in regard to the human race, not only is universal history interesting, but also that of a particular nation, and even of a single individual, if he has played an important part, so perhaps may a biographical treatment, if I may so term it, of the history of particular species of plants prove interesting, and the choice of the coffee-tree be approved of on account of the importance of its influence.

We will therefore make its acquaintance. In Arabia and in Java the coffee-tree attains a height of fifteen or twenty feet; in the West Indies it does not grow so high, because it is cut, in order that its crown may spread and thus bear a greater quantity of fruit, at the same time more accessible. The shoots are opposite, the leaves the same; they somewhat resemble those of the bay-laurel, and like them are evergreen. The white and sweet-scented flowers seated on short stalks are crowded in the axils of the leaves. When the coffee-tree is in blossom, it looks as if covered with snow, an aspect which must surpass that of our flowering fruit-trees. After the blossom, appears a red fruit, a kind of berry, which resembles the cherry in colour and form; the pulpy mass encloses two seeds, which are convex on one side and flat on the other; these we call the coffee-*beans*, an unsuitable name, since the fruit is not in a pod. The coffee-tree bears in the second year, but the proper crop does not arrive until the fourth or fifth year. To make it thrive it requires a warm climate; it will not grow when the mean temperature is below 68° to 70° Fahr., and the thermometer must not fall below 55°. Nevertheless it will not bear too strong a heat; in regions which have such a climate it will only flourish under the shade of other trees. It requires also abundance of rain or artificial watering. From these conditions of temperature and humidity, it may be concluded that the coffee-tree can only flourish within the tropics, or at most up to 30°, and that in this zone it succeeds but on the hills, and not in the flat coast regions.

The northern part of the Arabian peninsula has for the most part a dry sandy soil, a very hot and almost rainless climate; this is true of the southern coast border, turned toward the Red Sea; but at some distance from the sea, in the most southern part of the peninsula, there rises a considerable chain of mountains, with a cooler climate, abundance of rain, and a rich vegetation. Here, in Yemen or Arabia Felix, was long exclusively sought the home of the coffee-tree. Now it is known, that it not only occurs as a cultivated tree in Abyssinia, but that it is found both cultivated and wild in the woods in the countries south of Abyssinia, Enarea, and Caffa. On the other hand, it is probable that it is not indigenous in Arabia, but has been introduced from that African habitat. It goes as far towards the equator as our knowledge of the country extends, and northward it appears cultivated on the Lake Tsana, about 12°; in Arabia, as far as the 18°—20° N. L.

The history of many discoveries is enveloped in obscurity. Fabulous narratives readily take the place of actual facts. Among them must we reckon the following tale of the cause of the first use of the coffee-bean: The superior of a Mohamedan monastery had observed that the goats became very wakeful, jumping and skipping at night, after they had eaten this fruit; this led him to prepare a drink from the fruit, in order to keep himself and his dervises awake, when they had to pass the whole night in performing services in the temple.

That the use of coffee dates only from a recent period, is certain. The ancient Greek and Roman writers are quite silent regarding this beverage. An Arabian manuscript in the Paris library, written by Abdalcader toward the close of the sixteenth century, and published by the Oriental scholar Galland, places the first general use of coffee in Yemen no further back than about the middle of the fifteenth century; that is to say, only 400 years from our own epoch. The legend is related by the Arabian author in the following manner: In Aden, on the south coast of Arabia, lived a Mufti, named Gemaledin; on a journey to Aden, on the west coast of the Red Sea, he met with some of his countrymen, who used coffee as a beverage; on his return, it struck him that this might perhaps conduce to his health. Experiment convinced him that it was a good means of clearing the head and preventing sleep, and he therefore recommended it to the dervises who had to keep vigils; these and others soon found that it was a good day-drink also. Coffee thus became general in Aden, it spread from there over the rest of Arabia, and reached Mecca about the end of the same (15th) century. Here we have not, indeed, the epoch of the first use of coffee, but that of its general use in Arabia.

At the commencement of the sixteenth century (1511) the Sultan of Egypt named a new governor of Mecca. The latter, who was not acquainted with coffee, was greatly angered at finding some dervises in a great mosque, sitting in a corner and drinking coffee. He drove them out of the temple, and called a council of theologians, jurisconsults, and the most distinguished men of the city. The matter was argued at great length; one of those present made the assembly laugh, by declaring that coffee intoxicated as much as wine: thereby confessing that he had tasted the forbidden beverage, and he was punished for this crime by the bastinado, as prescribed by law. The council, being unable to come to an agreement, had recourse to the physicians. The governor called in two Persian doctors, who declared that coffee was injurious to health, upon which the council condemned it. It was forbidden to sell this beverage, all stores of it were burnt, and those who were convicted of having drunk coffee were led round the city sitting upon asses. Nevertheless the prohibition was soon withdrawn, for the Sultan at Cairo was himself a good coffee-drinker, and his most learned men declared it both harmless and permissible. Through this victory coffee became still more widely known and diffused.

Twenty years later, however, a zealot of Cairo, where the use of coffee had become quite general, took it into his head to preach violently against it; he declared that those who drank coffee were not good Mussulmans. His hearers were so excited by this, that when they came out of the temple, they hastened to the coffee-houses, broke the cups and tables, and ill-used the guests. The city became divided into two parties, and the matter began to grow serious. But the chief judge of the city called together the wise men, who declared with one voice that it had been long settled that coffee was both permissible and useful. The president then treated them all with coffee, taking the first cup himself. This new victory still further diffused the name and the celebrity of the beverage.

In the first half of the sixteenth century the use of coffee spread to Aleppo, Damascus, and various cities, and in the middle of the same century it reached Constantinople. Two private persons here opened, in 1554, an establishment with convenient couches, where coffee was served, and where the visitors might converse and play chess. A Turkish poet wrote a sonnet in praise of coffee. But as the number of coffee-houses increased greatly, the priests began to complain that these were more frequented than the mosques. The mufti declared that the beverage was opposed to the Koran, and therefore all the coffee-houses were closed. But a new mufti declared in favour of coffee; and the priesthood, the court, and the city, soon followed his example. After that, the coffee-houses were indeed occasionally closed on political grounds, as it was found that people had too good opportunity of gossiping about the sultan's undertakings; but this prohibition only extended to the metropolis, and did not there affect the drinking of coffee in private houses. Its use spread more and more; coffee was offered to every guest, and as among us the people are accustomed to receive drink-money, the Turks in like manner had their coffee-money; in large houses an especial servant was appointed to prepare and serve coffee; nay, there existed a Turkish law, that if a man refused his wife coffee, she had a legal ground for separation.

Thus was the custom of drinking coffee established in the seventeenth century, in the Levant and Egypt, about 150 years after its commencement in Arabia.

Previous to the middle of the seventeenth century, very little was known of coffee in Europe (excepting in Turkey). Prosper Alpin, a botanist of Padua, who was in Egypt towards the end of the sixteenth century, speaks of this beverage as general there, but unknown in Europe; his second edition, published under the direction of Vesling, speaks of coffee as a medicinal agent, rare in Europe. It is not improbable that it came first to Venice. A letter is extant of Pietro della Valle, from Constantinople, in which he says (1615) that he intends to bring some coffee with him when he returns to Italy. In 1663 some merchants, returning home from the Levant to Marseilles, brought some coffee-beans with them, and exhibited them and the utensils used in preparing them as a rarity; somewhat later, the drinking of coffee began to make its appearance there in the houses of the mercantile people, and in 1671 a coffee-house was opened. The first who brought coffee to England was also a merchant returning from Smyrna, who had brought a Greek girl with him to prepare his coffee; she married his coachman, and this couple opened the first coffee-house in London. In Paris, coffee came more particularly into use after the ambassador of the Sultan Mahommed IV. had resided there a long time, and had entertained the court with the new beverage. The first coffee-house in Paris was opened in 1672. In Marseilles, where, as already mentioned, coffee had come somewhat earlier into use through the merchants returning from Smyrna, it had still a contest to maintain. The physicians were disquieted by the diffusion of this beverage, which they regarded as injurious; they resolved to make it the subject of a public disputation. By a programme, which still exists, an invitation called disputants to the contest in the town-hall, and this programme had the tone of a declaration of war; but this was just as little able to banish the use of coffee as the attack of the Mohamedan zealots. Yet we see that the arguments of the defenders of coffee were not always of the soundest, for the manifesto confuted those who had urged as a proof that coffee was a good beverage, that it was called *bon* in Turkey, and that it came from Arabia *Felix*.

Coffee came into Denmark at a somewhat later period. That coffee was unknown in Denmark at the beginning of the seventeenth century, is seen from the work of the celebrated Bartholin, "De Pharmacopeia Danica," 1665. In this it is said: "Coffee has very rapidly seized upon the courts of Europe, not exactly because it is well-flavoured, but because it is something new; it is said to give a good appetite, and to prevent sleep. Thus we have here an opportunity of confirming Seneca's words: 'Foolishness readily causes trouble, while truth advances slowly and observes moderation.'"

The constantly increasing consumption of coffee in Europe increased the production in Arabia, especially when, at the beginning of the eighteenth century, the trade-route over Egypt to Marseilles was found insufficient, and vessels went round the Cape of Good Hope to Arabia itself. It was natural that men should then think of transplanting the precious tree to other countries. The Dutch governor, Hoorn, had plants brought to Batavia; but the cultivation of coffee does not seem to have commenced there until somewhat later (1723). He also sent, in 1713, several trees to the Burgomaster Wetsen of Amsterdam, and a year after one came to Paris from there. Here several plants were raised from seed, and not much later, namely, in 1717, Déclieux conveyed one of them to Martinique. The voyage across was difficult and tedious; they suffered from want of water; but Déclieux was sparing of his own store of water, in order to be able to water his young coffee-tree. It is asserted that all the coffee-trees of the West Indies and Brazils have been derived from this plant; and if this is true, the greater part of the enormous quantity of coffee which is now used in Europe has been derived from one single tree raised in a botanical garden. From Martinique the coffee-tree spread to St. Domingo and the other West India Islands, as also to Surinam; while the Isle of Bourbon and the Mauritius had obtained the coffee-tree direct from Arabia in 1718. St. Domingo long remained the chief seat of the American coffee-culture. In Necker's time this island exported 76,000,000 lbs.; this is several times as much as Arabia at any time exported; but the insurrection of the negroes very much diminished this flourishing off-shoot; the white planters took refuge in Cuba, Jamaica, and on the mainland of America. These countries, in which the cultivation of coffee first commenced towards the close of the last century, now produce an extraordinary quantity. Brazil has subsequently applied itself to this; the coffee-tree is here rapidly increasing, and Rio Janeiro has become a powerful competitor in the coffee-trade.

The annual consumption of coffee in Europe may be stated at present at 250,000,000 lbs. To 50,000,000 for North America must be added the consumption in the East, North Africa, and the countries which themselves produce coffee, and thus the total amount will not be set too high if we estimate it at 400,000,000 lbs. A little more than a hundred years ago, all coffee was fetched from Arabia, and the entire consumption amounted to about 10,000,000 lbs. or 12,000,000 lbs. In this degree, therefore, has increased the use of a beverage which two hundred years ago was unknown in Europe. What an alteration in the modes of life, in commerce and in navigation, and what changes in the civilisation of those countries which have successively appeared as producers of coffee! But the greatest increase of the use of coffee is a character peculiarly of the most recent times, for in 1820 the consumption of coffee in Europe amounted to only 140,000,000 lbs.

It would be interesting to know how the said quantity of 250,000,000 lbs. is distributed among the different nations of Europe; a map, with the countries marked with a particular colour, where coffee is drunk, and which indicated by shades the greater or less consumption, would show us at a glance which nations are the greatest coffee-drinkers, which drink only a little or none at all; but we have not sufficient material for such a survey. It would require to be made in one and the same year for all Europe, since different countries exhibit great revolutions in the consumption of coffee within short periods. In no country is this more the case than in the British Islands; up to 1808, the English drank scarcely any coffee; the entire consumption amounted only to 1,000,000 lbs., only one-third of what is now used in Denmark. From 1809 to 1820, it had increased to 7,000,000 lbs. or 8,000,000 lbs., and at the same time Paris alone consumed 5,000,000 lbs.; but in 1832, the consumption had risen to 22,000,000 lbs., that is to say, three times as much as in 1820, and twenty-two times as much as before the year 1809. In Denmark also the consumption has increased. Pontoppidan, in his Economic Balance of Denmark, estimated, in 1759, the annual consumption of coffee at about 500,000 lbs., and he included the whole of the agricultural population among those who drank no coffee. In the years 1824-1828, the amount upon which duty was levied for home use in the kingdom, amounted on an average to 1,500,000 lbs.; in 1829-1833, 2,500,000 lbs.; in 1834-1838, 3,330,000 lbs.; in 1839-1841, 3,600,000 lbs.

The Danes drink more coffee than the English, for in Denmark the consumption is at the rate of 3 lbs. for each person; in England (1832), only 1 lb. per head. In the German Customs Union (where the duty is much higher), 2 lbs. In Sweden, only 1½ lb. is consumed for each person.

If we inquire the principal cause of the great increase of the consumption of coffee, we find it undoubtedly in the great diminution of the price since 1818-1820. Humboldt estimated the 140,000,000 lbs. consumed in Europe in 1820, at about 6,000,000*l.*; if the 250,000,000 lbs. which are now consumed are estimated at 6d. per pound, we shall only get 6,250,000*l.*; and if the pound is estimated at 8d., only 8,333,333*l.* Europe, therefore, obtains much more for the same sum than at that time; when we compare the price, we see that it was, for example, in England, almost twice as high in 1820 as at present; in 1818 it was still higher; and in 1828, on the contrary, lower than at present. It has been found by experience, especially in England, that diminution of the tax upon coffee increased the consumption to such a degree, that the actual receipts of duty were even considerably increased. Before 1808 the duty was three times as high as at present; at that time the consumption amounted only to 1,000,000 lbs.; in the years 1809-1820, it averaged, as already mentioned, about 7,000,000 lbs. It must not be overlooked, it is true, that the reduction of the duty lessened the quantity introduced contraband, and that part of the increase which tax-tables give is no real increase of consumption of coffee; but it will readily be admitted, that there was not smuggled in before 1808 six times as much as then paid duty there. That it is chiefly the consumption which becomes increased, is seen from the fact that the increase did not merely occur in the first and succeeding years after the lowering of the duty, but that the consumption has only increased gradually in subsequent years. In Denmark, also, it has been proved that the diminution of the tax increases the consumption. Toward the end of the year 1830, the tax on coffee was lowered from 6½d. to 3d. The statements given above show the influence of this reduction.

While the lowering of the price produces an increase of consumption, the consumption does not decrease if the price subsequently rises, it being understood that this elevation of price be not too great, or occur too suddenly. It will readily be understood, that when coffee has come into use, the consumers do not give it up if the price should become a little raised.

The reason why the price of coffee has so considerably diminished since 1820, lies evidently above all in the increased production; and especially in the greatly increased product of Brazil, which has come forward as a stronger competitor.

With regard to the producing countries, the West Indies export the greatest quantity, namely, 100,000,000 lbs.; St. Domingo, 30,000,000 lbs.; Cuba, 28,000,000 lbs.; then follows Brazil and the rest of the continent of South America, with 64,000,000 lbs.; next Java, with 38,000,000 lbs.; and Arabia, with 24,000,000 lbs. The remaining places furnish but little compared with these.

The great mobility and changeableness of the producing countries, the amount of product, the consumption, and the price, must certainly be the cause of great calamities to individual traders, to individual mercantile cities, and to the planters of particular countries. In this way, all those who are interested in the Java coffee-plantations have suffered greatly from the lower price of the Brazil coffee, although the latter is certainly inferior. But it is equally certain that the coffee-trade, as a whole, must increase in compass; for as the price sinks, the consumption increases; the increased consumption then causes the price to rise, and the consumers, once secured, as already observed, are not lost to the trade when the price becomes higher. To acquire conviction of the fact that the trade must gain, on the whole, by the extended production and the increased consumption, it is simply requisite to look back to the coffee-trade a hundred years ago, when it was carried on with a few ships which brought coffee from Egypt and the Levant to Marseilles, and to compare this with the present condition of this branch of commerce. That the consumption of coffee will increase further, is more than probable. We have seen that 3 lbs. per head are used in Denmark. But since few would content themselves with this quantity, and since we must wish that as many as possible of our fellow-citizens should get as much as we do, it is clear there is full scope, a wide margin, at all events for wishes.

But when we reflect that Denmark now consumes about 80,000*l.* worth of coffee, perhaps the adherents of the old school of political economy, which regards it as a misfortune for a country to pay away so much money for foreign goods, might be a little disturbed. Yet this fear is groundless. We do not obtain our coffee from foreigners *for nothing;* but there is no danger of the foreigners emptying our gold and silver mines. Our gold and silver mines are grain and oily and fatty substances, and the more we can sell of these the better. If our people can so increase and improve their grain and fatty products as to place the country in a position to buy more coffee, we will gladly allow them this as a payment for their greater industry.

If we could represent by a map that condition, which I would call the movement of the production, consumption, and trade of coffee, it would present itself as a great current from America, another, smaller however, from Arabia and Java, towards Europe, currents which here divide constantly into finer branches from the great commercial cities to the smaller, from these to the villages, and in even smaller offshoots towards the hamlets and houses, not unlike the current of the blood which ramifies into all parts of the body. By this increasing ramification, the influx from the sources is especially increased, and this increase calls new sources into existence, which enlarge the stream. For example, the fact of the peasantry having begun to drink coffee, has contributed to render new land productive by the cultivation of coffee, in Brazil, and to enable new families to establish themselves there. The increased production thus diminishes the price of coffee, and the lower price brings new coffee-drinkers; thus the influx of coffee increases, and thereby the production. A reduction of the duty may be regarded as the opening of a new sluice for the stream to pass through.

Lastly, could we obtain a general view of the influence which the use of coffee as a beverage has had in diminishing the consumption of spirits, an influence which perhaps exceeds that which the Temperance unions have had, and could we, as we have done with the quantity and the price, collect into one sum all the cheerful moments which this beverage has procured, astonishment would also be excited in this respect. But it is a biography, and not an eulogy, which we promised to deliver here; the age of eulogies, moreover, has happily passed by.

(NOTE.—The following additional particulars in reference to the statistics of coffee are taken from a paper read before the Statistical Society of London, January, 1852, by Mr. Crawford.

Probable amount of Coffee produced at the present time.

Brazil	176,000,000 lbs.
Java	124,000,000 —
Philippine Islands	3,000,000 —
Celebes	1,000,000 —
Arabia	3,000,000 —
Cuba and Porto Rico	30,000,000 —
Laguaira and Porta Cabella	35,000,000 —
British West Indies	8,000,000 —
French and Dutch West Indies	2,000,000 —
Malabar and Mysore	5,000,000 —
St. Domingo	35,000,000 —
Ceylon	40,000,000 —
Sumatra	5,000,000 —
Costa Rica	9,000,000 —
Total	476,000,000 lbs.

476,000,000 lbs. estimated at 2*l.* 10s. per cwt. in Europe would exceed 10,000,000*l.* in value, and supposing 300,000,000 lbs. only to be subject to a duty of 3d. per lb., it would yield a revenue of 3,700,000*l.* to the various governments of Europe, with a prime cost to the consumer of 13,700,000*l.*; while the additional expenses of transport, and wholesale and retail profit, would raise the actual price paid by the consumer to 20,000,000*l.* per annum.

In 1850 the consumption in Great Britain amounted to 31,226,840 lbs., or 1·13 lb. per head of the population of Great Britain and Ireland; less than half that of tea. In North America the quantity of coffee consumed is four times that of tea. 3,000,000*l.* is paid annually for coffee in Great Britain. The use of chicory with coffee, which is extensively adopted on the Continent, does not lessen the consumption. The consumption of coffee is declining at present in England, preference being given to tea, which is moreover found more economical.—ED.)

CHAPTER XIX.

THE SUGAR-CANE.

The attention we have directed in the foregoing chapter to the history of the coffee-plant, has afforded us an opportunity of seeing how the spread of a plant which yields a product useful to man makes itself felt in trade and daily life. We have a still more remarkable example of this in the sugar-cane, the use of which is still more extensive than that of coffee, and the history of which is connected with some of the most notable occurrences in the history of mankind.

Among all the various groups of plants none is so important to man as that of the grasses. To this belong the northern grains, which furnish the inhabitants of the temperate zone with their bread and the most important articles of vegetable food, as also with beer and spirits. Rice and maize also belong to it, the plants which yield the most important articles of food and strong drinks in the torrid zone. The food of domestic animals is chiefly furnished by grasses, and in this way they constitute also the basis of cattle-feeding as they do of agriculture.

The *Sugar-cane* likewise belongs to this family, of so much importance to man. Like the other kinds of grasses it has a halm, composed of *joints*, but it is one of the largest species of this family, since the cane may grow from six to ten feet high and from one to four inches diameter. The leaves, as is usual among the grasses, are very narrow and long, and are distinguishable in this species by a longitudinal white streak. The flowers grow in a spreading panicle, as in the oat; they are formed simply of green membranous scales, but are clothed with long, fine, and silky hair.

In its *existing* distribution the cultivation of the sugar-cane is at home in the torrid zone, but in China it goes to about 30° N. L., and in North America as far as 32°; in Africa, if we include a few plantations in Madeira and Egypt, in like manner as far as 32°; and if we determine the north limit according to its occurrence in single gardens in Spain and Sicily, it will here lie at 37°—38°. In the southern hemisphere the cultivation of sugar scarcely goes further than to the tropic, for the Cape, Australia, and Buenos Ayres, produce no sugar.

Within the tropics the sugar-cane is cultivated in all four quarters of the globe. In America it occurs at a considerable height above the sea, namely, up to 4000 feet, and indeed, in particular places, under favourable circumstances, even over 6000 feet, especially on the elevated plateaux of Mexico. In Nepal it extends up to 4500 feet. The cane thrives best in a mean temperature of 77°—84° Fah., but it succeeds even at 66°—68°.

The ancient Greeks and Romans were unacquainted with the general use of sugar. According to Pliny, *saccharum* was produced in India and Arabia Felix, and was a kind of honey, which collected on canes, was white, like honey, crumbled between the teeth, the largest pieces being of the size of a hazelnut; it was used in medicine. As this seems to refer to a juice which crystallised in or upon canes, some have thought that *tabasheer* was meant, this substance sometimes occurring crystallised in the joints of the bamboo-cane. The accounts of other authors, Lucan, Seneca, Eratosthenes, Strabo, and Dioscorides, are imperfect, but can be better referred to cane-sugar, and Pliny's account may easily have been incorrect. But if cane-sugar was really meant, it is evident that it was little known, or only as a medicinal substance to the Greeks and Romans. On the other hand, the use of sugar appears to be of the greatest antiquity in China; perhaps this is true also of India: Cochin China and India are the countries usually cited as the native homes of the sugar-cane, as the countries in which it is found wild; nevertheless, a recent work (Roxburgh's "Flora Indica") states, "where it grows wild in the East Indies, is unknown to me." It is unknown when it came from India to Arabia, but it spread itself by this path over the west. The conquests of the Arabs caused the extension of the cultivation of the sugar-cane, in the ninth century, to Rhodes, Cyprus, Crete, and Sicily—nay, even to Calabria and Spain. The Crusades also contributed to increase the acquaintance of Europeans with sugar, and by degrees the most important commercial people of that time, the Venetians and Amalfians, began to import sugar, chiefly from Egypt, into Western Europe. Prince Henry the Navigator carried the sugar-cane from Sicily to Madeira; toward the end of the fifteenth and the commencement of the sixteenth century it was conveyed to the Canary Isles, where plantations were established, especially on Gran Canaria. The cultivation of sugar became even very considerable in those islands, and was carried on there at that time with negro slaves. But very soon afterwards, at the commencement of the sixteenth century, the sugar-cane had been brought to St. Domingo, and the cultivation of sugar there was before long found so much more profitable, that it gradually diminished in the Canaries, Madeira, Spain, Calabria, Sicily, and the Greek Islands, and finally ceased. In the sixteenth and seventeenth centuries the culture of sugar spread to Cuba and the rest of the West India Islands, and was one of the most important causes of the extensive trade in the negroes of Africa; it also became diffused over the continent of America, Mexico, Brazil, and Guiana. These parts of the continent now present themselves as competitors, and probably will hereafter obtain a preponderance over the islands, because the soil is less exhausted, labour and fuel are cheaper, population is greater, and capital is present in greater abundance; the cultivation of sugar will therefore migrate still further toward the west. That which at present keeps back the competition is the want of good machinery and canals, a want which time can satisfy. A circumstance which greatly furthers the increase of sugar cultivation is the fact that the sugar-cane gives a greater profit on the same area than most other agricultural products. The proportion between it and wheat is as eight to one; but it must not be overlooked that the cost of establishing and maintaining a sugar-plantation and the preparation of the sugar, is very much greater. All the sugar which France used in 1804 might have been grown on an area of seven square leagues. In Louisiana and Florida the cultivation of sugar has also greatly increased, through which the slave-trade has become very active there, and it has caused the people of Virginia and Carolina to provide themselves with more negroes, like any other "domestic cattle," for the purpose of sending to those more southern provinces, where, however, many fall victims to the unhealthy climate. In the East Indies, where the cultivation of sugar is old, it has nevertheless only begun to increase considerably of late years; but it will perhaps go on enlarging there, because the price of labour is small compared with that which is subject to the cost of purchase and maintenance of negroes.

The cultivation of sugar has spread in the South Sea Islands, especially in Tahiti. The sugar-cane growing wild in Tahiti is somewhat different from the ordinary plant; it was brought by Bougainville and Bligh from Tahiti to the Antilles, where it is now generally cultivated.

In the years 1828—1830, the average annual exports were: from the West Indies, 766,000,000 lbs.; from Brazil, 140,000,000 lbs.; from Bengal, Jana, Bourbon, 60,000,000 lbs.; Mauritius, 50,000,000 lbs.; making together, 1,016,000,000 lbs. Of this, 70,000,000 lbs. go to North America, so that about 950,000,000 lbs. come to Europe.

The European country using most sugar is Great Britain. In 1840, 360,000,000 lbs. were consumed there, which gives more than 20 lbs. of sugar for every consumer. This great consumption depends upon the general welfare and the better condition in which the lower classes stand. The consumption has greatly increased during the last century, although not in the same proportion as that of coffee.

In the year 1700, it amounted to 20,000,000 lbs.; in 1782, to 155,000,000 lbs.; in the year 1828, to 352,000,000 lbs.

Before 1700 very little sugar was used; it was an article which only made its appearance on the tables of the great. Its use was greatly increased as tea gradually became a general beverage in England. The consumption would certainly be still greater in England, if the duty were lower.

The consumption in France is much smaller, being only 7½ lbs. of sugar, of which 2½ lbs. are beet-sugar, per head;* Russia consumes the smallest quantity, among the European States.

According to an average of the years 1832-1838, the annual consumption in Denmark (excluding the duchies) is

* Humboldt, Voyage xii. (1828), assumes the consumption of raw sugar in France at 56,000,000 or 60,000,000 kilogrammes, and the number of inhabitants as 30,000,000; this gives about 4 lbs. of sugar for each person. According to the "*Nouvelles Annales des Voyages*," June, 1834, the consumption amounted to 80,000,000 kilogrammes, or 160,000,000 lbs., in 1821, the proportion of which to 32,000,000 of inhabitants makes 5 lbs. for each person. Under Henry IV. the use of sugar was so rare in France that it was sold by the ounce by apothecaries.

9,000,000 lbs., which divided by the population, gives 7½ lbs. for each person.

In the German Customs Union, the consumption is estimated at 5 lbs.; in the whole of Germany, at 6 lbs.; in Norway and Sweden, at only 3½ lbs.; in the Austrian States and in Russia, at 1½ lbs. per head.

It is well known that sugar may be prepared from many other plants besides the sugar-cane. But there are only two of sufficient importance to deserve mention here; they have acquired an increased interest through two attempts to oppose the use of cane-sugar, which derived their origin from most diverse motives; one decidedly from philanthropic considerations, the other had its chief cause in ambition. The Quakers of North America found it opposed to their consciences to use sugar produced by means of slaves, because in this way they indirectly contributed to maintain and increase slavery and the slave-trade. They found a substitute in the sap of the sugar-maple (*Acer saccharinum*), a North American tree, which, like the European birch, contains in spring an abundant store of sweet sap, from which sugar can be prepared by boiling down. Although this is used to a not inconsiderable extent in the North American States, it equals scarcely more than an eighth or a ninth of the consumption of cane-sugar in the whole of North America. When we consider this, and, moreover, that this sap yields only 2½ per cent. of sugar, while the juice of the sugar-cane gives 12 to 16 per cent., it is very evident that it cannot be expected that maple-sugar can ever be dangerous to the trade in cane-sugar, or to its production in those countries where the climate is adapted to it.

When Napoleon formed the gigantic, but neither practicable nor liberal idea, of stopping all intercourse between the continent of Europe and Great Britain, in order to destroy the commerce of that country, it was necessary to look for a substitute for this important colonial product, only to be obtained on the Continent by the help of an open trade. The discovery that sugar might be manufactured from the juice of the beet-root, was therefore, of course, very welcome to him. He made every effort to stimulate the agriculturists to grow this plant; he encouraged the chemists to contrive the best methods of preparing the sugar, and of applying the refining process to it. In 1810 there existed 200 beet-root manufactories, which annually delivered 2,000,000 lbs. of sugar; but still this was only $\frac{1}{58}$ of the consumption in France. After the West Indian sugar could again be introduced, the sale of beet-root sugar decreased; but its production subsequently increased in an extraordinary degree, through improvements in the manufacture and its combination with agricultural systems, and yielded annually about 24,000,000 lbs. It has again decreased in France since a tax has been laid upon beet-root sugar. It has at the same time extended over other European countries, Belgium and Germany.

Negro-slavery, it is well known, has been abolished in the British West Indies; the parliament voted 20,000,000*l.* sterling as a compensation to the planters, and thereby gave a brilliant example of how a nation, as such, can act from motives which lie beyond the sphere of egotism.

The result of emancipation, which is now embraced by the Danish islands also, as is well known, has been more successful than was expected, yet at the same time very different according to the different characters of the islands; more favourable in the highly cultivated than in the mountainous islands, in which the negroes can establish themselves independently more readily than where the land has been taken possession of and they are compelled to take work from the planters. Among the great results were the increased use of draught-oxen, of machinery, and steam, and improvement in the refining. But if the cultivation of sugar should decrease considerably in the West Indies, it will probably increase on the continents of North and South America, where climate and other circumstances facilitate the cultivation of sugar, and where the emancipation will also make its way in the course of time. In no case will Europe be destitute of sugar; at the very worst the price may rise for a time, but certainly only temporarily. But who among us will not gladly pay somewhat more for sugar when we know that this is a contribution towards the abolition of an institution which is a disgrace to humanity—a disgrace to every century that endures it?

CHAPTER XX.

THE VINE.

The two cultivated plants whose geography and history I have just been dealing with, the coffee-tree and the sugar-cane, yield products which belong to the alimentary substances of recent times, for in antiquity they were unknown, and only very little heard of in the middle ages. The vine, the history of which is to be the subject of the present essay, yields us a gift the use of which is as ancient as the oldest historical records, nay more, is connected with the oldest traditions and myths. The use of coffee and sugar, and the sphere of the cultivation of these two plants, have increased in an extraordinary extent in the most recent times, and continue to increase in a greatly advancing proportion; the culture of the vine and the use of wine spread but slowly. The coffee-tree and sugar-cane belong to the torrid zone; the vine to the warmer parts of the temperate zone.

Every one knows this plant; remembers the curved rough stem, the twisted branches, the handsome three or five lobed leaves, the tendrils (which are barren flower-stalks), the inauspicious green flowers, and the beautiful bunches of grapes.

In the most ancient myths, Dionysios, Bacchus, and Osyris occur as gods of wine, and as dispensers and diffusers of it; yet although these myths may have some connexion with the native home and with the cultivation of the vine, as well as with the diffusion of the use of wine, they are obscure, and present themselves under such various forms that it is scarcely possible to find in them a contribution to the history of the vine and wine.

The native country of the vine cannot be well ascertained, but it is probable that it must be sought in Mingrelia and Georgia, and in the regions between Caucasus, Ararat, and Taurus; for according to Tournefort, Güldenstedt, Bieberstein, and Parrot, it grows wild there, in extreme abundance, in all the woods. It does indeed also occur wild in Greece and Italy, indeed even in the south of France; I have myself met with it frequent and luxuriant in this condition in many places in Sicily and Calabria; but according to the reports of the travellers above mentioned it appears to be still more common in the more Eastern countries, and to be found more frequently and in greater luxuriance in proportion to the proximity to them; whence these would certainly be most correctly supposed to be the home of the vine, while those examples which occur at a great distance from them in a wild state, must be regarded rather as outcasts from cultivation.

The wide diffusion of the vine in Asia Minor and the Greek Islands before the Homeric period, is proved by many passages in the Homeric hymns. The shield of Achilles represented a vine-gathering, the grapes in the garden of Alcinoüs yielded rich wine abundantly, &c. Herodotus and Theophrastus speak of the cultivation of wine in Egypt, and in the very oldest Greek tombs are found pictures representing the vine-harvest.

The cultivation of the vine seems to have come somewhat later into Italy. Pliny relates that wine was scarce in the earlier times of Rome, and cites as a proof of this that Romulus sacrificed to the gods with milk instead of wine, as also that Numa Pompilius on the same grounds forbade the offering of wine at the burning of the dead, a custom otherwise general in antiquity. Pliny speaks of the moderation which prevailed in the use of wine in the earlier days of Rome, and mentions, in reference to this, that it was forbidden young ladies to drink wine; that a Roman lady was judged to have forfeited her dowry because she had drunk more wine than her health required, without her husband's permission; nay more, that a man was pardoned for killing his wife because he came upon her as she was in the act of drinking from a wine-vessel; that Cato thought it was the careful control of the conduct of young girls in this respect which gave rise to the right every Roman possessed to kiss his female relations. What Ælian relates in regard to this is remarkable: that no youth of noble parentage was allowed to drink wine before his thirty-fifth year. In after times, however, the use of wine became very great, and the luxury in foreign and rare kinds of wine considerable, among the Romans.

The cultivation of the vine seems to have commenced at a very early period in the south of France, for the Phocians who founded Marseilles are supposed to have brought the vine with them 600 years before the birth of Christ. But this could not have been very extensive at first, for Varro says (72 B.C.) that no vine-culture was found in Gaul beyond the Alps; while both Livy and Pliny relate that it was wine in particular which allured the Gauls to cross the Alps and make incursions in Italy. Notwithstanding that these attacks were made on Pliny's native land, he thinks that the effort to acquire such an important possession might well excuse a war of invasion. It is a well-known assertion that the Cimbri also crossed the Alps for the same reason. By degrees the cultivation of the vine spread in Gaul; Pliny speaks of the wine in the country of the Bituriges (now Bordeaux); but the Emperor Domitian promulgated a law which importantly limited the culture of the vine; for a year having occurred in which there was great failure of the corn, and a great superabundance of wine, he commanded that no new vineyards should be established in Italy, and that in the provinces one-half of the existing vines should be eradicated. The command excited universal discontent, and was the more absurd that wine and corn require different soils and different local conditions.* This decree of Domitian's was not indeed rigidly enforced, but it did certainly exercise considerable influence, for two centuries later the Emperor Probus granted permission to plant wines in Gaul. This emperor also allowed his soldiers to establish vineyards in Hungary and on the Rhine, and from that time forwards, therefore (from the third century), Germany has been a wine country.† The narrative even contains the remark that Probus gave permission to plant wine in England; yet it is possible that the same happened here as with the Papal rescripts of the thirteenth century, by which the monasteries in Denmark were confirmed in their possession of vineyards, notwithstanding that historians are totally silent as to wine-culture in Denmark. It must have been a result, namely, of ignorance of the climatal conditions of the distant countries, causing per-

* Absurd as such a decree is, it was repeated by Charles IX., who, on the occasion of a failure of the corn crop, commanded that no one should plant more than a third part of his fields with vines; nay, even in 1731, Louis XV. forbade the establishment of new vineyards.

† The merits of Probus in this respect were unfolded in a humorous manner in an essay, about 100 years old, in which the author proposed to canonize him, and to drive some other saint out of the calendar to make room for one who deserved so well.

mission to be granted which circumstances rendered useless. On the other hand it must not be overlooked, that various documents of the twelfth and thirteenth centuries testify that wine was grown at that time in the south of England, as was also the case in the north-west part of France (Brittany and Normandy), where it is not cultivated now, any more than in England. But we are not warranted in concluding from this that the climate of that country is altered, for the question arises what kind of wine it was, whether it may not have been somewhat of that sort of which the poet says:

> You call it wine!
> The name is fine,
> But it gladdeneth not this heart of mine.*

The following anecdote renders it highly probable that the wine was of this kind. A noble of Brittany was praising his native province at the court of Francis I., and boasted that three things were better there than in any other part of France—the men, the dogs, and the wine; to which Francis answered: "As to the first two, it is very possible; but as to the wine, I must own it is the sourest and worst in the whole kingdom." By degrees good cyder and good beer came to be preferred in these regions to the bad native wine, or wine was introduced from other districts; in this way the vineyards of north-western France and of England vanished, and the limit of the vine was driven further south. Even in the east of Germany the vine-limit was further north formerly, as high as 53°. In another part of the temperate zone also has the cultivation of the vine either disappeared or become diminished, namely, in the north of Africa and Western Asia, on account of Mahomet prohibiting the use of wine to the followers of his religion.

On the other hand, vine-culture has been spread in other parts of the world through European colonies; the vine was transplanted from Crete to Madeira and Teneriffe, which at present furnish such esteemed wines; vineyards were established in the Cape Colonies, and Cape Constantia from there, is known as an excellent kind. Swiss colonists planted

> * Heisst wein
> Ist aber kein
> Man kann dabei nicht fröhlich seyn.

vineyards in the interior of North America, at Vevais in Ohio, and several other places. The vine has also been transplanted into the temperate parts of South America (Buenos Ayres and the south of Chili) and into Australia.

Looking to the present geographical distribution of the cultivation of the vine, we find the northern limit on the west coast of Europe, at the mouth of the Loire, at 47½° N. L.; in the interior of France it rises and comes to 49° at Paris; then it advances in Champagne, and goes on beyond toward the east, still further to the north at the junction of the Moselle with the Rhine, 51°; in Saxony, Thuringia, Silesia, and Prussia, wine is grown in isolated spots as far as 51°, but this is so mediocre that it is better to exclude those points. Taken strictly, the vine-culture of Germany is limited to the valley of the Rhine and its side-valleys, those of the Maine, Neckar, and Moselle, and to the valley of the Danube. Hungary has vineyards at 48°—49°, the south-west of Russia (Zarizin) and the Crimea up to the same latitude, and the vine also succeeds on the north side of the Caspian Sea, at Astrachan, in 46°.

We see therefore that, although the climate becomes constantly colder toward the east, the northern boundary of wine sinks very little from the Rhine, and is at Astrachan almost as northerly as at the mouth of the Loire. The cause of this must be sought in the fact that the culture of the vine is chiefly dependent upon the summer being warm enough to ripen the grapes. Since, then, the summer temperature of the coast countries is not so considerable as that of the inland regions, the northern boundary necessarily sinks towards the Atlantic Ocean.

Eastward of the Caspian Sea, wine is still grown in Bokhara, and likewise in the elevated plateaux of Persia, where the Shiraz wine is famed, and on the south terraces of the Himalaya mountains, in Cabul and Cashmeer. But when we descend to the plains of India or to the coast border of Persia, we either miss the vine-culture or it is found inconsiderable. At Abuchaer, in Persia (29°), it is requisite to dig pits six to ten feet deep in the earth, to protect the vines from the overpowering heat of the sun. In China the cultivation of the vine is of great antiquity, but yet not of very great extent, and it has been almost annihilated several times. In Japan, again, it is inconsiderable. On the west side of Africa, the island of Ferro (27½°) is taken as the south limit. It is true that the vine is cultivated in many places within the torrid zone, but this is for the sake of the grapes, and not in order to make wine. When the heat is too great, the grapes become dried up, the tendrils shoot out too luxuriantly, and the grapes are produced too frequently; for in the tropics several crops of ripe grapes are obtained from the same vine within the year.

In North America the growth of wine is on the whole inconsiderable, but it increases in Louisiana and in several southern provinces; it extends northward as far as 38°—40° N. L., and it is not found southward of the tropic here.

The regions in which wine is produced in the southern hemisphere, namely, on the River Plate, in Chili, at the Cape, and in Australia, all lie in the temperate zone or close to it; the south limit in Chili is in Valdivia, 40°.

When we ascend to a certain elevation in the wine countries, the vine is found to cease, because the climate becomes too severe. In Wurtemburg it ceases at 1000—1500 feet; in the north of Switzerland, about 1700 feet; on the south side of the Alps, at 2000 feet; in the Apennines and in Sicily, at 2000—3000 feet; at Teneriffe, at 2500 feet; in the Himalaya mountains, at 10,000 feet.

France is the country which produces the greatest quantity, and taken altogether the best wines. Italy, Spain, and Greece, have, it is true, certain good kinds of wine, but the common wine is not good. The cause of this difference is, that in France more industry is applied, not only in the cultivation, but in the gathering of the grapes and the management of the wine. It is remarkable that some of the best wines, like Burgundy, are grown near the north limit of the vine-culture.

The vine thrives in very varied soils, and may be excellent in different earths. It has been thought that volcanic soil is peculiarly favourable, and as examples of this, are cited the *lacrymæ Christi* of Vesuvius, the excellent wine of Etna, Madeira, and Tokay. But champagne grows upon chalk, the wines of Bordeaux and the south of France upon an argillaceous gravel, several Rhine wines upon clay-slate, &c. If the volcanic soils have some advantages, the cause hardly lies, as some have supposed, in the internal heat of the ground, but in the dark colour, which increases the heat derived from the sun. I have seen on Etna, at an elevation of 2000 feet, vines planted in pots which were filled with the black, sterile volcanic ashes mixed with garden earth. In marshy or damp soils alone the vine will not thrive at all.

Yet although the vine will thrive in almost every soil, the special nature of the soil undoubtedly has a very remarkable influence upon the particular character of the wine, for we cannot well otherwise explain the circumstance that certain kinds of wine are limited, not only to a certain province or district, as Champagne, Burgundy, and the Rhenish wines, but even to very narrowly circumscribed estates, such as Tokay, Constantia, Johannisberger, &c., out of which the same wine is not obtained, even from the same variety of the vine when transplanted.

The peculiar characters of different wines have given rise to some remarkable literary productions, I mean the learned wine-battles which have taken place, especially in France.

The most remarkable combat, perhaps, is that which was carried on in the time of Louis XIV., between Champagne and Burgundy. Coffin, rector of the University of Beauvais, fought for the Champagne, and wrote a spirited Latin ode, which gained this wine a complete victory over the Burgundy, which was defended in a dull poem by Greneau. The victor received in payment an abundant quantity of the wine he had celebrated, from the citizens of Rheims, in which city the chief wine-trade of Champagne was carried on. Whoever is impartial enough to desire to know what can be said against Champagne, may read a spirited harangue in Tieck's novel, "Die Gemälde."

The vine is sometimes grown dwarf, fastened to short stakes rising but a few feet from the ground, in the most northern districts even but a few inches, as in the Rhine countries, in France, and in Spain; sometimes it is trained over trees of ten or fifteen feet high, between which the tendrils hang down in festoons, beautifying the landscape; this is the usual mode in Italy and Sicily; sometimes the vines are even suffered to climb up tall trees. This can only be the case in warm climates, for otherwise the branches and leaves of the trees would rob the grapes of the necessary sunlight. The reason why this method is most frequently adopted in Italy, is that the soil beneath can then be used for corn or pulses, and at the same time the wood of the elms or poplars to which the vines are attached. The wine is generally inferior under these circumstances, partly because the plants are deprived of sunlight, and partly because the soil is too much exhausted by the excessive crops. The vine sometimes attains a very great size and fertility. Audibert speaks of a vine in France, the stem of which was as thick as a man's body, and of which the crop gave 350 bottles of wine. In the gardens at Hampton Court Palace there is an exceedingly large vine, filling by itself a very large hot-house. The players of Drury Lane Theatre having once greatly pleased King George the Third, he gave permission that the gardener should cut them off 100 dozen bunches of grapes, if there were as many upon the vine. The gardener not only cut off this number of bunches, but sent word to the king that he could cut off as many more without entirely stripping the tree. The greatest number of bunches which have been cut from one and the same vine in the Rosenberg Garden at Copenhagen, amounted to 419, the total weight of which was about 650 lb.; the largest bunch weighed more than 2 lb. 10 oz. In the south of France there were said to be instances of bunches of grapes, weighing from 6 lbs. to 10 lbs.; a traveller in Palestine relates that they are to be met with there up to 17 lbs.; not to mention the bunches which the spies of the Jews brought back from the Land of Promise.

CHAPTER XXI.

THE TEA-SHRUB.

The tea-plant is a low shrub, which when left to itself may attain a height of 10 feet or 12 feet, but in cultivation generally grows only to 5 feet or 6 feet, in some places even only 2½ feet to 3 feet high; it is kept thus low in order to make it push out more shoots, and to facilitate the gathering; it bears longish lance-shaped, toothed, shining evergreen leaves, and flowers, in the axils, with a five or six leaved calyx, a six or nine leaved corolla of a white colour, and numerous stamens. The fruit is a three-lobed capsule, with separate cavities; in each chamber there is one seed, with a hard nut-like shell. *Camellia* is the genus nearest allied to it. The tribe to which these two genera belong is called that of the Camelliеæ.

It is not yet fully made out whether there is but one, or are several species of tea, and particularly whether the green and the black tea are obtained from two different species or two varieties, or whether the difference between them depends merely upon the different modes of management; but at present most botanists, as well those who have been in the native country of the tea as those in Europe who have examined the shrub growing here or dried specimens, are of opinion that all kinds of tea come from one species. The most active opposer of this opinion, however, is Reeves, the former tea-taster of the English East India Company in Canton.*

The countries in which tea is grown are China and Japan. In the north of China, for instance near Pekin, the tea-shrub will live in the open air, but the tea is not good, so that it does not pay to cultivate it on a large scale. It is in like manner only in the southern parts of the Japanese empire that the growth of tea is important. But while too cold a climate is disadvantageous to the tea-shrub, the same seems to be true of a too warm one. In Tonquin and Cochin-China, tea-growing is still met with, but it is not very extensive, and the product is not good; in like manner,

(* According to Dr. Royle, there are two Chinese species, while the Assam species seems also to be distinct.—Ed.)

most of the experiments which have been made to cultivate tea in the torrid zone, have failed. The extreme limits of the cultivation of tea in Eastern Asia, if we determine them according to where the tea-shrub thrives in the open air, are the 15° and 40° N. L.; but if we speak of the profitable cultivation, the zone is restricted between 23° and 31° (from Yunan to somewhat to the south of Nankin) in China, and between 30° and 35° in Japan. Toward the east, the area of distribution of tea is limited by the Southern Ocean; toward the west, it does not extend further than the limits of Thibet. In Assam, at 25°—26° N. L., and at a mean elevation of 2000-4000 feet, a wild shrub has been discovered, which Dr. Wallich recognised as the true (?) tea, and the cultivation of tea has been commenced there.*

Among the recent attempts to introduce the cultivation of tea into other parts of the globe, are those which were made in Rio Janeiro, where a tolerably large tract was planted with it, and Chinese colonists were brought to cultivate and prepare the tea; but the tea grown there is coarse and destitute of the delicate aromatic odour of the Chinese tea, and besides, the price of labour is too high; the Chinese have, therefore, gradually become scattered, and the plantation may be regarded as a failure.

The experiments made recently in Java (probably at some height above the sea in this mountainous country) have been more fortunate. Nearly 1,500,000 lbs. of Javanese tea are said to have been imported into Amsterdam in one year.†

The tea-bush is indigenous only in China, and, according to recent discoveries, in Assam, on the borders of China; not, however, in Japan, for the Japanese history mentions the Chinese bonzes who brought the tea-shrub into that country. This must have happened before the tenth century (A.D.), for mention was made of it in Japan in the commencement of that century. Perhaps it was in use even in the sixth century. The accounts of its cultivation in China go still further back. It is related that in the sixth century a physician recommended it to the emperor as a remedy for

(* Also in the Himalayas, where it is likely to prove very important.—Ed.)
† Meyen, Geography of Plants.

the headache, and he is stated to have been highly regarded on this account; and even in the fourth century it is mentioned that a minister drank tea. A tax was laid upon tea for the first time, in China, toward the end of the eighth century. The Japanese have a myth respecting the origin of this important plant. A Buddhist saint, Darma, came from India to China, with the intention of spreading his doctrines in that country; to strengthen him in his mission, and to give distinction to his religion, he made a vow to pass night and day in uninterrupted religious exercises, but sleep at length overtook him. When he awoke, in anger at his fault and in atonement for his broken vow, he cut off his eyelids, and threw them on the ground; but these grew up into a plant wholly unknown before, the leaves of which he tasted, after which he felt strengthened, and in a condition to withstand sleep better. He recommended this valuable plant to his disciples, chiefly with a view to the same ascetic purposes. It is evident at once that the myth contains a symbolical indication of the effects of tea upon the nerves. This Darma is an historical personage, who lived in the sixth century.

The tea-shrub thrives best on the south side of hills, and in the vicinity of rivers and brooks. It is cultivated in large or small plantations, where the shrubs stand in regular rows, but in Japan they are also found growing as hedges along the boundaries of the fields, for the domestic consumption of the owner.

The shrub is increased by seeds, and is cut down, apparently in order to make it branch sufficiently. In the third year the leaves may be used, and at the seventh year the shrub must be removed and replaced by a new one, to secure a good crop. Manure is applied; in Japan oil-cake is used, with dried sardines and the juice of mustard-seed.

The leaves are gathered at three separate times of the year: in February or March, when the delicate, scarcely unfolded shoots are picked; in April, at which time older leaves and new delicate shoots are gathered, these being sorted according to the delicacy of the leaves; and finally in May and June, at which season the coarsest leaves are removed, which, however, are likewise sorted. The first gathering yields the finest tea (" Emperor Tea," in Japan), and this is pulverised after being dried. The leaves are pulled off, each separately, either from the bush itself or from the branches carried home. If we may believe some accounts, there is a peculiar mode of gathering a certain wild kind of tea, which grows on steep, inaccessible cliffs. This gathering is stated to be made by monkeys, which are trained to it, or according to others (less probably), in the following way: the monkeys found on the bushes are excited by throwing stones, &c., and they then throw the branches down at the Chinese.

After the leaves are gathered, they are dried, by laying them in iron pans placed over a fire in little stoves. Great care is required to dry them without burning, and it is repeated several times. A man stands at each pan, turning the leaves over with his bare hand. Each time that they are taken from the pan, they are rolled in the hand, and in this way the tea-leaves acquire the form in which they are met with in trade. If this process alone is employed, it is called the *dry* way; the *wet* way is as follows: the tea-leaves are first placed in an iron sieve, and held over boiling water, the vapour of which rises into the sieve, penetrates and changes the leaves, after which they are dried in the same way as before. According to some accounts, green tea is produced by the first process of drying, black tea by the second; but Siebold seems to have entertained the opposite opinion of the matter.*

The dried tea-leaves are then either packed in this condition in stoneware jars or leaded chests, or they are made

(* Mr. Fortune, who has visited many parts of the Chinese coast, states that there are two species of tea-plant, *Thea bohea*, from which both black and green tea are made in the southern provinces; while *Thea viridis* alone is grown in the northern provinces, and in like manner constitutes the material for both kinds of tea; but as Dr. Royle observes, it is quite possible that the Chinese may prefer varieties of the same plant, in particular soils and situations, for the preparation of particular varieties of both black and green tea.

The following is the account of the modes of preparing teas, by Mr. Ball, late inspector of teas to the East India Company in China:†

In the manufacture of *black tea*, the leaves are exposed to the air after gathering, so that they lose their natural crispness, and become soft and flaccid; they are kept in this state until they begin to emit a slight fragrance, upon which they are sifted, and tossed about with the hands in large trays; the leaves in each sieve are then collected into a heap, and covered with a cloth. They are then watched with the utmost care, until they become spotted and tinged with red, at the same time increasing in fragrance; they must be then instantly roasted, or the tea would be injured. In the first roasting of all black tea, the

† "An Account of the Cultivation and Manufacture of Tea in China."

into a kind of cake by the aid of ox's or sheep's blood, or fat (the *brick-tea*, as it is called, which is very extensively used

fire is prepared with dry wood, and kept exceedingly brisk; any heat suffices which will produce the crackling of the leaves described by Kæmpfer. The roasting must be continued until the leaves give out a fragrant smell, and become quite soft and flaccid, when they are in a fit state to be rolled. The roasting and rolling are repeated, often a third, and with large and fleshy leaves, sometimes even a fourth time; and it is only when juices can no longer be freely expressed in the process of rolling, that the leaves are considered to be in a fit state to undergo the final drying, in sieves placed in the drying-tubs, above a charcoal fire, in a common chafing-dish. During this process they begin to assume their black appearance. A considerable quantity of moisture is dissipated, and the fire is then covered with the ash of charcoal, or burnt rice-husks, which both moderates the heat and prevents smoke. The leaves are then twisted, and again undergo the process of drying, twisting, and turning, as before; which is repeated once or twice more, until they become quite black, well twisted, and perfectly dry and crisp.

Of *green tea*, there are only two gatherings, the first about the 20th of April, the second at the summer solstice. The *green-tea* factors universally agree, that the sooner the leaves of green teas are roasted after gathering, the better; and that all exposure to the air is unnecessary, and to the sun injurious. The iron vessel (called a *kuo*) in which the tea is roasted is thin, about sixteen inches in diameter, and set horizontally in a stove of brickwork, so as to have a depth of about fifteen inches. The fire is prepared with dry wood, and kept very brisk; the heat becomes intolerable, and the bottom of the *kuo* even red hot, though this is not essential. About half a pound of leaves are put in at a time; a crackling noise is produced, much steam is evolved from the leaves, which are quickly stirred about; at the end of every turn they are raised about six inches above the surface of the stove, and shaken on the palm of the hand, so as to separate them, and to disperse the steam. They are then suddenly collected into a heap, and passed to another man, who stands in readiness with a basket to receive them.

The process of rolling is much the same as that employed in the rolling of black tea, the leaves taking the form of a ball. After the balls are shaken to pieces, the leaves are also rolled between the palms of the hands, so that they may be twisted regularly and in the same direction. They are then spread out in sieves, and placed on stands in a cool room.

For the second roasting the fire is considerably diminished, and charcoal used instead of wood, and the leaves are constantly fanned by a boy who stands near. When the leaves have lost so much of their aqueous and viscous qualities as to produce no sensible steam, they no longer adhere together, but by the simple action of the fire, separate and curl of themselves. When taken from the *kuo*, they are of a dark olive colour, almost black. After being sifted, they are placed on stands as before.

For the third roasting, which is in fact the final drying, the heat is not greater than what the hand can bear for some seconds without inconvenience. The fanning and mode of roasting are the same as in the final part of the second roasting. "It was now curious to observe the change of colour which gradually tock place in the leaves, for it was in this roasting that they began to assume that bluish tint, resembling the bloom on fruit, which distinguishes this tea, and renders its appearance so agreeable."

The foregoing being the general mode of manufacturing green or hyson tea, it is separated into different varieties, as hyson, hyson-skin, young hyson, and in the north of Asia); in the south-west of China, the tea also occurs in round balls, which are sent to Ava and Cochin-China. Sometimes sweet-scented flowers are mixed with the tea, for example, *Camellia Sasanqua* and *Olea fragrans*; but it is quite a mistake to suppose that the peculiar aromatic odour is due to these, and not to the tea itself.

The tea is bought from the producers by small traders, and brought by them to the great merchants in Canton (the Hong merchants).* The following are the different lines of trade:

1. Seawards, in reference to China, hitherto almost exclusively from Canton to Europe, North America, some to *India*, as well as to the Indian islands. The English are the most important traders; next to them come the Dutch and the North Americans.

2. Overland toward the north, through the Desert Gobi, over Kiachta to Siberia, and from thence partly to Europe. This trade has increased extremely in the last twenty or thirty years. Timkovsky met with many caravans in his journey, each with 100, 200, and 250 camel-loads of tea.

gunpowder, by sifting, winnowing, and fanning, and some varieties by further roasting.

It is stated by Mr. Ball, that the peculiar colour of green tea does not arise properly from the admixture of colouring-matter with the leaves, but naturally out of the process of manipulation; and from some experiments which he made, it appeared that leaves, while undergoing the third roasting in the same vessel, but kept separate by a thin partition of wood, became of a black or a green colour, according as they were kept in a quiescent state or in constant motion.

With regard to the colouring and adulteration of teas, much discussion has recently taken place, but the matter may be regarded as tolerably well settled by the investigations of Mr. R. Warington, who has lately read a paper on the subject before the Chemical Society of London. Various travellers had stated that Prussian blue is used in the *facing* of green teas, while some had imagined the colouring matter to be indigo. Mr. Warington has shown that the substances used in *facing* green teas by the Chinese are Prussian blue, gypsum, and turmeric; and he states, on the authority of Mr. Reeves, that they are used to suit the fancy of European merchants, as the dealers dislike the yellowish appearance of uncoloured green tea. "The small quantity employed to give the 'face' precludes the idea of adulteration as a source of profit." Mr. Warington has also shown that the Chinese prepare what they call *Lie*-teas to suit the low prices of the English merchants, selling them under this name. One specimen of black Lie-tea was found to be made up of tea-dust, dirt, and sand agglutinated into a mass with a gummy matter, and rolled into little balls to look like leaves, of which *none whatever* were included. The black Lie-teas are faced with black-lead, the green with Prussian blue, gypsum, and turmeric.—Ed.)

(* In the treaty made after the late war, the British authorities stipulated that the monopoly of the Hong merchants should be abolished.—Ed.)

3. Overland toward the west, from the south-west provinces of China towards Mongolia, Bokhara, and Persia.

4. Overland toward the south-west, from the south-west provinces of China toward Thibet, and the terraces of the Himalayas, Nepal, Butan, &c.

5. Overland southward to Ava and Cochin-China. Much tea is carried to the Burmese from the province of Yunan.

In China and Japan, tea is, in the truest sense of the word, the national beverage, and has been at least for the last thousand years. It is used by all, from the emperor to the common people; it is drunk at all meals and at all times of the day; it is offered to visitors; it is sold everywhere, in the streets and roads, in public-houses, like beer or wine in Europe. It is part of a good education to prepare tea and serve it with grace, this being taught by masters, as fencing and dancing are with us. The true connoisseur in tea can distinguish 700 kinds; nay, it is said, he can even taste what wood was used to boil the water, and in what kind of vessel it was done.

Both the Chinese and the Japanese drink it without milk and sugar; sometimes, however, essences are added to it. It is taken either as an infusion of the leaves (as in Europe) or as a powder, upon which warm water is poured in cups, and stirred up till it froths.

The consumption of tea among the many nomadic races of Northern and Central Asia is considerable. It renders the bad, saline waters of the steppes drinkable; and tea is a strengthening, invigorating beverage to those who lead a wandering life in a dry, sharp atmosphere.

Similar reasons have given rise to a large consumption in Thibet, where tea is drunk to assist the digestion of the dry barley-meal.

Tea was unknown in Europe before the seventh century. Russia and Holland seem to have been the countries which first became acquainted with it. A Russian embassy to Mongolia received tea in return for its presents, consisting of sable-furs; a protest was made against such useless wares, but they were forced upon the ambassador, and when he brought the tea to Moscow, it met with approval. It is related by the Dutch, that in 1610 they carried to China, sage (a plant in high esteem for its medicinal properties in days of old), and exchanged this for tea. The Chinese soon discarded the sage, but the tea found a constantly increasing demand in Holland.

Tea was introduced into England somewhat later. In Pepys' Diary, of 1661, we find: "I sent for a cup of tea, a Chinese beverage, of which I had never drunk before." In 1664, the East India Company made the King of England a present of 2 lbs. of tea, and in 1667 a ship received orders to bring home 100 lbs.

Tea appears to have been introduced into Denmark at about the same time. It met with an active opponent in the celebrated Danish botanist, Simon Pauli, who at first asserted that it was nothing else but the bog-myrtle (*Myrica*), and afterwards he made such constant representations against its use to Frederic the Third, whose body-physician he was, and who was fond of tea, that the king, one day, tired of his importunities, answered with the well-known equivoque, "*Credo te non esse sanum.*"

A great difference prevails between the different countries of Europe in reference to the consumption of tea. The inhabitants of England use the greatest quantity,* then come Holland and the north. In France and Germany the consumption is but small, but has begun to increase in quite recent times; in the south of Europe very little is consumed.

While in 1711 only 142,000 lbs. were consumed in Great Britain, the consumption in 1781 amounted to 3,500,000 lbs.; in 1785 (after the duty was reduced from 119 to 12½ per cent.), to 13,000,000 lbs.; in 1801, to 20,000,000 lbs., and 3,500,000 lbs. for Ireland. The consumption has increased since then, for example, in 1828 it was 27,000,000 lbs. for Great Britain and Ireland, but not in the same proportion as the population has. The cause of this lies especially in the monopoly of the East India Company in China, on account of which the English had, up to a few years ago, to pay twice as high a price for tea as it fetched in Hamburg or Amsterdam, and since the duty (100 per cent.) was determined in proportion to the price, the tea had really to pay a quadruple price, without great advantage to the Company's interests. Since the monopoly was abolished in England, and the duty reduced, the consumption has increased, so that it may be estimated now at 36,000,000 lbs. for the British Empire, which makes about an average consumption of 1½ lb. for each per-

(* 12,000,000*l.* is annually paid for tea in Great Britain—four times the amount paid for coffee. (Crawfurd, 1852.)—ED.)

son (2lbs. for Great Britain, 1¼ lb. for Ireland). In Holland the consumption amounts to 3,000,000 lbs.; in the north of Germany, to 1,500,000 lbs.; in France, only to 230,000 lbs.; in Russia, on the contrary, 5,500,000 lbs. The consumption of the whole of Europe may be put at about 60,000,000 lbs. North America consumes 10,000,000 lbs. The value of the tea which China exports by sea has been estimated at 11,000,000 piastres (about 2,000,000*l.*).

Opinions are, it is well known, divided with regard to the beneficial or injurious effects in a dietetic point of view. But it may surely be assumed that tea is on the whole a wholesome beverage when not used in excess. Its reviving and refreshing power is especially experienced after a hard pedestrian journey, or any other effort; it opposes corpulence and sleepiness, it does not intoxicate, but acts against the intoxication produced by strong drinks.

Tea was celebrated in verse by the Chinese emperor, Kien-Long. His poem was written on a hunting-excursion; it was greatly admired, published in a splendid edition, and introduced upon porcelain cups which were used for imperial gifts. Among other things we find in it:

"Set over a moderate fire a three-footed vessel, whose form and colour indicate that it has been long in use; fill it with clear water of melted snow; let this be warmed to the degree at which fish grows white and the crab red; pour this water into a cup upon delicate leaves of a choice kind of tea; let it stand awhile, till the first vapours which form a dense cloud have diminished, and only a slight cloud hovers over the surface. Drink then slowly this delicious beverage, and thou wilt become strong against the five cares, which commonly disturb our spirits. The sweet *calm* which is obtained from a drink thus prepared, may be tasted, felt, but not described."

The Europeans seem to have been agreed that wine is the only beverage that deserves to be celebrated in song. That the Chinese consider their national drink worthy of it, is not wonderful. Is there not some one-sidedness in the fact that we only sing of the beverage which awakens passion, and not that which calms it? But truly war is more frequently celebrated than peace.

CHAPTER XXII.

THE COTTON-PLANT.

Of all the materials which mankind use for clothing, none plays so important a part as cotton; this, therefore, certainly deserves especial attention, as also the plant which furnishes the substance.

This plant belongs to the Mallow tribe. The stems of some species are herbaceous, even annual, as the cotton-herb, and other species are more or less woody, as the cotton-shrub and the cotton-tree, the last of which attains a height of 15—20 feet. The leaves are broad and lobed, usually five-lobed. The calyx is double; the corolla five-leaved, usually yellow, but sometimes red. A great number of stamens exist, blended together by their filaments. The fruit is a capsule, which opens with several valves, and contains numerous seeds; these seeds are covered with a long, close, white, or sometimes yellow* pubescence, which is closely compressed in the capsule. This woolly pubescence is the cotton.

As in other cultivated plants, there are many species and varieties of cotton, and it is very difficult to determine which are species and which are to be considered merely as varieties.

The cotton-plant requires a warm climate; it thrives within the tropics, and in the warmer parts of the temperate zone, to 30°—40°. The most northern cultivation of cotton in Italy is near Naples, at 41° N. L., particularly about Castellamare. More to the south, it is found in Puglia, Calabria, and Sicily. When the trade of the Continent was closed under Napoleon, the Italian cotton-culture was more considerable than at present. In Spain, cotton is cultivated on the south coast and also on the east coast of Valencia up to 40°—41°; it extends even to the plateaux. The cotton-culture in Greece and in the Greek islands is not inconsiderable, and it reaches to Constantinople, that is, to about the same latitude here as in Italy and Spain. It occurs exceptionally in the Crimea at 45°, but only on the south

* For instance, in the cotton from which Nankin is made.

side of the high mountains, which afford shelter from the northward, and therefore cause a local warm climate in a limited district. The Asiatic coast of the Mediterranean, Asia Minor, Syria, as also the Asiatic islands, produce cotton, likewise Egypt, especially of late years, since Mahomet Ali made great attempts to extend the cultivation of this plant. Cotton is also grown along the rest of the North African coast. Although Asia is colder than Europe in equal latitudes, the cultivation of cotton extends as far towards the north here, both in the west and in the east of this quarter of the globe; for it is met with in Chiva and Bokhara, up to 40°—41°, probably on account of the comparatively dry and warm summer; and likewise in China and Japan up to the same limit. In the interior, however, it is missed, on account of the extensive highlands. Both the Indian peninsulas, as well as Persia, produce cotton; it flourishes also in the South African group of islands, and in the English colonies on the east side of Australia.

That portion of Africa which lies within the tropics has cotton-culture, not only on the coasts, especially in Senegal, Guinea, and Congo, but also in the interior, as at Timbuctoo, Bornu, &c. In North America cotton-growing is now diffused in an extraordinary manner, both eastward of the Alleghany mountains in Carolina, Georgia, and Florida, and westward of this chain in the basin of the Mississippi. The northern limit occurs here also about 40°.

Cotton-culture is diffused also in the West Indies and Mexico; also in tropical South America, especially in Brazil. The south limit is 30° on the east side of South America; 30°—33° on the west side. In the torrid zone of South America the growth of cotton extends up to a height of 4200 feet above the sea.

The growth of cotton succeeds best on a soil not too rich; it prefers to all others a dry, sandy soil. In several places it has been found that sea air has a beneficial effect upon the cotton-plant. The best kind of cotton, "sea-island cotton," as it is called, which is very long in the staple, comes from the low sandy islands lying between Charleston and Savannah, in North America, and the cotton becomes gradually inferior as it is grown further from the coast. It is thought that the particles of salt which the atmosphere contains act advantageously upon the plants, whence saline mud is regarded as a very excellent manure. Rain has an injurious and sometimes destructive effect at the season when the capsules begin to open, for the cotton then becomes exposed to putrefaction or mildew. The sowing and harvest seasons vary in different climates; in the south of Europe cotton is sown in April and May and gathered in September or October; in some districts there are two crops in the year. The seeds are laid in rows at a certain distance; when the plants have attained a particular height, they are snapped off with the fingers to make them produce several shoots, and consequently more numerous flowers and capsules. The cotton-bush and the cotton-tree are also cut, with the same intention. Careful weeding is requisite to ensure a good crop. A cotton-field presents an extremely beautiful aspect in autumn, from the broad dark-green leaves, the large yellow flowers, and the snowy cotton which projects from the half-open capsules, for the plant bears ripe fruit while it is still in flower. Hence the gathering of the capsules has to be continued for a long time. This is effected by picking off, by hand, the capsules which have begun to open. They are then dried, and next the cotton is separated from the seed by means of an apparatus formed of two rollers, for as the seeds contain oil, they would otherwise destroy the cotton. When the cotton is packed for transport, it is compressed by very powerful presses contrived for the purpose.

We are able to trace the history of the diffusion of the cotton-plant and cotton with a tolerable degree of probability. Before the birth of Christ, the cultivation of the plant and the use of cotton for clothing was probably confined to India. Herodotus, who lived in the fifth century before Christ, reports that the Indians had a plant which bore, instead of fruit, a wool like that of sheep, but finer and better, of which they made clothes; and Arrian narrates that the Indians made their clothes of a fine white kind of flax, which grew on trees. Other nations do not seem to have cultivated the plant at that time, or even to have used cotton; at all events, only exceptionally, as a rare and expensive stuff. Thus it is assumed that the precious material called *byssus*, spoken of among the Jews, was cotton. The growth of cotton and its use seem to have become diffused shortly after the birth of

Christ. Strabo (in the first century of our era) speaks of cotton being cultivated and manufactured in Susiana, on the Persian Gulf; and Pliny mentions that the plant was cultivated, not only in India, but in Upper Egypt, and says that the Egyptian priests used the material there grown for clothing. In all probability, the Arabs brought the cultivation of cotton into Europe. In the time of Mahomet, the use of cotton was general among them, and the first country of Europe in which mention is made of the cotton-plant as an object of cultivation is Spain. The Arabian author, Ebn Alvam, mentions it as generally grown in the last-named country. Cotton-culture did not come till afterwards into Sicily, the south of Italy and Greece; but cotton goods were brought from India, by Constantinople to Europe, in the middle ages.

It is unknown when the growth of cotton was introduced into China; various reasons lead us to suppose that it does not go back further than to the ninth century, and that silk was previously the general material of clothing; while at present the rich use silk, and the poor cotton.

Although, as already noticed, there existed at a very early period a trade in cotton goods from India to Europe, which took place partly by way of Constantinople and partly by way of Egypt, which trade became gradually extended, still the use of cotton stuffs was very limited throughout the middle ages—in fact, for long after; and although there were cotton-manufactories in Granada in the thirteenth century, in Venice in the fourteenth century, in Flanders in the sixteenth, and lastly in England in the seventeenth century (at least, of stuffs in which the woof was of cotton), these manufactures were inconsiderable in Europe till after the middle of the last century. Few cotton goods were in use, and most of these were imported from India and China. It was in itself improbable that it could be made to pay to establish cotton-manufactories in Europe, for the Indians and Chinese had brought these branches of manufacture to a considerable degree of perfection, the transport of the raw material from such distant regions necessarily increased the price of the manufactured article, while the cost of labour is extremely low in India, on account of the few necessities of the natives, and the small price of them. Yet the reverse has come to pass. The cotton-manufacture has risen to an extraordinary pitch in Europe, and above all in England; in fact, to such a point has it come, that in spite of the low price of labour in India and China (which amounts to only one-tenth of the cost of labour in England), and in spite of the distant transport, no inconsiderable quantities of cotton-stuffs are exported from Europe to India and China. In the year 1832 cotton-manufactures to the value of 1,500,000*l.* sterling were exported from England to those countries.

This unusual phenomenon is owing to machinery. For while the work is done in India and China, now as formerly, simply by hand, or by the aid of very rude, simple, and poor instruments, the manufacture is carried on in England by the most complicated machinery, spinning-machines and looms, which are driven by steam-engines; and there can hardly be an event in the history of industry that demonstrates so clearly the triumph of machinery and of the human power of invention, as the history of the development of cotton-manufactures. With a spinning-machine one man can spin as much in one day as an Indian can with his distaff in a whole year; and goods are bleached in two days which formerly required six or eight months.

The cotton-manufacture has advanced with giant's strides in England, one of the last countries of Europe into which this branch of industry was introduced. In the middle of last century only 3,000,000 lbs. of cotton were imported into England; so late as the year 1775, only 5,000,000 lbs.; in 1820, 152,000,000 lbs.; and in 1833, 300,000,000 lbs. Of these 300,000,000 lbs., about 17,000,000 lbs. were exported raw; the remaining 283,000,000 lbs. were manufactured. The value of the cotton goods exported in the year 1764 amounted at most to 500,000*l.* sterling; in 1833, notwithstanding the much lower price, to 18,500,000*l.* sterling; the value of the entire manufacture was 34,000,000*l.* sterling. In 1760 the manufacture of cotton employed 40,000 persons; at present 1,500,000 (almost forty times as many), although machines do the greater part of the work. To do all by hand that is now manufactured, would require every fifth person in the whole of Europe to work in cotton.

Liverpool is the greatest staple place in England for the import of cotton and the export of cotton goods; for eightninths of the cotton that enters England goes through that town. Manchester is the most important manufacturing place. In 1700, Liverpool had 5000 inhabitants; in 1770, 34,000; in 1821, 120,000; and in 1831, 165,000. Manchester had, in 1774, 41,000; in 1831, 187,000.

Originally, only the coarser kinds of cotton-stuffs were manufactured in England; but subsequently, the manufacturers applied themselves to the finer, even to the finest muslins. That muslin of the highest degree of fineness, such as is made by hand in India, is not furnished by machinery, is because the consumption is too slight to make the manufacture of such goods pay, and not because it cannot be done. The making of the very finest Indian muslins is confined to certain districts and certain families, and it is decreasing. A report of two Arabian travellers of the ninth century states, that they had seen muslin so fine that a whole garment could be drawn through a finger-ring. A recent traveller, Ward, speaks of muslin so fine, that when it is spread out on a meadow, and wetted by the dew, it is quite invisible. Hence the Oriental poets call fine muslin "woven wind."

The great consumption of cotton in England increased the demand for this article, and this demand called forth a greatly increasing cultivation of cotton, first in North America, and subsequently in South America. In the year 1784, some bales of cotton were confiscated in Liverpool, because cotton was said to be an article not produced by the North American States; in 1835, 386,500,000 lbs. were exported from thence. The home consumption is estimated at above 70,000,000 lbs., so that it may be assumed that the total production reaches 450,000,000 lbs. In the year 1821, 125,000,000 lbs. were exported, so the production rose to more than double in those fourteen years. South America, especially Brazil, has subsequently come forward as a competitor, and some kinds of the cotton it furnishes are excellent. The worst cotton comes from its original home, India; but it is thought that the cause of this lies in the neglectful and bad treatment used by the Indians, who have no taste for improvement. Dr. Wallich reports that he has cultivated cotton in the Botanic Garden at Calcutta, which can stand beside the best North American for quality.

The greatly increased production, and the less expensive manufacture by the aid of machinery, have lowered the price both of raw cotton and of the manufactured cotton goods; this reduction of the price has increased the consumption, and thus again the production and manufacture. Comparing the prices of 1833 with those of 1818, we find them sunk to little more than half. Cotton goods, which were formerly used for the most part only by the higher classes, the rich and independent, have gradually extended to the middle class, to the lower ranks, and even to the labouring classes. Every one must have observed the change in clothing which has occurred in this respect.

It will not be without interest to compare the clothing of us Northerns in different periods. The oldest inhabitants clothed themselves in the skins of wild animals. Subsequently, as the feeding of cattle gradually increased, the skins of domestic animals (sheep and calf skins) were used in combination with those of wild animals for clothes. At a more recent period the wool of the sheep was shorn, and coarse woollen stuff and cloths prepared, which constituted the most important part of the dress; flax-cloth was a luxury at that time, and wool took the place of linen, even for the coverings next the body. The use of linen, together with that of wool, became more and more general, as by degrees the increasing commerce introduced more linen, and the cultivation of flax was increased in the country. Finally, cotton-manufactures have, to a considerable extent, taken the place of linen goods, and the substitution seems to increase constantly. In this manner, not only has the more-manufactured material taken the place of the less-manufactured or raw material, but the products of the more remote countries have displaced the home products of the land and those of the neighbouring countries.

The history of clothing leads the thoughts to the history of the development of the human mind. Not alone in their dress were the skin, wool, linen, or cotton clothed inhabitants different; simultaneously with those changes, and not uninfluenced by them, occurred manifold changes in their whole mode of life, in their mental occupations, and in their entire spiritual development.

CHAPTER XXIII.

FLAX.

Every one knows the flax-plant; the little shining seeds (linseed) are sown in April or May, and from them soon spring up slender, delicate stems, which branch at the upper part; these stems are closely covered with lance-shaped leaves, and bear quickly-falling, sky-blue flowers at the top, after the fall of which the seed-vessels soon present themselves, indicating that the plant, within three or four months after it was sown, may be pulled up to yield its fibres, which furnish us with an important article of clothing. I will not enter any further upon the description of the plant, but by a little deviation from the main subject, I will direct attention to some of the laws of nature which prevail in the vegetable kingdom, and appear very distinctly here.

Daily experience must have made it sufficiently apparent, that all the more perfect animals are formed according to a type, wherein the organs are placed in pairs on each side of a middle line. This is abundantly shown by the four legs of the mammalia, and most reptiles, the wings and legs of birds, the pectoral and ventral fins of fishes, the six feet of insects, the eight of spiders, the great number of pairs of feet in the Crustaceans and Annelides, the eyes and ears of animals, the two sides of the jaw, &c. The type of plants is totally different. When conditions regulated by law present themselves distinctly, which is chiefly the case in flowers and fruits, the organs generally radiate, as it were, from a central point. But there are some plants in which the parts are arranged on each side of a middle line (the *symmetrical* flowers of some authors), as, for example, in the Labiate flowers. On the other hand, the lower animals (Radiata, Polypes) exhibit the condition which prevails in most plants.

Connected with this difference is the fact that *even* numbers prevail in the animal (except in the lowest classes), while *odd* numbers are most common in plants. The two numbers, 3 and 5, with their multiples, 6-9 and 10-20, are those which especially occur in the vegetable kingdom, in such a manner that in one large group of plants, the number *three*, in another the number *five* predominates. We may hence call these the *Ternary* and *Quinary* plants. The flax exhibits the latter number very distinctly.

Another natural law which we learn from the examination of plants is, that the flower is a collection of several circles of more or less transformed leaves, and that the leaves of these circles frequently alternate with each other. In the flax there are five sepals, which do not differ much from the proper leaves of the stem; next follow five large and more delicate sky-blue petals, each of which is placed between two of the sepals; inside the petals occur five stamens, the blue colour and the structure of which betray their relationship to the petals, while they alternate with the latter; then come five minute tooth-shaped bodies, which must be regarded as an inner circle of stamens which are undeveloped and barren; finally, inside these are five carpels or fruit-leaves, which are blended together, but which exhibit the number five in their prolonged free points. These carpels subsequently form a fruit which is divided into five chambers, but each of these is again divided by a partition which projects from the mid rib (in the common flax reaching only half way) to the centre, thus forming ten cavities in the capsule.

The most important use of flax, is that of the *fibres*, the long tough fibres which traverse the cellular tissue of the stem. These fibres are of the same structure as the *bast* or *liber* of trees (the *bast* of the lime-tree, for example, of which matting is made), as the fibres of hemp, of the New Zealand flax, and of many other plants, which furnish material for clothing. Under the microscope these fibres appear as very long tubular cells, with very thick walls, composed of several membranes deposited on the inside of the primary membrane. In the preparation of flax, the bast-cells are separated from the looser proper cellular tissue. The use of the seeds is of less, but still considerable importance, the oil they contain (linseed oil) being used in many branches of manufacture, and for medicinal purposes.

Flax is part of the inheritance of temperate climates. It is grown in Europe, the north of Africa, the temperate parts of Asia (wherever the warmth of the climate is not lowered by mountains), and on the east side of North America; in the southern hemisphere as yet but sparingly; in the torrid zone but little, and partly for the oil alone, as on the plateau of the Dekkan. The northern limits of its cultivation in Europe are at 65° in Norway, at 64° in Sweden and Russia. Flax is grown up to an elevation of 5500 feet above the sea, in the Alps.

But there exist within this area of distribution certain tracts in which the cultivation of flax is very considerable, while in others it is repressed. The countries south-east of the Baltic (Russia and Prussia) are the most important flax districts, from thence there is an exceedingly large exportation by Riga, Reval, Liebau, Pernau, and St. Petersburgh; a large portion of Northern Europe, especially England, derives flax in a raw or manufactured state from this storehouse. Belgium, Holland, and a part of France, form another flax district. Egypt is a third, chiefly supplying the countries of the Mediterranean with this important product. It will, perhaps, be thought strange that flax should thrive both in hot Egypt and in the cold regions of Russia as far as 64°; but this circumstance is explicable when we remember that flax is a plant which rapidly completes the cycle of its life, and that in the north it is an object of culture in summer, in Egypt in winter. In the latter country flax is sown in December or January, in the fields just quitted by the waters of the Nile, and is harvested in April or May; in the north, it is sown in April or May, and harvested in August or September. The conditions of temperature are thus not very different in these two places during the period of growth of the flax.

In the torrid zone, partly even in the sub-tropical countries, flax is replaced chiefly by cotton as a clothing-plant; in certain districts, also, by other plants; for example, in tropical America, by species of pine-apple and agave, the leaves of which contain fibres; in China, Japan, and in the South Sea Islands, by the *bast* of the paper mulberry; in New Zealand, by the New Zealand flax, as it is called (*Phormium tenax*); in Australia, by the *bast* of *Melaleuca linariifolia*. In the temperate zone, hemp as well as flax is a clothing plant.

Records of cultivation and use of flax lose themselves in hoary antiquity. In the second book of Moses, it is said that hail destroyed the flax and barley, when Moses was striving in vain to move Pharaoh to allow the departure of the Israelites. The Egyptian mummies are wrapped in linen, and thus furnish a decided evidence of the use of flax in the most remote past. It is related that the priests of Isis were clothed in linen, because wool, growing on the body of an animal, is not so pure a substance as flax, which is a product of the earth, and therefore worthier of the holy ones.

The use of flax among the Romans for linen and for the sails of ships is beyond doubt; its cultivation in Italy cannot be denied, since it is mentioned by Pliny and the writers on rural economy. In older times woollen clothes were more usual than linen, especially for those next the body, among the Romans, but the use of the latter was quite general in the time of the emperors. "Why is not the product of flax used in daily life?" says Pliny, in the first century after the birth of Christ. It is remarkable that flax and linen were also general north of the Alps; Pliny speaks of the use of linen among the Gauls and Germans, and says that the Batavi, the enemies of the Romans beyond the Rhine, were acquainted with it, and that their women knew no finer clothes than those made of linen. (Just as in Holland at the present day.)

Skins and wool certainly constituted the only materials of dress in Scandinavia in older times; but so early as the ninth and tenth centuries, the use of linen was greatly diffused, for not only the "Jarls," but even the free peasantry, used linen, and the serfs alone did not. In the old poem "Rigsmaal," *Ase Rig* comes into the house of the Jarl, where he finds husband and wife sitting; they are looking at each other and plying their fingers; the husband is twisting strings for a bow, the wife is looking at her arms and smoothing the linen; she afterwards takes an embroidered tablecloth of flaxen thread, white wheaten bread, swine's flesh, roasted birds, sour milk, and wine; and at the son's wedding, a fine linen is thrown over the bride and bridegroom at the ceremony; the new-born son is wrapped in *silk*. In the peasant's house the wife sits and spins, the husband cuts pegs for a loom; and the new-born son is wrapped in *linen;* when he is married, the *sheets* form part of the dowry. On the other hand, linen is not spoken of in relation to the third class, the serfs.

Yet it is doubtful whether flax was cultivated in the north in former times. It is indeed related, by Svend, of the son of Canute the Great, who ruled for a short time in Norway, that in the eleventh century he levied a tax, consisting of *unspun flax;* but on the other hand, there is evidence of a considerable importation of flax and linen into Norway, coming from England, and into Denmark and Sweden from the Hanse Towns, probably Flemish linen. It therefore appears, that the cultivation of flax was, at any rate, small in the north, in early times. Flax is first mentioned among the natural products, in Arent Berntsen's "Fruitful Glory of Denmark and Sweden," 1651. With the growing civilisation the use of linen constantly increased in the north, although the cultivation of flax did not keep pace with its use. Notwithstanding that the whole of Denmark lies to the south of the limit of flax-growing, it is far from providing for its own requirements in this important article.

In the present century, as we have seen above, another clothing material from the vegetable kingdom, cotton, has attained a wonderful diffusion, and contributed to limit the use of flax. We have seen, moreover, how the remarkable phenomenon of the manufactures of a material which is fetched from countries so distant as India, Brazil, and North America, being furnished at a cheaper rate than those of a substance which is produced in Europe, is owing to machinery, which greatly economising labour, renders the manufactured article so infinitely cheaper. The stiffness of the fibres of flax prevents its being treated so easily with machinery as cotton or wool, the short soft fibres of which are very readily combined; it is therefore only lately, and after many attempts, that flax has been spun by machinery. This important discovery has already caused a fall in the price of linen, and flax will perhaps, consequently, again diminish the consumption of cotton.

In the passage in his Natural History where Pliny speaks of flax, he remarks on the wonder that so great a power should be developed from so small a seed, that there should be a plant which can bring Egypt so near to Italy (inasmuch as navigation and commerce principally depend upon the product of this plant); but at the same time some rather absurd ideas entered into his head, for he grows angry that men should venture to brave nature by setting several sails on their vessels; he curses those who invented navigation, as well as those who brought it to pass that men should perish not only on the earth, but on the sea, without finding burial; he discovers in the rapid washing of flax, and in the zeal with which it is cultivated, a proof that man hastens his own misfortunes; nay, more, he regards the circumstances that flax exhausts the soil, and that it must be pulled up in order to be used, as proofs that the cultivation of this plant is a strife against nature.

If Pliny had lived in our days, he would have found the wonder still greater; for he would then have known not only that this little seed gives birth to a product which clothes nations and carries ships across the ocean, but that this product, after it is worn out, plays a still more important part; that it not only conveys thoughts from man to man, but from individuals to thousands and millions; that it diffuses knowledge and enlightenment among the many different nations of the earth, and carries the Gospel to our antipodes. Whether he might have then looked with dismay at the error and mischief which paper has spread abroad in the world, I cannot venture to decide; but I doubt it, for I think that paper would have put an end to such narrow views in him, as in the naturalists of the present day.

CHAPTER XXIV.

THE PEPPER PLANT.

The pepper-plant (*Piper nigrum*) is a climbing shrub, with opake, leathery, dark-brown, smooth leaves. The very small flowers are seated on a thick, fleshy, pendant spike or club-like body. After the flowers have faded, come the reddish brown berries, each of which contains *one* seed.

This climbing shrub is increased by cuttings, and trained either on sticks and posts or on trees, between which it hangs down in festoons, like the vines among the elm-trees in many districts of Italy. The looser branches of the trees on which the pepper-plant is trained are usually lopped, and the upper ones pruned into the shape of a fan, in order that the pepper-shrub may spread out conveniently upon them. In Malabar the mango-tree is often employed for this purpose, but its fruits, otherwise so excellent, are rendered perfectly uneatable by the evaporation from the pepper; in the Indian Archipelago the Dadap-tree (*Erythrina corallodendron* and *indica*) are principally used for this purpose. The nature of the soil has not any very important influence, because the pepper-plant absorbs the moisture of the atmosphere very actively; but a moist, and at the same time glowing hot climate (80°—84° Fahr.), is requisite. It is usually gathered twice a year. The first crop is yielded in the third year; the best and richest from the fifth to the eighth year; in twenty years it becomes perfectly useless. The berries are pulled off before they are quite ripe; they are dried on mats in the sun, which renders them black and wrinkled; they are then packed in bags as *black pepper*. *White pepper* is not a peculiar species, but is obtained by steeping the berries in water or lime-water for eight or ten days, which loosens the outer shell, so that it can be easily peeled off. Of this kind, which has a milder flavour, comparatively little is brought to Europe—for instance, only one-fortieth of the entire consumption in Denmark; but it is much esteemed in China.

The *area* of the *cultivation* of the pepper-shrub is *very limited.* It is not grown further north than Goa, 15° N. L., and on the northern part of the Siamese Gulf, at about 12°;

nor further south than 5° S. L.; nor further westward than the Malabar coast; nor more eastward than Siam and the east coast of Borneo, thus between 75° and 120° eastward of Greenwich, with the exception, however, of a few plantations in Cochin China. It therefore occurs only in the most southern parts of the two Indian peninsulas, in the peninsula of Malacca and the islands near it (for instance, Pulo Penang), and in the Sunda Islands, as also in Ceylon.

According to Crawfurd, the production is as follows:

Sumatra	28,000,000 lbs.
The other Islands of Polynesia	6,300,000 „
Siam, Cambogia, and Malacca	11,700,000 „
Malabar	4,000,000 „
	50,000,000 lbs.

The Malabar pepper is the best. The exportation from Malabar and Sumatra goes chiefly to Europe and North America; from Siam, only to China; from the other points, pepper is sent both to the east and to the west. The natives of Sumatra, and the other parts of Polynesia where pepper is so widely diffused, use it only as a medicine.

The consumption in Europe is estimated at 16,000,000 lbs., that is, about one-third of the whole production. If the population of Europe is estimated at 230,000,000, it would give rather more than 1 oz. annually to each person, if all used pepper, and in equal quantity. The present consumption in the British Islands amounts to about 2,000,000 lbs., one-eighth of that of Europe, and more than 1¼ oz. for each person. In the year 1615, only 500,000 lbs. were imported into England.

In the kingdom of Denmark, the average annual importation for twelve years (1832-1843) was 37,490 lbs., which gives about half an ounce for each person.

The price has fallen greatly in recent times, partly on account of increased production, partly on account of the opening of the East Indian trade. In England it amounted, without the tax, to about:

1814	1s. 0d. per lb.
1822	5½ „
1830	3½ „
1832	4 „

According to Buchanan, the pepper-shrub is found wild on the Malabar coast, and in no other place; this statement, the circumstance that the cultivated pepper is finest here, and that it has no aboriginal name elsewhere,* indicates that pepper has migrated from hence toward the east. It is remarkable that it only extends, in the Indian Archipelago, as far as the Hindoo civilisation is shown, by other memorials, to have extended. This diffusion of the pepper-culture, in spite of the comparatively narrow limits of its area, is still so considerable that, as above mentioned, the production in the original home constitutes only about one-twelfth of the whole.

Pepper was known to the ancients as an Indian production. Pliny says, that in antiquity so high a price was set upon it that it was weighed out with gold or silver, which, however, must not be taken literally, but only that it was sold by weight at a very high price. The contribution which Alaric laid upon the city of Rome, in the fifth century, included 3000 lbs. of pepper. It appears that the pepper which was obtained in Europe in ancient times came solely from Malabar and Ceylon; but in the middle ages, the Venetian traveller, Marco Polo, already speaks of pepper from the islands lying further east. The Arabs brought pepper to Aden and Socotra, from whence it came chiefly by Alexandria to the countries of the Mediterranean. The Genoese and the Venetians gained extraordinarily by this, as they took an enormous profit on the article. Subsequently, after the Portuguese had discovered the road round Africa, the profit diminished; but when they had acquired dominion in the Indies, the price again rose, so that in this respect Europe gained nothing by the new road. Still greater was the profit of the Dutch at a period when they had a monopoly, and, besides, intentionally limited the production. They were gradually robbed of this vast profit, chiefly by competition of the English.

The Spanish pepper, as it is called (*Capsicum annum*), as also the Cayenne pepper (*Capsicum baccatum*), belong to another group of plants, the family of the potato. They are American plants, which are used in that continent on account

* It has one, however, in Siam also.

of their burning taste, instead of the pepper of the Old World. The betel, however (*Piper betel*), belongs to the pepper genus, and like the black pepper, is a climbing-plant; but its use is quite different. The leaves, namely, of this plant are chewed, in combination with the Areca-nut (the fruit of a kind of palm) and lime, in the same way as tobacco, a custom which is extraordinarily diffused in tropical Asia. The area of its cultivation is hence much wider than that of pepper, but as it is not used in other parts of the world, the betel does not play such an important part in general commerce as pepper.

CHAPTER XXV.

THE CLOVE-TREE AND THE NUTMEG-TREE.

The clove-tree (*Caryophyllus aromaticus*), belonging to the myrtle family, is a handsome tree, as tall as our cherry. The trunk is slender, has a smooth bark, and the branches form a beautiful crown. The leaves resemble those of the bay-laurel, and remain upon the tree during the greater part of the year. The flowers, which are developed in the rainy season, are borne in corymbs; the calyx is blended with the germen, fleshy, bright red, and its limb four-parted. The four leaves of the corolla are blended at their borders, and thus form a kind of cap. The fruit is a longish brown-violet berry. What we call cloves are the blossoms—namely, the calyx and closed corolla; they are remarkable for their strong aromatic, and at the same time pungent flavour, which remains long upon the tongue. Besides the direct use as spice, the waste from the gathering (in particular the flower-stalks) is used for the preparation of oil of cloves. The harvest of cloves is gathered from October to December. The ground beneath the trees is cleaned, and the bunches of flowers picked by hand and by means of crooked sticks. The cloves are then laid upon woven mats and exposed to the smoke of a slow fire, which renders them brown; they are afterwards dried in the sun, and there acquire the dark-brown colour they possess when exported.

Five or six pounds are reckoned as the average yield of one tree; but the crop varies very much in different years. A clove-tree ordinarily attains the age of seventy-five years, but there are examples of trees living 100 or 150 years.

Few plants have naturally so limited an area of distribution as the clove-tree. Originally it was found only in the five very small Molucca Islands, especially on the island of Machian. Shortly before the advent of the Europeans it was conveyed to Amboyna, but it does not thrive so well there, and requires greater care. The Javanese, who were in possession of the clove trade before the advent of the Europeans, have tried in vain to transplant the tree to Java. The Europeans have carried it to the island of Mauritius and to

Cayenne, but the cloves produced there are but poor, and the cultivation probably only pays on account of the Dutch keeping the cloves which come from Amboyna at an incredible price, by an artificial system of trade. It is remarkable that the original inhabitants of the Moluccas do not use cloves, and have only learnt their importance from the demand of foreigners.

The *nutmeg-tree* (*Myristica moschata*) is a handsome tree, forty or fifty feet high, with spreading branches and evergreen leaves. The flowers are borne in small bunches, and bear some resemblance to the lily of the valley. The fruit is like a peach; it is green at first, but as it ripens, acquires a reddish colour. It then bursts in the furrow which runs round it, and the carmine red covering of the seed (the *arillus*, an expansion of the stalk of the seed) emerges; this *mace*, as it is called, forms a network round the seed or *nutmeg*.

The tree bears flowers and fruit during the whole year, but the fruit is only gathered at three periods, namely, in April, July, and November. The first gathering yields the best, the second the most abundant product. The tree bears in the ninth year, and attains an age of seventy-five years.

The pulp, which is indeed juicy, but at the same time astringent and disagreeable, is thrown away; the mace is then separated from the nut, and dried in the sun, which causes its bright red colour to pass into pale red, and finally into light yellow, such as it appears in commerce. The nut is dried for three days in the sun, and then exposed to the smoke of a slow fire for three entire months, then freed from its shell, next dipped two or three times in lime and salt water, and finally dried once more, which requires two months. All this is done to preserve the nut from insects. Some, however, assert that it is done with intention of destroying the power of germination, so as to prevent the diffusion of the nutmeg-tree. Crawfurd assumes that the whole of this expensive and tedious mode of treatment is superfluous, and that the nuts should be exported in their shells, which would best protect them. The increased cost of transport of the heavier goods would, he believes, be repaid by the saving of that tiresome labour and the careful packing. A good tree yields annually 10 lbs. to 14 lbs. of nutmegs and mace together.

Although the natural diffusion of this tree is confined to a limited area, this is not so narrow as that of the clove-tree. Originally this tree grew wild in most of the eastern islands of the Indian Archipelago, and even on the north coast of New Holland and Cochin China; but the limits within which the tree would yield good fruit were at first more confined, namely, New Guinea, Ceram, Gilolo, Ternate, Amboyna, Booro, and the surrounding islands.

While the English had possession of the Spice Islands during the last war, they transplanted the tree to Pulo Penang and the West Indies, but it did not thrive at all in the latter, and in the former place the tree afforded such a mediocre product that it fetched but a low price. It has also been transplanted to the Mascarenhas Islands, and its cultivation has been attempted in Brazil.

The use of the nutmeg was just as foreign as that of cloves to the aborigines of the native islands.

In Europe, neither cloves nor nutmegs were known in antiquity. The first traces of the knowledge of cloves are met with during the decadence of the Greek empire. The Arabs first brought cloves to Europe, and in the Arabian writers we find the first traces of the nutmeg; they obtained these spices from Java, whither the Javanese, who had a considerable commerce at that time, brought them from the Spice Islands.

After the route round Africa had been discovered, the Portuguese, English, Dutch, Javanese, and Chinese, at first competed in the spice-trade, which was then perfectly free. But about the commencement of the seventeenth century, the Dutch monopolised the production and the trade. They extirpated the clove-tree in the five Molucca Islands, in which it was originally indigenous, and restricted its cultivation to the little island of Amboyna, in order so to make themselves sole possessors of this product, and to place themselves in a position to determine the price according to their own inclination. They likewise, as far as they could, destroyed the nutmeg-tree in all the islands where it was found, and restricted its culture to the three small Banda Islands. In order to carry out this system of destruction effectually, the Dutch not only destroyed the trees themselves, but distributed gifts among the native princes, under an engagement from them that they should extirpate these in their territories. This naturally gave rise to great dissatisfaction among the natives, and often led to the shedding of blood and to wars. The Dutch sent a fleet annually to examine whether the princes had fulfilled their promises. In the island selected for the cultivation of the clove-tree (Amboyna) the natives were allowed to grow it, but the trees were counted once a year, and the product was required to be given over yearly to the government at a fixed price.

The nutmeg-groves were let chiefly to invalids and speculators, and their descendants are the present prosecutors of the branch of food-growing, with the aid of two thousand slaves. The natives have been, for the most part, driven out. The product of the nutmeg-trees is also required to be given up to the government at a fixed price. Contraband sale of nutmegs is punished, among the slaves and lower classes, with death, among the higher ranks with banishment.

This system of monopoly is still upheld, although apparently it has been somewhat moderated very recently. It has produced evil effects on every hand:

1. To the inhabitants of the islands where these productions were destroyed, since they were robbed of the opportunity of profiting by the gifts furnished them by nature.

2. To consumers generally, since the price was unnaturally exalted. The present price of nutmegs in Europe is (without duty) twelve times the natural price at the place of purchase, which is shown by the comparison with the price of pepper, the cultivation and trade of which has remained free, and which stood at the same price as nutmegs while the commerce was unrestricted. In like manner, the price of cloves is twenty-one times the natural price at the place of purchase. The price is now the same as it was two centuries ago, while the price of unmonopolised spices has fallen greatly. Pepper was formerly almost as dear as cloves. It is partly in consequence of this that the production and consumption of these spices has diminished. At the commencement of the seventeenth century, when the trade was free, 3,500,000 lbs. of cloves were produced in the Moluccas; o the introduction of the monopoly, the production sank a once to 800,000 lbs., and now amounts to only 700,000 lbs At present, 750,000 lbs. of nutmegs (nut and mace) are pro duced on the Banda Islands. Crawfurd estimated the con

sumption of nutmegs in Europe, about 200 years ago (before the monopoly), at 550,000 lbs.; in the middle of last century, at 250,000 lbs.; and in the year 1810, at 110,000 lbs. After the English had conquered the islands, and transplanted the nutmeg-tree to Pulo Penang and other places, the consumption rose to 450,000 lbs., which is less, therefore, than it was two centuries ago, notwithstanding that the population of Europe has so increased both in numbers and in wealth.

3. To the producers—for as they must deliver the product at a fixed price, while in regard to the cloves the number of trees is fixed, there exists no stimulus to industry. Of the price which the clove-producers obtain, in the first place one-ninth is deducted for the military and civil officials, and from the remainder one-fifth is again taken, half of which goes to the rajah, and half to the elders of the race who superintend the cultivation.

4. And lastly, to the government. For since the product is so small, and the supervision expensive, the net receipts, in spite of the enormously high prices, are small, and, doubtless, much smaller than they would be under a moderate tax or a moderate duty, with free production and open trade. The government is constantly troubled by the producers requiring a rise in the legally fixed price, which demand it has frequently been obliged to grant.* The monopoly, and the compact to take the entire product, lead to the formation of great accumulations in store, which often spoil. When the English conquered the Banda Islands, in 1810, they found in the magazine 37,000 lbs. of nutmegs fallen into dust.

Thus the history of these spices affords a striking example of the destructive operation of the system of monopoly; certainly the system has been driven to its extreme limits in this instance, and stands exposed in its vilest form; but we find more or less of the same unwholesome effects in monopoly generally.

* The price allowed by the government to the producers is five times that which prevailed during the free trade.

CHAPTER XXVI.

THE TOBACCO PLANT.

THE plants belonging to the tobacco genus are, with few exceptions, annual herbs, with undivided, broad, and somewhat fleshy leaves; the flowers have a five-toothed calyx, five-parted corolla, and five stamens; the fruit is divided into two chambers. The tobaccoes belong to that natural family which Linnæus called the "suspicious," and to which the henbane, thorn-apple, belladonna, and several of the most powerful narcotic poisonous plants, belong, as also, however, the potato. In a fresh condition the plant has little smell or taste, but when dried, the leaves acquire a stupefying smell, and a very sharp, bitter flavour. Tobacco, like the potato, is indigenous in America.

Considering that this plant affords no edible fruit, root, or other nutritious part, that it is distinguished neither by beauty nor sweet odour, but, on the contrary, has a disagreeable smell and taste, produces, when eaten, nausea, vomiting, and giddiness, and in larger quantities is even deadly,*—dwelling only upon these properties of the plant, it was a result very little to be expected that it should come to play any part besides that of a medicinal agent, still less that it should become an important object of cultivation, of manufacture, and of trade, employing many thousand human beings, and consumed by millions. But experience has proved the reverse, and shown here, as sometimes happens with persons, that those of whom one least expects it, rise to high honour and dignity.

The Spaniards found this plant in America when they arrived there. It was stated by the earliest travellers that the natives used it medicinally, especially as an important application to wounds.

It is likewise related, that it was customary for the higher personages of the Mexican court to smoke cigars. When the English founded colonies in North America, they met with the same custom among the natives, especially in Virginia. Europeans seem to have first made acquaintance with

* Nicotine, as it is called, an alkaloid substance contained in tobacco, is so strong a poison that four or five drops will kill a dog.

tobacco in the Antilles, for the name "tobako" is Haytian, (in Haytian, properly not the plant, but the pipe through which it is smoked), while in Mexico it is called *yete*, and in Peru *sagri*. It is erroneous to suppose that it derived its name from the island of Tobago.

An Italian, named Benzoni, who travelled in the West Indies in the years 1542-1546, thus half a century after the discovery of America, treats at length of the consumption of tobacco. Not long after, namely in 1559, tobacco was transplanted, as a medicinal herb, to Lisbon; and the French ambassador to Portugal, Nicot, in honour of whom the plant received its botanical name, *Nicotiana*, sent seeds of it to Queen Catherine de Medecis, whence the plant acquired in France the name of the "queen's herb;" while in Italy it was called Herbe de St. Croix, and Herbe de Ternabou, because the Papal Nuncio in Lisbon, St. Croix, and Ternabou, the ambassador to France, conveyed it into Italy. In 1586, the English colonists who returned from the settlement founded in Virginia by Sir Walter Raleigh, brought tobacco with them to England; and Raleigh's companion, Harriot, relates that the English learned tobacco-smoking from the Indians. Through Raleigh and other men of fashion, this custom spread rapidly in England, and soon after likewise in Holland, Spain, France, and Portugal. The fashion is said to have passed into Holland by means of the young Englishmen who went over to Holland to study. The custom seems also to have spread with great rapidity to Turkey, Persia, India, Java, and even to China and Japan. Already in 1601, therefore scarcely fifty years after the introduction of the plant into Portugal, tobacco-smoking was known in Java and in China, and it is believed that the custom is still older in Japan. Some conclude from this that tobacco was known in Asia, especially Eastern Asia, before the discovery of America. They state that the species cultivated in China is different from the American species, and also that the species grown in Persia, which furnishes the renowned Shiraz tobacco, is an indigenous Asiatic species. But the essential ground for assuming that tobacco has been introduced into Asia, lies in the fact that it has not a special name there, and that throughout India, in Java, China, Japan, and the Lochoo Islands, it has kept the name of tobacco, except in Arabia, where it is named by a word signifying smoke. But it is possible that the Chinese, after having learnt the use of tobacco from the Portugese, may have applied a native, nearly-allied plant* to the purpose, and that the same may have occurred in Persia in reference to the Shiraz tobacco.

The use of tobacco, like all novel customs, necessarily experienced attacks and persecutions; but it also had its active defenders and diffusers. In the former respect, the diatribe of the English king, James I., against the smoking of tobacco, which appeared in 1619, under the name of *Misocapnos*, is a remarkable work. He advances how unworthy it is for a civilised nation to adopt habits from such barbarians as the wild Americans; that the use of tobacco is injurious to health, weakens the body, dulls the understanding; that it brings uncleanliness with it, and acts mischievously upon the tone of social life; that if tobacco-smoking should increase in the way it has commenced, women would at last be compelled to have recourse to it, otherwise they could not bear to live with their stinking husbands; and he concludes his treatise with the following strong expressions: "Have you not, then, reason to forbeare this filthy noveltie, so basely grounded, so foolishly received, and so grosslie mistaken in the right use thereof? In your abuse thereof, sinning against God, harming yourselves both in persons and in goods, and raking thereby the markes and notes of vanitie upon you; by the custome thereof, making yourselves to be wondered at by all forreine civill nations, and by all strangers that come among you to be scorned and contemned: a custome loathsome to the eye, hatefull to the nose, harmfull to the braine, dangerous to the lungs, and in the black stinking fume thereof nearest resembling the horrible Stygian smoke of the pit that is bottomless." It must be observed, however, that although James was really an enemy to tobacco, which is shown by his forbidding its cultivation in England, this essay was rather the fruit of royal caprice than of full earnestness; hence it was superscribed "A Royal Joke against the Abuse of Tobacco," (*Lusus regius de abusu Tabaci*). But it was, nevertheless, refuted in perfect seriousness by some Jesuits in Poland, in a treatise called *Antimisocapnos*. It is evident

* The Chinese species is said to stand so close to *Nicotiana Tabacum*, that it may be a variety produced by cultivation.

King James preached to deaf ears. Tobacco-smoking increased in England to an extraordinary degree, and did not begin to diminish again until the last half of the last century, when it did so to some extent, on account of persons of the higher ranks no longer considering it quite elegant to smoke tobacco; but the use of snuff increased.

On the other hand, a certain Raphael Thorius, in 1628, wrote a hymn in honour of tobacco, while Pope Urban the Eighth excommunicated those who took snuff in the churches.

One thing which greatly contributed to diffuse the use of tobacco was the ease with which this plant could be cultivated in most climates, so that it was not long before the growth of it was commenced in various parts of Europe, Asia, and Africa. In some countries, however, its culture was either wholly forbidden, or subjected to numerous restrictions. From the constantly increasing consumption, the governments found this article of luxury very well adapted for becoming a source of income to the state. It thus happened that all tobacco-trade became a royal prerogative, the governments selling the tobacco at a very high price. The consequence of this was, that either the cultivation of tobacco must be forbidden, or only allowed under condition of handing over all the product at a fixed low price. This arrangement existed until very lately in Cuba, and still prevails in Mexico, two countries particularly well fitted for the cultivation of tobacco. The tobacco is only allowed to be grown at particular places, and it must be delivered up to the officers of the government; a few officials are distributed about the country, in order to pull up all tobacco-plants found elsewhere, and they have to see to the delivery of the tobacco in the districts where the cultivation is permitted. It is natural that such a system should give rise to much infraction of the law and extortion.

In many countries where the tobacco-trade is not a royal monopoly, an extremely high duty is laid upon the article.

In Great Britain the growth of tobacco is forbidden. In other countries the home production of tobacco has been encouraged, as in Pomerania, Silesia, and also, formerly, in Denmark, where a little is still grown near Fredericia.

The cultivation of tobacco has become diffused over the greatest part of the torrid and temperate zones. The north limit in Scandinavia is at 62°—63° N. L.*

Most regions of America produce excellent tobacco, especially Virginia, Carolina, Venezuela, and Cuba, and these are also the places which furnish the greatest quantity. Of 33,000,000 lbs. imported into England in 1831, 32,000,000 lbs. came from the North American States. Cuba exported, in the year 1840, 200,000 boxes of cigars, or 200,000,000 cigars. If we estimate the average price of a box containing 1000 cigars at 15 piastres (2*l.* 12s. 6d.), the foregoing gives a value of 3,000,000 piastres (525,000*l.*)†

Brazil also exports a great quantity of tobacco; according to Martius, 3,000,000 lbs. were exported from Rio Janeiro alone in 1817. In Europe, the most important cultivation is carried on in Holland, Flanders, Alsace, in the Palatinate, Hungary, in the Ukraine, and Turkey; but the tobacco grown in these places is inferior to the American. In the Levant, on the contrary, the tobacco is excellent. India and the Indian Archipelago produce much tobacco. In Java the young plants are raised on the mountains, at an elevation of 2000-3000 feet, and sold by the mountaineers to the inhabitants of the plains, who plant the young seedlings in the fertile low grounds. Still more is grown in China and Japan. Tobacco has also been introduced into the Cape and Australia.

According to the average of the years 1832-1843, duty is levied upon 2,400,850 lbs. annually, for home use in the kingdom of Denmark; of this, 2,279,034 lbs. are tobacco-leaves, so that about nineteen-twentieths are manufactured within the country itself.

If we calculate how much of the various principal kinds of tobacco comes from a certain quantity of leaves, and add to this the imported manufactured tobacco, we obtain something like the following figures, which, however, are somewhat doubtful, because I am not in a condition to reckon accurately the proportion between tobacco for smoking and that for chewing. It must be observed here that the leaves which are used for tobacco, especially for chewing-tobacco, from the additions they receive in the manufacture, yield more, and in

* The author has seen tobacco in the bishopric of Bergen.

† According to Liebman's account.

reference to the latter kind almost twice the quantity, and that the waste of raw tobacco-leaves is slight. In this way we get a greater quantity of tobacco consumed than is introduced in the form of leaves.

Smoking-tobacco (including cigars) and chewing-tobacco	2,336,175 lbs.
Snuff	576,040 lbs.

If we then take as the annual average—

12 lbs. for a smoker and chewer,
6 lbs: for a snuff-taker,

we obtain

194,681 smokers and chewers,
96,006 snuff-takers

290,687 consumers of tobacco.

Assuming, then, that one-fourth of the snuff-takers are women (24,000), there remain about 267,000 men who use tobacco. Now, as there are 400,000 of the male sex above fifteen years in Denmark, it follows that out of forty grown-up men, twenty-six to twenty-seven, that is, considerably more than half, are consumers of tobacco.

CHAPTER XXVII.

THE MISTLETOE.

In Nature we are accustomed to see the organised bodies which, from their reciprocal resemblance, are accounted members of the same natural groups, retaining their agreement both as to form and vital functions in all essential points, and also that the differences within individual groups, as well as those between different groups, do not occur without mediating transitions. Hence we are surprised when we sometimes come upon isolated forms or physiological arrangements, and we strive, by more minute investigation and the enlargement of the sphere of observation, to reduce the deviations under general laws.

We are amazed when we find a group of animals among the Mammals which fly in the air (the bats); among birds, a genus which lays its eggs in the nests of other birds, and leaves the care of providing for its young to them (the cuckoo); or when, among the fishes, we find one which climbs up trees (the climbing perch of the East Indies). I shall now call attention to a similar anomaly in the vegetable kingdom. It is exhibited in the plant known as the mistletoe, or bird-lime (*Viscum album*).

Let us imagine that on a winter's day we see upon the branches of an apple-tree a bunch of intercrossing yellowish-green twigs, bearing leaves of the same colour. The unusual character of this sight arrests our attention. Perhaps we at first suppose it to be a climber, like the ivy, which, although fixed in the ground by its root, has wound itself up the trunk, and become attached to this and the branches by means of its sucker-roots; but this idea must soon be abandoned, for we see nothing of it on the lower part of the trunk, only at the top. We then cut off the apple-branch, to examine the yellowish-green plant more closely. We see that it is wood, just as the apple-tree is; that annual rings occur in its wood, as in other trees; and when we trace its numerous crossing shoots to their origin, we find that the main stem springs from the branch of the apple-tree; we discover, moreover, that the union is not confined to the barks, but that the wood of this plant is connected with that of the apple, somewhat as a graft is connected with the wild stock upon which it has been grafted. But the matter only becomes more strange from this, for it is very readily perceived that the apple-tree cannot have become so changed as to be able to send out yellowish-green forked shoots, and to bear leaves, thick leathery leaves too, in winter. As little can the apple-tree bear little leathery flowers with a four-parted envelope, or a berry filled with tenacious glue, instead of an apple. And we are equally unable to suppose it to be a graft, for not only do we know that only nearly-allied plants can be grafted on one another, while the mistletoe is extremely different from the apple, but we seek in vain for the mistletoe upon the ground. It is met with only upon trees which all differ in the highest degree from it. Consequently, there is nothing left for us but to suppose that the mistletoe is propagated by seed upon the tree itself, and obtains its nourishment from this, and need not, like other woody plants, grow upon the ground, and draw its principal food from it. We have, then, before us a true *parasitical plant*, and it is a parasitical shrub of quite as complex structure as other completely developed plants.

We readily find the seed in the glue which fills the berries, and if we open a seed, we are struck by finding, not, as in the generality of seeds, one germ of a new plant, but either two or three* (in the latter case the seed is triangular, in the former, oval), and that during germination the radicle, which is close to the end, grows out from each germ. Another striking peculiarity is, that while the germs (or embryos) of most seeds are white, or at all events not green, they are green here. The rootlet which grows out in germination is also green, while roots in general never have this colour. It is well known that the radicle of plants generally has a definite tendency towards the earth, so that when a seed is reversed, that is, placed with the radicle turned upwards, this makes a curve and grows towards the ground. The seed of the mistletoe has not a tendency towards the earth, but towards the interior of the branch upon which it rests; therefore, if it is upon the upper side of the branch, it has a tendency down-

(* One seed is most common, three very rare in the ripe fruit.—Ed.)

wards, while if the enveloping glue fixes it to the under side, it grows upwards. One of Dutrochet's experiments showed that this tendency to the interior of the long branch, is an endeavour to seek the dark. When he placed mistletoe seeds on the inside of a window, the radicle grew in towards the darker room; while if he placed them on the outside, it strove, no matter in what position the seed was placed, to grow towards, and not away from the glass. The attempt to make the plant grow in earth or water is vain. It succeeds only on another tree. When the seed germinates upon a tree, a kind of thickening is produced in the bark of the latter, at the spot where the radicle is in contact—much as when the bark of a tree is attacked by certain insects; the root-fibres then shoot through the swollen and injured bark down into the wood, and spread out partly in the bark, and partly between the bark and the wood. They gradually grow thicker and become woody, like the roots of any other woody plant; the tree upon which the plant grows, deposits the new annual layers of wood around the roots of the mistletoe (like those of a stock around its graft), and thus originates the close connexion which we see between the full-grown mistletoe and the tree upon which it grows. The branches of the mistletoe grow in all directions, and divide into widely spreading little shoots; thus giving rise to that close interlacement of branchlets which clothes the apple-tree.

There can be no doubt the mistletoe derives its nourishment from the tree upon which it grows. The stiff, leathery leaves could not, like the leaves and stems of succulent plants, absorb moisture from the air, and experiments have shown that colouring matters pass from the wood of the tree into that of the mistletoe; and if the mistletoe is abundant, the tree upon which it grows suffers. Instead, therefore, of drawing its nourishment from the earth or air like other plants, the mistletoe derives it from another vegetable. Yet it cannot be assumed that it absorbs the descending, elaborated sap, but only the crude ascending sap. We are led to conclude this when we see that the mistletoe has leaves, and, in fact, *green* leaves, and is provided even with the organs which especially serve to elaborate the sap in plants, and moreover, when we observe that mistletoe flourishes equally well upon different trees, which could not be supposed if it took up elaborated saps, which would then be of different kinds. Yet, although it is thus the crude sap which is absorbed by the mistletoe, this must not be supposed to resemble the crude nutrient fluid which plants in general take up from the soil, for it is well known that at a certain height in the trunk, the latter has already undergone a chemical change, and the fact that the mistletoe will not grow in earth or water, also indicates this, although this may, indeed, arise partly from the absence in the roots of the organs through which the nutrition elsewhere takes place.

The mistletoe is found on many different trees—on apples, pears, and other orchard-trees, on the mountain-ash, the elm, the willow, the lime, the ash, the poplar, the beech, the oak (but not frequently), nay, even on Coniferous trees. In the north it occurs but seldom, and only within very restricted local conditions; in Zealand it is found only near Petersvaerk and Vemmeltofte; in old times it was found near Fredericia; in Holstein, near Neumünster; in Norway, on some islands in the Christiania fiord; in the south of Sweden it is much more frequent, but likewise very much scattered within its area of distribution—for instance, near Christianstad in Schoonen, Kinnekulle in West Gothland, in the island of Mälar, &c., in Bleking, Smaaland, and Halland. In Central and Southern Europe it is more frequent. Its diffusion extends to the most southern parts of Europe, for I have seen it upon Mount Etna.

In the greater part of Europe, the mistletoe is the only parasitical shrub, the only one of the more perfect plants which draws its nourishment out of the trunk and branches of another tree. But if we extend our inquiries to other parts of the globe, we see this fact, isolated in the north, connected with others, and the peculiarity thus loses some of its importance. Even in Austria and Hungary, we find a nearly-allied parasitical shrub, *Loranthus europæus*, which, indeed, is not rare in the south of Europe. Out of Europe, especially in the tropical countries, several hundred species of both these genera are met with, which are all parasites upon trees.

But we find an extension of this phenomenon in another direction also. We have, in Europe, certain parasitical plants which grow upon the roots of other vegetables (trees or herbs), such as *Monotropa hypopitys*, the species of *Orobanche* and *Lathræa squamaria*. In these, the rootlets of the parasite penetrate the roots of the plants, as those of the mistletoe do into the stem, or else they are interwoven with the extreme, delicate fibrils of the root upon which they occur; and it seems as if, in the last case, the nutrition was carried on by the root-fibrils of the parasite absorbing the moisture from interposed roots of the foster-plant.

These root-parasites are distinguished from the mistletoe by the fact that they are of a pale yellow, or, at least, by no means of a green colour, and that they are destitute of perfectly-developed leaves, which appear only in the form of white, yellow, or brown scales. The Dodders (*Cuscuta*) form an interesting transition from the ordinary plants growing in the ground, to parasites. Their seeds germinate in the earth; the extremely weak, thread-like growing stem winds up another plant, and shoots little papilliform processes into it; the lower part of the stem gradually decaying, the nutrition is then carried on solely by these papillæ; in this condition, the plant can wind from one plant over to another, and send new absorbing organs into the latter. It thus becomes a very mischievous weed, as, for example, upon flax.

Transitions toward the parasites have been found even among the twining-plants, that is, plants which wind round other plants or lifeless objects, without drawing nourishment from them. There have been instances of *Convolvulus arvensis* sending papillæ into the substance of the plant on which it grew, while ordinarily it only twines around it, and is rooted in the soil.

It is not a matter of surprise that a plant of such peculiar aspect, and which occurs in such a remarkable position, as the mistletoe, should have awakened the attention of various races, and exerted influence over their religious ideas. It played an especially important part among the Gauls. The oak was sacred with them; their priests abode in oak-forests. Oak-boughs and oak-leaves were used in every religious ceremony, and their sacrifices were made beneath an oak-tree; but the mistletoe, when it grew upon the oak, was peculiary sacred, and regarded as a divine gift. It was gathered, with great ceremony, on the sixth day after the first new moon of the year; two white oxen, which were then for the first time placed in yoke, were brought beneath the tree; the sacrificing priest (the Druid), clothed in white garments, ascended it, and cut off the mistletoe with a golden sickle; it was caught in a white cloth held beneath, and then distributed among the bystanders. The oxen were sacrificed with prayers for the happy effects of the mistletoe. A beverage was prepared from this, and used as a remedy for all poisons and diseases, and which was supposed to favour fertility. A remnant of this seems to exist still in France; for the peasant-boys use the expression, "au gui l'an neuf," as a New Year's greeting. It is also a custom in Wales* to hang the mistletoe to the roof on Chrismas-eve; the men lead the women under it, and wish a merry Christmas and a happy new year. Perhaps the mistletoe was taken as a symbol of the new year, on account of its leaves giving the bare tree the appearance of having regained its foliage.

The mistletoe also occurs in the Northern mythology, particularly in the Balder Myths.†

Balder was the wisest, the most eloquent, and the most pious among the Asen (demi-gods); he diffused light around him, and nothing unclean was suffered to be near him. But it was prophesied that he should die, and unquiet dreams made it known to himself. Then did Freya, his mother, obtain oaths from all existing things that they would not injure him—from fire and from water, from trees and all metals, from all animals, snakes, and from all diseases. It then became an amusement in the assemblage of Asen to cast weapons at him, and strike him; for nothing hurt him, and the Asen rejoiced. But the wicked Loke was angered at it. Putting on the shape of a woman, he asked Freya whether

(* Not in other parts of Great Britain? Our author does not seem fully to understand this custom.—Ed.)

† The expression in Voluspa, xxix, that the mistletoe was slender and fair, and rose from the ground, might lead to doubt whether this could mean our mistletoe; hence some have given other explanations; but the circumstance that the Icelandic name, *Misteltheinni Voluspa*, corresponds to the name *mistel*, in the Northern languages, seems decisive for the ordinary interpretation of the word. It is not only called *mistel* in Germany and Denmark, but also in Norway and Sweden; we find the same name in the English *missel* and *mistletoe*, and the Anglo-Saxon *misteltan*; and as, in Icelandic, *tein* signifies a slender stick, the Anglo-Saxon *tan* means a branch; and the Danish word *teen*, still used for the slender iron of a distaff, likewise signified a branch or twig, in the old language. In West Gothland, in Sweden, the mistletoe is called *vispelten*.

nothing in the world could hurt Balder. Freya then said that she had not obtained an oath from the mistletoe, because it seemed too young and thin to require an oath from.* But Loke went and cut a spear from it, and persuaded the blind Hodur that he also should confer on Balder the honour of throwing a weapon at him. Hodur took the spear, and when he cast it at Balder, the latter fell to the earth dead. All the Asen were speechless with sorrow; the heart of Nanna, Balder's wife, broke, when she saw the corpse of Balder carried to the ship on which the funeral-pyre was to be lighted. But Freya sent Harmoder to the world below to buy Balder free. The answer was, that now was the time to find out whether Balder really was so amiable and so beloved as men said; if all things, without exception, upon the earth, living or lifeless, mourned for him, he should return. The Asen sent messengers over the whole world, and all mankind, all animals, trees, and rocks, shed tears; but as the messengers returned, they met a Jette woman, named Thock, who refused to shed tears, and said: "Let the Shades keep their prey." It is believed that this was Loke, who had assumed the woman's shape.

* The mistletoe, although woody, is rather slender. If this insignificance had not been mentioned expressly as the cause of its being passed over, we might have been inclined to seek it in the fact of its not growing from the ground like other trees.

CHAPTER XXVIII.

CHARACTERISTIC PLANTS OF NATIONS.

When investigating the geographical distribution and diffusion of plants, we ordinarily look at them in relation to the zones of the earth, to climates, quarters of the globe, or to the different elevations above the sea, in which they are met with. We inquire, for instance, within what degrees of latitude the palms grow, in what parts of the globe the vine flourishes, or at what height above the sea the Alpine herbs occur.

But we will look at plants in relation to the various races and nations; we will inquire what plants *originally* fell to the share of each, and played an important part in their lives.

In the happy climate which the South Sea Islands present within the tropics, flourishes the *bread-fruit tree*, the most important food-plant of the natives of Oceania. This noble and beautiful tree has a richly foliaged crown, and bears a great number of very mealy fruits, which, when cooked, taste like wheaten bread. These trees are sufficient to support a man for eight months of the year, during which long period they bear fruits which gradually ripen. During the remainder of the year, fruits are eaten which have been placed in pits, and undergone a kind of fermentation. Thus, as Cook somewhere remarks, it is easy for a man to provide for himself and children, since it is only requisite to plant ten such trees to supply food for a family. But this tree has other uses; the wood is used for canoes and furniture, and the bast for textile fabrics.

Another tree which plays an important part in Oceania, especially in the lower Coral Islands, is the *cocoa-nut palm*, which, however, also grows abundantly in the Indian group of islands between Asia and Australia, and on the coasts of India. The trunk furnishes wood; the fruit yields the almond-like kernel, the oil, and the milk; the shell is used for household utensils, the fibrous substance round it for woven fabrics; the houses are thatched with the leaves, and the cocoa-nut tree also gives palm-wine and palm-cabbage.

The *New Zealand flax* (*Phormium tenax*) is characteristic of the islands whence it derives its name. The leaves of this plant are remarkable for long, tough fibres, which far exceed our hemp and flax in strength. The natives make their clothes and thin string and cordage of it.

Among the Malays of the Indian Islands, the spices—the *clove-tree*, the *nutmeg*, the *pepper*, and the *ginger*—are the principal characteristic plants, but they have these for the most part in common with India generally.

Maize (giving the most abundant but also the most uncertain crops of all kinds of corn) was originally solely possessed by the American races. The cultivation of it was considerable in Peru, and this up to a considerable elevation above the sea; it was even grown, though not without difficulty, around the Inca's Temple of the Sun, on an island of lake Titicaca, 12,000 feet above the ocean, to furnish a sacrifice to the Sun-God, and that the corn grown there might be distributed throughout the nation, who regarded a single maize-grain raised near the temple as a noble and fortune-bringing object.* Maize was cultivated in North America, also, before the advent of Europeans. America inherited another glorious gift in the *potato;* it flourished in the higher regions, and furnished abundance of food in its mealy tubers.

Before the time of the Europeans, also, the *maguey-plant* (*Agave potatorum, Zuccarini*), the vine of the Mexicans, was cultivated on the elevated plateaux of Mexico. This plant does not flower in its native country until the eighth or tenth year, but when the great flowering stem is about to be developed, an extraordinary quantity of sap flows towards the bud. The development is arrested by cutting out the heart-leaves, and then the sap is drawn off three times a day for several months; this sap is caused to ferment, and affords a beverage (*pulque*) of a pleasant acidulous taste, but having a disagreeable, decayed odour. The maguey-fields which are ordinarily met with on the plateaux of Mexico (6000 or 7000 feet) do not usually yield until the fifteenth year. The production is so large that the tax on the consumption for the three states of Mexico, Puebla, and Toluca, amounts to 1,000,000 piastres (175,000*l.*) The fibres of the leaves of

* Meyen, Geography of Plants.

another species of this genus (*Agave americana*)* are used for making clothing-stuffs. It has been transplanted into the south of Europe, and is there known as the aloe.

At a greater height in Mexico than where the maguey grows, as also above the limit of rye and barley in Peru and Chili, there is another characteristic plant, the *quinoa* (*Chenopodium quinoa*). Its small but numerous and very mealy seeds furnish a food much used in these districts, partly boiled into a kind of porridge, partly roasted (the *chocolade* of the highlands).

But the greater portion of the aboriginal races of America (especially in the lower districts) were, and are still, unacquainted with cultivation of the soil, and stand at a very low degree of intellectual development; very often they have no characteristic plants. But there is one example of a race whose existence is most intimately connected with a single wild plant. The country of the Guaraunas, on the lower part of the Orinoco, is overflowed during the rainy season, at which period of the year this race of savages live upon trees like monkeys, upon the *Mauritia palm*, which occupies this tract, growing socially. From the leaf-stalks of this palm they manufacture mats, which they suspend between the trunks; here they live and make themselves at home, light fires, feed upon the abundant fruit of the palm, and prepare a palm-wine from its sap, and bread from its sago-like pith.

Turning to Africa, we find in its northern parts, as also in the north of Arabia, the vast zone of deserts, so poor in vegetation, where the nomade Arabs have received a glorious inheritance in the *date-palm*. Its numerous and well-flavoured fruits give them food, and also to their camels and horses; the trunks provide them with wood and fuel, the leaf-stalks and leaves serve for woven fabrics.

In the southern part of the Arabian peninsula, and in Abyssinia, the *coffee-tree* appears as the characteristic plant; it yields the ordinary beverage of the races living here.

The Hindoos received two important plants — *rice* and *cotton;* the first forms the daily, and, as this race eats no meat, almost the exclusive food; the second furnishes almost

(* The American aloe, or hundred-year plant of our gardens.—Ed.)

the sole material of their clothing. Without these material gifts the Hindoo cannot exist; a failure of the rice-crop causes universal famine.

The characteristic plant of the Chinese is soon found; it is the *tea-shrub*, which yields a beverage which for them is the same as wine in the vine-countries, and beer and spirits in the north of Europe.

The original characteristic plants of the races which inhabit Western Asia and Europe, and which are called the Indo-Caucasian races, are *wheat*, *barley*, *rye*, and *oats* (which are generally called the European Cerealia, but scarcely with right, since Western Asia seems far rather to have been the part of the globe from which they emanated). These, and, among them, wheat especially, form the chief objects of agriculture and the principal material of the food of these races.

Southern Europe, and the part of Western Asia which borders on the Mediterranean, have an important characteristic plant in the *olive*, which gives the South-Caucasian races oil, which is not merely used for illumination, but takes the place of the butter which is so extensively used by the northern races of the same origin.

The *vine* also forms part of the inheritance of this race; it constitutes an important object of cultivation, and between 30°—35° yields a beverage of great consequence.

The Laplanders, who belong to the Polar race, have no characteristic plants, unless we reckon as such the *reindeer-moss*, the principal food of their domestic animal, from which it takes its name.

In this sketch we have only noticed the original distribution of plants among the races; but great revolutions have occurred in this distribution, and the present conditions are very different from those which existed at first.

A close investigation will show, however, that it is almost solely the Caucasian races which have effected these revolutions, and that these have taken place almost simultaneously with the increasing civilisation of the former. The Caucasian races, above all, the Europeans, have been able to transplant, by degrees, into their own homes the characteristic plants of other races. They have fetched the finer kinds of fruit—the *almond*, the *apricot*, and the *peach*—from Asia Minor and

Persia, the *orange* from China; they have transplanted *rice* and *cotton* to the coasts of the Mediterranean; brought *maize* and the *potato* from America to Europe, where they now support millions of human beings, and have chiefly contributed to prevent famine in the failures of crops which have taken place. These races have, moreover, been able, by their extensive industry and their commerce, to acquire possession of the products of foreign characteristic plants which will not thrive at home. They have procured, partly even for daily necessities, the tea of the Chinese, the coffee of the Arabs, and the rice and cotton of the Hindoos.

But the influence of the Caucasian races, and of the Europeans in particular, in changing the distribution of characteristic plants, becomes far more extensively evident when we look to the colonies established in all climates, where in some cases the countries have passed wholly into the possession of an European population. For they have not only carried their own characteristic plants to the colonies, or those also which they had previously transplanted into their own homes, but they have, after acquiring countries with different climatal conditions, transplanted into these such as would not flourish at home, and thus have found themselves in a position to collect the characteristic plants of almost every race around them. Thus have the European corn-plants acquired a widely-spreading cultivation throughout North America, in Mexico, and the elevated countries of South America, in Chili and Buenos Ayres, in South Africa, in the temperate parts of Australia and Van Diemen's Land; thus the vine has become an object of cultivation in Madeira, the Canary Islands, South Africa, and the highlands of South America; thus rice and cotton are now grown in extraordinary quantities in the warmer parts of North America and in Brazil; thus have the coffee-tree and the sugar-cane been transplanted into the West Indies and Brazil; the nutmeg and the clove into Mauritius and Bourbon, and various West Indian islands; and thus has the plantation of tea commenced in Brazil, in Java, and in India; and the cultivation of the New Zealand flax in New Holland.

The Europeans have even conveyed characteristic plants to other races, which knew how to value them. They have transferred several European and tropical plants into the

South Sea Islands, which, previously unknown, are now cultivated by the natives; the remnants of the American population which are still found in the highlands of Peru, Chili, and Mexico, have acquired European plants; in like manner the negroes of the west coast of Africa have received from the Europeans maize, tobacco, and other American plants. On the other hand, what other races have done to change the distribution of characteristic plants, is very little: the Arabs contributed to diffuse cotton, the sugar-cane, coffee, and the date-palm; but the Arabs belong to the same primary race as the Caucasians. The Chinese appear to have procured cotton from Hindostan, and the Japanese the tea-shrub from China.

The Europeans, and above all the North Europeans, consequently are those who, both in their own home and in their colonies, have been able to acquire the greatest quantity of the characteristic plants of other races; while their own country, especially the north of Europe, is so very poor in characteristic plants; for all the important cultivated plants of Northern Europe have been introduced (*cabbage*, *turnips*, *carrots*, and *asparagus*, which are perhaps indigenous, are among the less essential). We find in this a great proof of the intellectual superiority of these races, and we have here an example that the child of the poor man, gifted with great natural powers, industry, and activity, has far more power over prosperity than the rich heir.

I know not whether there may be any among my readers who would be inclined to see in these revolutions a serious confusion of nature, or might fear that as the races gradually appropriated each other's peculiar possessions, the globe would approach nearer and nearer to a tiresome uniformity. One sometimes hears expressions which indicate such a fear; complaints are now and then made, that interesting descriptions of strongly contrasted races become rarer in accounts of voyages and travels. Not only have many differences vanished in Europe, so that, for instance, in a drawing-room in Moscow one can fancy himself in Paris; but those attractive accounts of the natives of the South Sea Islands which the earlier circumnavigators gave us, are exchanged for reports of how the inhabitants of these islands now go clothed in the European fashion, build ships, establish schools for mutual instruction, and build churches. High up in the Himalayas, 7000 feet above the sea, where a few years since a wild race dwelt, only visited by tired pedestrian Hindoo pilgrims, there are now, as Jacquement reports, the baths of Simla, with sixty European houses, where people in shoes and silk stockings ride in European equipages to a dinner-party, served in the European fashion, where champagne and Rhenish wines are drunk. In Australia, where not long ago nature existed in virgin condition, and the savages stood at the lowest point, where a few suspended branches served to protect from the weather human beings who lived on sea-mollusks, there exist at present European cities, with hotels, coffee-houses, billiard-rooms, reading-rooms, and horse-races.

The incalculable advantages which mankind attains through the increased intercourse of nations, the progress of civilisation, not only material, but intellectual, which keeps pace with this, must very soon remove the discontent at the increasing uniformity. But it may even be asserted that civilisation is far from favouring uniformity among nations, and that it rather calls out increased natural diversities.

We must not overlook, namely, that civilisation arouses many intellectual powers which have slumbered, and that many entirely new conditions arise; and the awakened intellectual faculties are not all developed in the same manner; the new conditions do not remain everywhere the same; and, in this way there is formed, contemporaneously with the uniformity which is undeniably produced in certain directions, abundance of new differences which far exceed the old ones. Who can question that there is much greater distinction between the English and French than between the negroes of Guinea and those of Mozambique, or between the different savage races in the interior of Brazil?

CHAPTER XXIX.

THE ACTION OF THE HUMAN RACE UPON NATURE.

MAN is a part of nature; she acts upon him, and he is subject to her laws; yet man stands, as it were, outside nature, and hence is capable of reacting upon her in a totally different way from all other creatures—of transforming her, and even to a certain extent to conquering and prescribing laws to her. Civilisation, the development of the intellect, is the means by which man has gradually freed himself from the rule of nature, and passed, as it were, from the position of a servant to that of a master.

Looking at the savage in his lowest type, he whose dwelling is composed of a few interwoven boughs, whose food consists of marine shell-fish, or the raw fruits of the wood and field, whose clothing is of undressed skins, we see that nature does not suffer any appreciable change or transformation at his hands; on the contrary, his food, his clothing, his dwelling, his whole existence, are entirely dependent upon natural occurrences, lying out of the sphere of action of his will.

As long as man is still a hunter or a fisher, his position remains, in a high degree, dependent upon nature; his action upon her very slight, since at this stage of human development population is necessarily very scanty. His influence is essentially confined to accidental deterioration of the forests, through careless use of fuel, or to the extirpation of particular species of animals in certain regions.

The nomade affects nature more than the hunter or fisher. Particular animals are tamed, and multiply in comparatively greater abundance; the aspect and habits of these animals are modified, wild animals are attacked, the pastures of one region become exhausted, and recourse is had to others; meanwhile the heaths and forests are destroyed by fire, their ashes giving rise to a more luxuriant growth of grass.

But it is when man becomes an agriculturist that his great influence upon nature comes into operation; and, step by step, as agriculture, and, with it, intellectual development progresses, the effect becomes evident in many directions, although, indeed, not always so violently as at first, when, for instance, the forest is rooted out, without mercy, to form arable land.

We will glance over the most important changes which man produces in nature at that stage of his development. The soil, bearing for the most part perennial grasses and other perennial plants whose roots are interwoven in the ground and form a firm covering of turf, or filled with innumerable stones, is cleared, and brought under the mastery of the plough and spade; the soil is loosened, and sown, in tracts of varying extent, with plants which are usually harvested in the course of a half, or, at most, a whole year; many weeds, especially annual plants, thus have an opportunity of becoming diffused. But dry, unwooded regions often require no little labour to make them available; it is, therefore, often found more convenient to burn off the heaths, to cut down the forest, and to burn either it or the stumps of the trees which are left; which has, at the same time, the advantage that the ashes manure the earth, and increase the crops. This is the "haidebrande" of Jutland, and the "braatebrand" of Norway, still occurring in those countries, though less extensively than in former times;* it is applied, at the present day, and on a gigantic scale, in North America, Brazil, Java, and many other tropical countries where colonists have settled; it was formerly carried on in the Antilles, Canaries, Madeira, and the Cape de Verd Islands, where the forests were soon extirpated. The fires often spread accidentally far wider than is intended. Subsequently, when the wooded land has been cleared by fire, and the treeless by the plough, that land is attacked which is naturally too wet for agriculture; the moor and marsh are now laid dry; the water is drained from damp meadows; the beds of rivers or brooks are narrowed, or another direction is given to their course. Even the sea is not spared; not only are the

(* It is practised also in the Rhine provinces. On the Moselle, tracts of wood may commonly be seen on fire, in autumn, on the hill-sides. The ground is cropped with corn about once in fourteen years, and wood allowed to grow up in the interval. Portions of this are cut, and removed for use, but the greater part is burnt for the sake of the manure given by the ashes.—ED.)

coasts protected by dykes, but bays of various sizes are dammed in, and the sea-bottom changed, first into pastures, and then into arable land.

But it is not merely to a few of the plants *belonging* to the country that man grants the privilege of clothing the earth and displacing the rest; so far as the climate does not oppose hindrance, he brings in many *foreign* plants from near and distant regions. Our corn-plants, for instance, have been brought to us from Asia, most of our fruit-trees and kitchen vegetables also; the potato and tobacco from America; cotton was conveyed from India to North America and Brazil; coffee from Abyssinia and Arabia to Java, the West Indies, and Brazil; we have obtained a great number of useful and ornamental plants from North America, Asia, and the south of Europe. There exist also remarkable instances of the plants introduced by man becoming greatly diffused independently of his agency, so much so as in certain cases to displace the original plants; the artichoke and the peach-tree afford examples of this in the pampas of South America; paralleled there in the animal kingdom by the wild horses and oxen, which have in like manner become very widely diffused over those plains. In St. Helena the original flora has been almost driven out by the foreign plants which have made their way to the island.

That which is true of plants holds also of animals. Our common domestic animals have been conveyed to all parts of America, which was totally devoid of domestic animals before the advent of the Europeans*—to South Africa, Australia, Van Diemen's Land, New Zealand, the South Sea Islands, &c.—and great revolution both in nature and in human life have resulted from it. On the other hand, civilisation has caused the extirpation or expulsion of many kinds of animals, as the elk, the aurochs, and the beaver in Northern Europe; the furred animals in North America, the hippopotamus and crocodile in Egypt; these and the rhinoceros and the giraffe at the Cape, the lion in Greece, the wolf and wild boar in Denmark and Britain.

(* The llama is said to have been domesticated at that time by the Peruvians.—Ed.)

But not only has man brought about great changes by transporting plants and animals from one country or from one part of the globe to another, man has also produced, or, to speak more strictly, compelled nature to bring forth a considerable quantity of new creatures, which did not previously exist, and are now daily increased in number. I here, of course, allude to the origin of modified forms (*varieties* and *races*). The infinite number of races of dogs, from the large mastiff to the little spaniel, from the light, long-legged greyhound to the short-legged, thick-set terrier, would not have existed if man had not influenced the wolf and jackal; and as little the many races of horses, from the light, delicately-formed and swift-footed Arabian to the clumsy, elephant-footed Norman horse, unless man had obtained influence over the wild horse. If nature had been left to herself, we should not have known the many kinds of apple (1400-1500), but only the wild crab, from which they have all been derived; nor the numerous kinds of coleworts, the thousand varieties of roses; and without the most recent cultivation, we should now have only, as we had fifty years ago, the simple dahlia, instead of 1500 double varieties.

Man effects changes on the soil as well as in the plants and animals of a country. Working the land, clearing it from stones, burning off heath and wood, manures, draining away water or restricting it in proper channels, alternation of crops and pasturing, all this must essentially change the character of the soil.

Yet the effect is not confined to this; man exerts influence even over the climate, even though, as I believe, not so much as is usually supposed. The removal of forests influences the condition of humidity, at all events in the warmer countries, and particularly in mountainous regions; the earth and air beneath trees become cooled, and this cooling causes the condensation of the vapours in the atmosphere, which fall as dew or rain, and so springs are more readily produced. The felling of the forest gives the winds free play; the drainage of marshes and lakes, as also the deepening of streams, diminish evaporation, and thereby again somewhat lessen the moisture of the atmosphere. The temperature and the winds are modified together with the conditions of humidity.

The enumeration I have here given, consists of well-known facts, and it was not my intention to treat that rich theme in greater detail. My purpose was simply to furnish a concise and striking representation of the effect of man upon nature, in order, in the next place, to examine two questions which arise from the consideration of the foregoing, and will not perhaps prove destitute of interest.

It is an often-expressed assertion, that culture, or civilisation, destroys the original beauty of nature; that, regarding only material advantages, it robs us of the enjoyment of free inartificial nature. Such statements come especially from the more æsthetic portion of the people; poets, landscape-painters, and the fair sex, are particularly inclined to make these complaints. The uniform corn or potato fields meet us tiresomely everywhere, instead of picturesque places, adorned with the most varied herbs and flowers, and with alternations of forest and thicket; the natural flowery meadows give place to clover-fields or other artificial, uniform meadows; cattle may no longer wander about unobstructedly in the open country, they are kept in stalls, even in summer, or they are fastened up in pens in the fields. The roads must no longer curve and wind, and thus bring variety into the landscape; we are carried forwards on mile-long lines, straight as a stretched cord, slowly on the high-roads, rapidly on the railways, where the landscape vanishes before the eye can seize it; straight hedges, in the south high walls, divide the land into quadrangular sections, and limit the prospect; the trees are not allowed to retain their picturesque disorder, they are planted or sown at fixed distances apart, and still less are they allowed to attain their natural age, their natural size or beauty. The stag and roe are either wholly expelled or confined in zoological gardens; the song of birds is silenced; the solitary trees in fields are cut down, because they stand in the farmer's way; the moors disappear; fixed boundaries and courses are prescribed to the brooks and running streams, so that they may not injure the fields, or to make them drive mills and manufactories. The fruit-trees are cut, nailed and trained upon walls, losing their natural beauty, &c., &c. A number of animals are converted into monstrosities, to increase the amount of flesh or fat.

All this, and much more, I admit. But the matter must be examined on the other side also.

I will not make any remarks concerning the many ways in which civilisation increases the pleasures of human life, especially the intellectual pleasures, and thus richly repays the *supposed* loss in the beauties of nature; for all must agree with this. There can scarcely be any one in these days who would exchange the advantages of civilisation for the enjoyment of the beauties of nature; that period of sentimentalism when men were of opinion, or at least represented themselves as of opinion, that the happiest life is led in savage nature, has already passed away. The painter also knows well that he is a son of civilisation, for savage nations have no painters.

On the contrary, paradoxical as it may perhaps appear at first sight to many, I will venture to assert that civilisation, while it limits the enjoyment of the beauties of nature in some cases, does really on the whole increase these enjoyments in a far higher degree, nay, I may say, also in the most varied manner. In the first place it must be remarked here, that important as the influence of man upon nature is, it is not nearly so great as is often thought by those who do not look closely into things. Great as the transformation of the soil, and the plants and animals covering it, is, the atmosphere, the clouds, the sun, the moon, and stars remain to us unchanged; for even when a large city or a manufactory rob us of these beauties of nature in their immediate vicinity, through coal-smoke, this extends over such a little space that we can soon get out of it, especially since coal itself assists us, and will rapidly remove us from the smoky cities. We have the sea too, for the largest of the dyked-in tracts of it are but very minute portions of the vast ocean. In like manner we retain the chains of mountains and hills, with all the variety which their lines afford under the play of sunlight. The great lakes and rivers also remain to us. While the sea, the atmosphere, and the contours of the earth's surface remain to us, we have all the prominent features of the landscape, which cannot be essentially injured by changes in detail.

We must not forget, moreover, that the natural objects arranged by man also possess their peculiar beauty, and we should be altogether ignorant of these without civilisation. The waving corn-field has its beauty, and so have the long alleys of Lombardy, with their vines twining from tree to tree; the orchard, when in full blossom in spring, or loaded with fruit in autumn, is beautiful; an avenue of limes, an arcade of growing trees, a wall covered with blooming roses, a well-planted flower-bed, every one of these is beautiful.

Besides, civilisation procures us the sight of an incredible number of plants which we should never otherwise see in our houses. Without civilisation we might certainly see beeches or oaks, perhaps finer than at present, but we should not see the fir, the pine, the larch, the acacia, and the plane; we should indeed have the hawthorn and hazel bushes, but not the flowering shrubs and bushes which now adorn our pleasure-gardens. We should not see the blossoming peach or apricot trees, nor their fruit; we should be destitute of the whole of the large foreign flora, which enlivens us and produces so many enjoyments, so much variety, in our gardens and rooms, not to mention our conservatories, which give at least an imperfect idea of tropical vegetation.

Again, the infinite variety which arises in races and varieties, would not exist without cultivation. We could not feast our eyes on the endless series of roses; we should have to be content with the simple wild rose; the stock, the dahlia, the aster, and the auricula, with their countless varieties, would be unknown to us. And no one will deny the beauty of these objects, or assert that they are not beauties of *nature*. Here I shall, at all events, have the flower-painter and the ladies on my side. Without cultivation we should not have the fine varieties of fruits, as of the apple, for the poor wild crab of the woods would be our only fruit of this kind. The same holds good of animals; a handsome Arabian horse, pretty races of pigeons, are certainly beauties of nature.

And how many ways and means to the enjoyment of the beauties of nature civilisation itself affords us—beauties which we should know nothing of without it! With what facility we now reach the Alps and Italy! Do not more than a hundred times as many persons now go to those places as did half a century ago, to enjoy beauties which their eyes had else never beheld? or, to confine ourselves to a narrower sphere, how many people, even of the poorer class, are able now, compared with former times, especially by the aid of railways, to visit the nearest mountains, the nearest sea-coast, &c.! Do we not find here an infinite increase of natural pleasures, which are solely owing to civilisation? If we do at the same time suffer some little detriment in our immediate neighbourhood, it is richly repaid by foreign beauties of nature being brought nearer to us. And beyond this, the enlarged circle affords us a much greater variety. It is not now so easy as it was to find nature in her original condition, but, on the other hand, we have the greatest facilities now for travelling to where she still persists in that condition.

But there is another important consideration. Without civilisation there exists no taste for the beauties of nature, or at most a very rude one. We scarcely find anything of it among savage races; it is weak among the common people even of the civilised nations; in Norway, we may now and then hear such expressions as "the odious cliffs;" and to many a Swiss peasant, whose lands afford the prospect over a beautiful district, the pecuniary gain connected with it is certainly the only thing which he values. The more civilisation increases and becomes diffused, the more does the taste of the beautiful in nature become developed, and enjoyment of this kind become increased. The beauties of nature, in fact, only become valuable to man when he acquires the taste for them.

Reflecting, then, that civilisation creates natural beauties which had no existence previously, that it leads us to beauties which were formerly unknown to us, and infinitely facilitates our visiting foreign, far distant regions, so that we enjoy those beauties from which we should otherwise be shut out,—finally, that it increases the number of those who are capable of enjoying nature,—and that civilisation does all this on an immeasurably large scale,—we shall certainly be comforted for that loss of beauty which it undoubtedly involves, which, however, does not affect natural conditions on a large scale; civilisation itself makes good that loss in the most manifold fashion, and step by step will even lessen it. When the taste for natural objects becomes really active, it will, for instance, prevent the removal of the venerable old oak from the corn-field or the plantation, even though it may not pay, &c.

Civilisation, however, is not only blamed for diminishing the beauty and the poetry of nature; a far harder accusation is heard, if not so generally and distinctly, yet here and there, even in the present day. It is asserted that civilisation exhausts the earth, consumes its strength, and gradually converts it into a desert; according to this view, not only do the races of mankind grow old and die out, but countries are subject to the same fate, and the lot of transitoriness spreads from east to west, even as civilisation takes this direction. The examples especially cited to prove this assertion are the countries which were the seat of ancient civilisation—Northern India, Persia, Assyria, Babylonia, and Mesopotamia, which are all said to have been formerly fertile and thickly populated, sown with large and splendid cities, while they are now converted, for the most part, into sterile deserts; Syria, Cyrenaica, and other parts of Northern Africa, are also mentioned; and even Greece and Sicily, which have lost considerably in fertility, and have acquired a different, drier climate, and which therefore, like the older countries, are in the passage to decay. Hence, it is said, it is a vain hope to expect the regeneration of Greece; for not only does the life of the nation approach its term, even the land itself is in the same condition, and it would be impossible to save it without infusing foreign elements into the people. Thus speaks Fraas, who has taken especial pains to allege a number of presumptive proofs, how the moisture, and with it the vegetation and animal life in Greece—where he resided for a number of years, and investigated the natural conditions—have diminished, and continually go on decreasing.

It is not to be questioned that a portion of those countries of antiquity in which civilisation and a dense population formerly existed, are now desert, but at the same time it must not be forgotten that those countries lie in the regions which have received the name of the rainless zone, or at least lie near to this zone: North Africa between 15°—30° (Sahara, Nubia, and Upper Egypt), also Arabia, the lower portion of the countries of the Euphrates and Tigris, Southern and particularly Eastern Persia and North-Western India. All these countries want rain, or it is so rare and accidental that no agriculture can be based upon it; this can only be carried on either where a large river, like the Nile, overflows the land at a certain period, or where the smaller streams are cleverly distributed through canals, or their water is pumped out so as to moisten the soil. But when, under such conditions, the population becomes diminished and sinks to a lower standing, through war, migrations, and retrogression in an intellectual point of view, these and other institutions, which are absolutely necessary conditions of agriculture in these countries, and are the offspring of civilisation itself, are thus neglected. That the cause of the fall of these countries is to be sought in this, and not in climatal changes, is shown at once by the fact that the total want of rain in those countries depends on general natural conditions which are unalterable. The absence of rain is caused by the ascending current of hot air within the tropics causing an influx from the nearest lying regions outside the tropics, therefore in our hemisphere northerly winds, which, since they come from colder regions and from the vast dry plateaux of Asia, can only bring dry air. But historical testimony also exists. Herodotus says expressly that no rain flows into the Nile, and explains thereby the strange circumstance that water of the river stands so low in winter, at the time when all the other rivers of the Mediterranean are fullest; he also states that it was regarded as a miracle that it once rained in Upper Egypt. The conditions are the same at the present day, for rain falls but sparingly in Lower Egypt, while in Upper Egypt and Nubia it may almost be said that it never rains. Some assert that the rain has somewhat increased in Lower Egypt in recent times. Strabo places the northern limit of the tropical rain at 16° N. L.; at present, different authors give it at 15°—17°. Many passages in the ancients may be quoted to prove that Persia, Babylonia, Assyria, and Syria, were also dry countries of old, requiring artificial irrigation for the cultivation of their fields and gardens; or at least so circumstanced that the dews must recompense the absence of rain. In reference to Greece also, mention is made of the prevailing north and north-east winds, which certainly were not drier then than now. I have in a former essay endeavoured to show that the vegetation of Egypt, Syria, Palestine, and the countries of the Mediterranean, was essentially the same in antiquity as it is at present. Even though it must be admitted that the destruction of the forests has exercised an injurious influence over the conditions of humidity, still this influence is undoubtedly overrated. The evaporation from the ocean, with the south and south-west winds (the return trade-winds), furnish the great mass of the clouds and rains of Europe. I have already called attention to the fact that there are districts in the south of France where, according to observations, the amount of rain is on the increase, while the forests have been considerably diminished, and Lombardy displays similar conditions.

We have a proof in China that a country may still be fertile after civilisation has possessed a home in it for thousands of years. In Tuscany, Lucca, and Lombardy, also, civilisation is very ancient, and these are among the most fertile countries known; during the middle ages the civilisation of these countries was greatly borne back by the immigration of rude nations; it has subsequently risen to the high stage at which it at present stands. Sicily, formerly the granary of Italy, certainly produces much less corn now; many tracts of land lie desert, but this is to be ascribed to the deficiencies of social circumstances, not to the climate; many districts, for instance, that at the foot of Etna, are among the most fertile and populous in the world. If the social conditions of Algeria could be reduced to order, the fertility there would certainly not be inferior to what it was in antiquity.

Moreover, it is readily seen how civilisation directly increases the production of countries in many respects, and how the more profound knowledge of natural forces gives a counterpoise to whatever hurtful effects civilisation brings with it. In tropical and sub-tropical countries, the removal of forests and drainage of marshes and swamps drives out the unwholesome air, and the diseases arising from it. If water is lost, on one hand, through civilisation, this gives the knowledge how to procure it better, and make use of it to greater effect. The forests injured by former recklessness are restored by new plantations, and by better care of what has been preserved. If the earth loses nutritive substances, man learns to replace them by the addition of new, and by more skilful alternations in agriculture, &c.

And therefore I believe the fear that countries advance gradually through civilisation to meet their destruction, is groundless, and that civilisation in this, as in all other respects, acts to *ennoble;* that in every case it richly recompenses the calamities that follow from it.

CHAPTER XXX.

NATURE AND NATIONS.

MAN is a link in nature, but his intellectual faculties enable him to rise above her, to battle with and acquire influence over her.

But that nature affects mankind as a part of herself in manifold ways in *material* respects, rests on experience so abundant and clear, and opinions so unanimous, whether we refer to single men or to entire races, that we need only give a brief indication of it.

The varied character of nature in the different regions of the earth in a great measure determine the food, the dress, the dwellings, the means of intercourse, and the diseases of races.

In the warm climates nature displays her gifts in rich superfluity; sparingly does she present them in the colder, and stints them in the furthest-inhabited Polar regions. In the latter, where the temperature is so low that it will not call forth any nutrient vegetable substance, or but in the scantiest quantity, animal food exclusively, and on the coasts almost solely fish, is assigned to man. In the cold climates the body requires more or less covering, and fuel is necessary in the dwellings; while in hot countries, the climate dispenses with the necessity of clothes, and artificial heat is only used for the preparation of food. A very damp climate is injurious to health, and causes many troubles; an excessively dry one brings similar effects.

Between islands and coasts intercourse is easy; rivers and extensive plains also assist it; while mountain-chains form obstructions, and separate nations from each other. The presence or absence of wood in a country has an essential influence on man and his mode of life; in like manner different results occur through the soil affording pasturage or consisting of salt-steppes. The animals also furnished by the land or water for the use of man, have their influence upon him.

Yet, while man is thus dependent *materially* in manifold ways upon surrounding nature, he is capable, and no one doubts this, of freeing himself to a great degree from this dependence through civilisation. By artificial heat, man procures for himself and his domestic animals, and for some of his cultivated plants, a totally different climate from that the country in which he dwells has; he introduces from other countries and quarters of the globe, plants and animals which were not there before; and he brings in by commerce the products of the most distant regions, whenever they will not thrive in his own country. He converts prairies, heaths, and woods into fields and gardens; lays dry marshes, changes the course of rivers, extirpates noxious animals; removes by artificial roads the obstructions which mountains place in the way of communication, and increases its rapidity by the force of steam. But can that dependence which is true of man in material respects, be assumed in intellectual also? and in particular, can it be stated that the different characters of nations are determined by, or at least essentially depend upon, the nature which surrounds them? This is the question on which I wished to furnish evidence. Such a dependence is pretty generally assumed by historians, philosophers, naturalists, and poets; but, nevertheless, I dare assert that this opinion represents a great error, which has only become so general because conclusions have been drawn upon the subject with a superficiality which would not be endured in any other science,—because the comparative method, which has given such rich results in other branches of science, has not been applied here.

At the same time, it is not my intention to deny all influence upon national character to the climate, soil, and other natural conditions; in particular, I am willing to admit it where the natural forms greatly overrule human force, so that this is compelled to give up the contest, as in the extreme Polar lands and in the African deserts; but I hope to be able to prove that the influence *in general* is very *slight*.

In proving my assertion, I will not have recourse to analogies which may be drawn from individual men, and refer, for instance, to cases where of two men brought up in the same house, on the same food, and dressed alike, one may prove a genius, the other an idiot; one a great poet, the other a distinguished painter; the one passionate, the other phlegmatic, &c. I will hold to facts furnished by nations themselves.

If nature had a considerable influence upon national character, in *the first place*, two nations placed in the same natural conditions ought to have the same character, or great affinities ought to show themselves. But it will soon be discovered that such is by no means the case.

The atmosphere is not less foggy or less stormy on the south than on the north side of the Channel; the same temperature, the same low chalk-hills, and the same vegetation, are met with on both sides; and yet the two nations, between which the Channel forms a natural boundary, are extremely different; and the Englishman who lives on the Channel, is no less an Englishman than the one who lives far inland; the Frenchman of the Channel coast is no less French than his fellow-countrymen. The French and German characters likewise form a strong contrast, although the east and west boundaries are essentially similar in their natural conditions: in the north, both have plains; in the south, mountains of moderate height, with fertile fields and vine-hills. Switzerland exhibits three distinctly-separated races on her mountains and in her valleys; the watershed, indeed, very often forms the boundary-line of the races, without standing in any connexion with the natural characters of the mountains or valleys; sometimes, as for instance in the Valais, two races are found in the same valley. Hungary is inhabited by three races of totally different descent, and different character; in some parts they are very much intermingled, and consequently are placed in the same natural conditions. The same occurs in Turkey, where Turks, Greeks, and Slavonic races, are, in like manner, intermingled; and yet each of these nations has preserved its characteristic features, and still retains them, in spite of the common climate and soil. On the north coast of Africa, the Berbers, the immigrant Arabs, and the still later visitors, the Turks, live among one another without the community of natural circumstances causing any approximation of character. The Europeans are now entering among them as a fourth nation. The same holds good of the Copts, Arabs, Turks, and Negroes, in Egypt; of the Caffres, Hottentots, and Negroes, with the subsequently invading Dutch and English, in South Africa; in Lapland, Lapps and Scandinavians live beneath the same natural conditions; in Sleswick, Germans, Frisians, and Danes.

In the second place, if natural conditions had considerable influence, the same people could not live under different climatal conditions without a difference of character becoming prominently evident. The Italian who lives in the elevated Alpine valley, under a cold climate, and without agriculture, is still an Italian. It is the same with those who inhabit the middle heights of the Alps and Apennines, which resemble Northern Europe in their natural conditions. The Tyrolese on the High Alps is no less German than the marsh-peasant, whose land lies below the level of the sea; and it can by no means be demonstrated that the provincial differences which are actually met with depend upon climate; at all events, the German Tyrolese is infinitely nearer to the peasant of the marshes than to the Italian Tyrolese, who lives close beside him. The French also live under very different natural conditions; compare Dauphiny or the Pyrenees with Bretagne, or with the heaths of Bordeaux, or with the vine-hills on the Rhine and Moselle!

This becomes still clearer when we examine *colonizing* or emigrant nations. The Englishman remains English in the hot plains of the Ganges and in the Alpine valleys of the Himalayas, although he lives in both cases under natural conditions differing in the highest degree from those of England. In Australia the Englishman is surrounded by a nature which forms, as it were, a new world, especially in respect to the animals and plants. The Dutch, who have exchanged the low, flat marsh-land, and damp, foggy atmosphere of Holland, for the dry sand-stone plains and arid plateaux of the Cape, where clear air and rainless weather prevail, have not become either Hottentots or Caffres, but remain Dutchmen. The Spaniard retains his character not only on the high plateaux of Mexico, which, although they bear some resemblance to those of Castile, have a warmer climate, and differ in other respects, but he remains Spanish in the highlands of Peru, in the unhealthy rainy regions around Panama, and in the insular climates of the Philippines and of Cuba. The Chinese is Chinese throughout the many varied regions of Asia in which he has settled, and is everywhere readily distinguishable from the rest of the population. The Negro persists as Negro in every part of North and South America, and acquires no resemblance to the aboriginal races. And the Jews, who have immigrated into all parts the west side of the Old World, preserve their intellectual peculiarities, as well as their distinctive bodily marks, wherever they may have penetrated. Wherever they have changed, and become blended with nations among whom they have settled, it is evidently the social conditions, and not the climate, which have produced the alteration.

The *third* consideration, which leads necessarily to the same result, is, that in comparing the inhabitants of one and the same country at different periods, we sometimes find a considerable *change of character*, while it is highly probable that the climate has remained unchanged. We may take as examples the modern compared with the ancient Greeks, the Italians with the ancient Romans. If we trace such changes closely, we find their causes in political and historical circumstances. They have become intermixed with foreign immigrant races, as civilisation has advanced or retrograded. The idea which is perhaps entertained by some, that the races which migrated in the middle ages from the north to the south of Europe have become altered by the effects of climate, and have assumed the South European character, ignores the fact that in these migrations, as indeed in most, the number of invaders was small compared with that of the previous inhabitants, and that therefore, in the mixture, the character of the latter must preponderate, while, on the other hand, the influence of the intermixture can be demonstrated even after many centuries, as in Normandy the mixture of Normans and Gauls, in South Spain of Moors and Spaniards, &c.

The slight influence of natural conditions upon national character, is also made evident by investigating a few examples of the causes which are generally assumed to operate in this direction.

Nothing is commoner than to hear persons talk of the warm blood of the South Europeans, which is supposed to depend upon the warm climate, and there must produce violent outbursts of passions. This is used to explain the bloody revenge of the Corsicans. But the Hindoo, who lives in a far warmer climate than the Italian, is brought forward as an instance of patience and resignation; while the Turk, who has come to Europe from warmer regions, is noted for his phlegmatic temperament. Is the Dutchman more passionate than the Norwegian or Scotchman? and whence came the sanguinary vindictiveness of olden times to Scandinavia, nay even in the cold Iceland?

It is imagined that mountaineers possess more strength, or more energetic character, and a more warlike spirit than the inhabitants of plains; the character of the latter is supposed to be softer. Thus it is thought the Norwegian and Swede are more energetic than the Dane. Mountainous countries, perhaps, afford more numerous examples of obstinate defences behind the cliffs of narrow valleys; but a man is not to be called more courageous because he has a good shield. The soil of Denmark, however, has not sunk since that time when it sent out those combatants who kept the populations of the Atlantic and the Mediterranean coasts in terror; whence did they acquire their spirit, and has it now really vanished? They were inhabitants of the plain of Northern Germany who rose against Napoleon's despotism; the July revolution took place in the plains, and in the plains did the Poles, alas in vain! fight probably the last battle for their liberty.

It is believed that the great pre-eminence of the Europeans above the inhabitants of the rest of the world is caused by Europe being so intersected by the sea, and so free from elevated plains, so that communication between the nations is much facilitated. But in the great Indian Archipelago, or in the Archipelago of the West Indies, communion is still easier. The cause of the earlier civilisation in India and Egypt is sought in the great rivers Indus, Ganges, and Nile, which so greatly facilitate intercourse; but civilisation did not exist on the largest rivers of the world, the South American Amazon and Plata, until the Europeans brought it.

The beech-wood is regarded as the symbol of the Danish character. But I have rambled through beautiful beech-woods in Calabria, and on the higher plains of the Apennines, and the rest of the plants and the fresh air reminded me of home; the leaf of the beech also unfolded itself at the same time as in Denmark. Yet in the people I found not the slightest thing that could be called Danish; they were completely Italian. In one district, however, they were not Italian—but Albanian. A colony of Albanian herdsmen had settled there several centuries before, and had preserved their language, dress, customs, and character.

Finally, it must not be overlooked, that even as the influence of nature upon the food and habits of nations declines with increasing civilisation, since nations thereby, and through intercourse, become masters of foreign natural conditions, so not only does the same hold of the slight influence which we must ascribe to nature in the character of nations, but the national characters are caused even to vary among themselves by the direct action of civilisation. I am well aware that it is a frequent remark, that civilisation effaces national peculiarities and causes them to diappear, but I will ask whether there are not many more differences now between the three great nations of the highest civilisation, the English, French, and Germans, than was the case formerly; and much greater distinctions than between any uncultivated nations? People allow themselves to be deceived so easily by external, inessential similarities of food, dress, and outward customs. Inward intellectual phenomena, on the contrary, are constantly being newly developed by civilisation, and hence new differences. It is as in individuals; there is a greater distinction between educated men than between the common people. That a strong national feeling is at present awakened in many parts of Europe where it formerly slumbered, is therefore an inspiriting and not a boding sign.

Consequently, the character of nations is not a product of nature, nor is it essentially determined by her; and from the influence which she exercises, mostly, however, in a lower sphere, nations emancipate themselves by civilisation. The victory of nations over external nature, is the *victory of the mind over matter*. Popular character has its soil, its intellectual soil in *History*, out of which it springs,—it has its intellectual climate in *Language*, in which it lives and moves.

FINIS.

POPULAR SKETCHES

FROM

THE MINERAL KINGDOM.

BY FRANCIS VON KOBELL.

TRANSLATED FROM THE GERMAN.

PREFACE.

An active endeavour has everywhere shown itself, in recent times, to open the sciences, and above all, the natural history sciences, to the general public, to interest the uninitiated in them through simple and clear explanations, and by an indication of the fruits which their well-cultivated garden furnishes for the common benefit, to obtain a worthy recognition of these studies from those who were formerly accustomed to speak of them only as a dull and pedantic pursuit. Thus have arisen societies for simple lectures on these sciences, and the publication of popular treatises, which have gradually gained increased diffusion and participation, especially among the female sex.

The present sketches are intended as a contribution to the same end.

The essays on the precious stones and metals were delivered as lectures in the Museum of Munich, and were subsequently published in the "Deutsche Vierteljahrschrift." The favourable reception they obtained from the public determined me to draw up similar accounts of the ordinary stones and ores, and thus to give a review of the entire subject.

Many observations have been added to the natural history text, principally in reference to technical application, but partly of a character adapted to indicate by a few touches the past and present condition of the science.

F. von Kobell.

Munich, Dec. 1849.

POPULAR SKETCHES

FROM

THE MINERAL KINGDOM.

I.

THE PRECIOUS STONES.

HUMAN activity is not entirely absorbed in care for the absolute necessities of life, it extends to the *decoration* of life in the most varied aspects, in works of art and poetry, in changes of "fashion," in the great and important possessions which become stamped with a permanent value, as acquisitions of the cultivated intelligence, as well as in the thousand trifles which, like the unassuming flowers of a meadow, are sought after for the pleasure they afford. The desire to decorate and embellish the objects around us, from the superfluous to the most indispensible, is an universal phenomenon, met with in all nations and in all ages; it is learnt, as it were, from Nature, who decks herself with many-coloured flowers, who has imprinted upon the wings of butterflies, the feathers of birds, the scales of fishes, on countless things living and lifeless, the marvels of the sun's light, shining in that rich fulness which we all so gladly behold, so joyfully appreciate and extol.

Mankind have sought, according to their capacity, power, and skill, to share among them that inexhaustible treasury of nature, to earn and enjoy adornment; their intelligence has by art fixed, or by imitation striven to fix, those transitory things which hurry away from them in nature, like the flowers of spring, the grace of youth; they have reviewed and selected throughout all creation, and the great mother has lovingly yielded to her children the glories which heaven has given to her, with which the Lord of all has endowed her.

On inquiry, we find that the external character and rarity of occurrence are the principal qualities concerned in giving natural products a value for ornamental purposes. Thus form, colour, and brilliancy, are especially regarded. The sense pleased by decoration is the sight; the eye rests with pleasure on the tender glow of the rose-blossom, on the light and elegant form of a marabout feather, on the sparkle of the diamond, and on the sunny lustre of gold, without caring much about the internal qualities of these things and whether they are valuable or not in other respects; whether, like iridescent soap-bubbles, they are empty and vacant, or the beautiful shell encloses a worthy kernel. For in such a contemplation of an object the imagination is active, while the reason mostly plays but a subordinate part. And really it would be very disagreeable if this inexorable grand inquisitor were always keeping guard over the eye with his analysis; were such the case, many a highly-prized ornamental substance would come badly off, and wants and weaknesses would be revealed, of which we are willingly ignorant; lovely soft pearls, the fanciful images of sad tears, and the fresh red coral to which we compare the lips of fair maidens, would actually be decomposed into the lime of bricklayer's mortar and the carbonic acid which bubbles from beer and wine in the fermenting tubs; the blue turquoise, the forget-me-not stone, in great part into iron-stained bones and teeth of animals long dead; the marabout and ostrich feathers, waving so proudly among perfumed locks and shining silken stuffs, into the elements of bristles and claws. It is true the eye of reason will not overlook the wonderful ways in which the invisible material has been fashioned; it will inquire how the atoms are placed and maintain themselves, to construct the form presented. It surveys all this much in the same way as many master-masons look at a miracle of Gothic architecture, busied above all with considering how the stones are arranged, how they are joined and built up; this is the utmost, and it sees no more. But Imagination has a lovely playfellow—Poetry—and these dear friends always see things of which the learned Professor Reason never thinks. The rose does please so much, merely because it is a delicate red flower, the imagination connects with the sight of it the image of blooming youth, and a thousand other images float around this; we compare, often unconsciously, and thus embellish the given object; in Gothic ornament we see not artistically entwined curves and flowing lines, but the branching of ancient oaks, the ramifications of graceful foliage; and in the brilliant emerald, not the regular, transparent structure of silicate of alumina and glucina, but the glittering green of young leaves—we think of the beauty of young blades of grass, and the like, and are readily induced to prolong this play of thoughts, of which the reason would not let us dream. How much of what embellishes would reason cast away! How much imagination preserves! It would, truly, be a strange kind of ornament if the reflections of the reason were set up as lawgivers. Undoubtedly they would hold the permanent, the immutable, higher than the transitory and less enduring, that which has many uses would be preferred to what is recommended only by one good quality; perhaps even the cheaper would acquire a preference over the costly; and who knows whether the flint would not displace the pearl, the straw-blossom the March violet, the goose-quill the marabout feather, and iron gold? though the latter would be truly hard to bring about. Whether, however, it be accident, as is probable, or a merit of our judgment, there certainly are many ornamental substances which can abide the verdict of the said inquisitor, and the diamond, for example, and gold, are noble both in external and internal qualities, as will be shown by-and-by. Nevertheless, the manner in which, for instance, platinum is treated, compared with gold, shows that a thoroughly noble ornamental substance may be held in very different esteem. The case of gold and platinum in this respect is pretty nearly the same as that of two fine horses principally distinguished by one being cream-coloured, the other of an iron-grey hue. Grey horses are not so much liked, and so the other cream-coloured gains the preference. The iron-grey is always used for heavy draught, and sees little of courtly pleasures and festivities; the cream-coloured passes his time in stately service with rich cavaliers and fair ladies, and severe labour, in which he would be less useful, but seldom falls to his lot. Platinum, unattackable as gold, serves in the laboratory of the chemist, to brave the action of acids and fire, and even passes also as money, but it enjoys little of the favour, like gold, of decorating the fair sex, glittering in rich diadems, winding round their necks, or furnishing rings to which attach so much real and imaginary happiness and tender significance.

How many other things present similar conditions! A bird with brilliant plumage, in a delicately-worked cage, certainly forms a beautiful decoration to a drawing-room, revealing as it does an attractive play of colour in every movement; for nothing exceeds the living ornament, created so abundantly in birds and flowers by Nature. Yet how many birds there are which do not enjoy this decorative service, even though they are in no way second to those which are sought after, and frequently made idols of! I have always a kind of sympathy in this respect with our native nut-hatch, against which many parrots couldnot stand, if fairly judged. It is not a flagrant sign-board of red, green, yellow, and blue, such as is especially beloved by savages; it is a quiet harmonious form, having but the single fault that it is not at home in Brazil or the Cape, that it inhabits *our* woods, and is as well known to the poor gamekeeper as to the princely forester. That flowers often have a similar fate, is known well enough, and the best that can be said about this is, that it probably makes very little difference to them.

It was requisite to touch upon these points in order to give a general indication of the true character of the ideas entertained respecting precious stones, which form the subject of this little essay. The precious stones are ornamental stones, and whatever is true regarding decoration in general, is true also of these. Patents of nobility are distributed here in the most arbitrary manner, and outward aspect and character weigh heaviest in the scales by which they are determined. To such an extent is this the case, that the stones which have literally and truly fallen from the skies are not reckoned among the precious stones, although they have been in all times objects of curiosity to the most cultivated minds, and certainly are of *very high descent*, since they come, *at least*, from the moon, and are even imagined to be young worlds, little princes, which would in time have come to reign as planets. And whence this injustice? Because these little strangers, which, perhaps, are pleased to travel *incognito*, have an inconspicuous exterior, are enveloped in a dark weather-proof cloak; because from under this cloak only a greyish suit, without gold-lace, with merely a little iron scattered about it, comes to light; because this aspect does not show from afar off that they have fallen from the skies; and because they do not say to everybody, "My mother lives in the mountains of the moon."

But whatever walks proudly in a brilliant suit, even though it be essentially of no particular value, and is even without an interesting history and descent, is in a condition to enter the ranks of the noble or precious stones; and usually only one thing is required as a qualification for this honour—namely, that the candidate who is desirous of moving in drawing-rooms and high circles, must assume a certain *polish*, which, indeed, is no more than what is reasonable. The prevalent mode of polishing, however, is as yet still so rough that a considerable degree of hardness is requisite in order to sustain it; and hence, at present, this is a property which is demanded of every ordinary precious stone—at least of those which claim attention; nature, indeed, understands this better, and very often makes the most delicate and softest stones, such as gypsum or selenite, mica, calcareous spar, &c., shine with smooth faces, such as no cutting and polishing is capable of producing.

As bodies are often termed hard, in the language of every-day life, which are difficult to break, it is necessary for me to remark that this idea of hardness is incorrect, and that the real characteristic understood by the term hardness of a body, is its power of resisting the mechanical penetration of any other body into its substance. The diamond, as the hardest of bodies, may readily be broken with a hammer, but it cannot be scratched by anything else, as for example, glass is scratched by flint, the last example showing that flint is consequently harder than glass.

The names of the commonly received precious stones are as follows: diamond, corundum, spinel, chryso-beryl, emerald, topaz, hyacinth, garnet, tourmaline, chrysolite, opal, and chalcedony, with quartz and amethyst in many varieties. Among these occur the most costly and expensive stones, peculiarly coloured varieties of which also have particular names, as for example, sapphire, ruby, aquamarine, and the like. The following are of comparatively inferior quality; but also very highly valued under particular circumstances: lapis lazuli, turquoise, cordierite, dichroite or iolite, Vesuvian, diopside, felspar, and labradorite in certain modifications, hypersthene, nephrite, obsidian, fluor-spar, fibrous calcareous-spar, and fibrous gypsum, malachite, manganese-spar or rhodonite, and amber.

It has been observed already that the most arbitrary conduct prevails in the distribution of the title of precious stone, and in the reception of a stone into this select class; and even among this tolerably well-established nobility of the mineral world just named, proceedings take place even now-a-days which border upon barbarism. For example, it would be a very great mistake to suppose that a person would think very highly of possessing a piece weighing several pounds of a stone which the most trustworthy mineralogist would declare to be emerald, since it might happen that there would be much difficulty in disposing of this precious substance, even if only a few shillings were asked for it. For it is only the *beautiful* children of such a family that can make any way; the plainer and ill-favoured are only valued by the learned, who are impartial and look more deeply into things; elsewhere they are almost valueless, or are used even for very common services, are degraded to the embellishment of knives, to the cutting of glass, to assist in the slicing of common stones, and are frequently employed in services for their preferred relatives, like Cinderella with her sisters, to deck them out, living themselves among the dust and dirt. The ancients were more reasonable in this respect, and the learned Bœtius von Boot (1600) gives, among other things, the following division of the precious stones: 1. small; 2. large; and again, 1. beautiful, and 2. ugly, or of commoner colour. At the present day no one pays attention to the latter. For example, we find at Bodenmais, in the Bavarian forest, a great mass of emerald or beryl; we find large pieces of tourmaline, and even of little spinels; but they acquire no value. They have dull faces, and wear unattractive clothing, and, in spite of their descent, they are only allowed entry into the cabinets of mineralogists, to place themselves beside the lovely little things from Peru and Ceylon, which bear the same family names.

Why have they such different aspects, wherefore are they so very dissimilar, when their essential nature is the same? Does nature prefer these nobles in one country and neglect them in another? Is it with them as with plants and animals, which in like manner are by no means common property of all zones, but differ in the north and south, differ in the snow-limits and on the strand of the sea? These questions may be answered almost entirely from our experience. With regard, in the first place, to the occurrence of precious stones in general, they are not bound, like plants, to a certain geographical latitude, to a definite climate, any more than the common stones; we find them frequently in equal perfection in the most diverse latitudes, albeit they do not choose a dwelling-place in every kind of rock. The diamonds, for instance, which are found in Golconda, cannot be distinguished from those met with in the Ural mountains or in Brazil; some of the Peruvian emeralds are the same as those from the Red Sea and from Catherinenburg; the amethyst which Ceylon furnishes occurs in equal beauty in the district of Zwei-brücken (Deux Ponts), and in the Ural, &c.

Therefore it is not geographical position which causes the variety, although it cannot be denied that the East Indies and Ceylon, and Brazil, produce precious stones more plentifully than other countries. (The ancients ascribed this to vapours rising from the earth, out of which the precious stones originated, the warmer sun of the tropical countries favouring such exhalations.) The variations we are considering are to be attributed in most cases to the more or less favourable conditions under which the stones crystallize, and the presence of colouring substances, which, although not influencing the essential composition, importantly affect the outward aspect.

Under the term crystallization we understand the phenomenon of the solidification of a mineral substance, accompanied by the acquisition of a determinate form bounded by flat surfaces. Bodies thus formed, commonly called crystals, do not grow, that is to say, increase in size, like an animal or a plant, but like a wall, by being built up. For example, first one little cube originates, and on the surfaces of this are deposited other little cubes, mostly very slowly, and thus it grows and finally becomes a large cube or cubical crystal. If foreign matters, such as sand or particles of dust, are present in the fluid substance in which this formation takes place, for example, in a solution of salt crystallizing, they become enclosed in the crystals which are being produced; if at the same time any motion occurs, the little crystals are not equably deposited together into one large crystal, and such interruptions interfere with the transparency, as it is interfered with in glass when much sand is mixed with it at the time it is becoming solidified, or when a clear sheet of it is broken into powder, through which we can no longer see, although previously we could perfectly.

Thus a happy conjunction of circumstances must exist, producing a natural crystallization of the precious stones, to cause them to appear with the desired transparency; and this holds good also of the colouring substance which pleases our eyes. For a large portion of the precious stones, and in fact the most valuable of them, have no colour in the purest state of their composition; this is the case with corundum, to which the sapphire and ruby, emerald and beryl, spinel, topaz, chryso-beryl, and others, belong. But they are not worthless on that account, because, when well cut, they in many cases display brilliancy and fire; but they have a far higher value when coloured. The essential nature, however, as already stated, is not affected by the colour, any more, for example, than the shells of Easter-eggs by the colour laid upon them, or masses of sugar which are stained or painted with red, blue, or other solutions. The Peruvian emeralds are coloured by a trace of oxide of chromium; the Bodenmaiser emeralds contain no chrome, and are therefore not green, but yellowish. Amethysts are coloured violet by a peculiar compound of iron, of which they contain only a trace; in common rock-crystals this colouring matter is absent, and hence they are of less value. But the colouring matter itself is by no means anything rare or costly. Iron, manganese, chromium, and nickel, the four metals which principally produce the colours, occur in great quantity in nature; and if we knew how to colour with them, there would be plenty of material to make all the precious stones in the world as beautiful as those which the earth of the East Indies and Ceylon has coloured, and which we purchase at so high a price. The question why these colours are not present universally in the precious stones, may be referred to similar causes with the fact that the several daughters of one mother often have not all black hair, very likely there may be a blonde or two among them.

It may be thought a great pity that the number of useful precious stones should be so greatly diminished on account of such trifles; that emeralds, for instance, do not all contain the particle of chromium which makes them so charming. But how would it be if these green stones were found in such abundance—if it were not necessary to fetch them from Peru or Pegu at a heavy price of money? They would be like the nut-hatch, still beautiful to behold, but no longer sought after.

Such are mankind, they wish only for what is unusual, rare, and above all, foreign; and thus they were ages ago, for even Pausanias complains that the Greeks preferred the foreigner to the native, and would rather praise the pyramids of Egypt than the incomparable treasures of Minyæ or the walls of Tyre. This seems indeed to have somewhat altered in the later times of Hellas, but in general it is incontestibly valid, and of especial weight in regard to the precious stones and their value, as to every other kind of ornament. In reference to the above-mentioned imperfections of the precious stones and their causes, these admit perhaps of another explanation than that given, derived from a most strange doctrine, which arose some time ago, namely, from the doctrine of the *diseases* of minerals, from "mineral pathology." In old times they talked of male and female stones, for example, cornelian and sapphire; also of ripe and unripe stones, as garnets and asbestos; recent times have brought forward diseased stones, with normal and abnormal appearances, &c. It is hardly credible that such a thing could come into any mind, but it has occurred to one. But instead of dwelling upon this doctrine, I will refer to a stone which the Greeks called *sophronista*, that is, "the discretion-bringing," and which has unfortunately been lost, although it is true the mode in which it was applied is mentioned, and might be of service even with a common stone. It is said, namely, that when Hercules wished to put to death the Amphytrions, the discreet Minerva cast the stone Sophronista at his head, which had the good effect of causing him entirely to forget the abominable undertaking. But these are old tales, and now-a-days, alas! Minerva allows doctrines like mineral pathology to come to light undisturbedly.

Although it was stated that the precious stones are not the exclusive property of any particular geographical situation, still their occurrence seems subject to certain limitations, in so far that they are not observed in all kinds of rocks or geological formations. The most valuable are chiefly found in those rocks which are considered to be the oldest on the earth—in the primitive rocks, as they are called—to which belong granite, gneiss, micaceous-slate, &c. Of the grounds on which these rocks are supposed to be the oldest, I will merely mention, that no petrifactions are found in them—that, consequently, they probably existed before any organic creation; while the later calcareous and sandstone rocks are often full of shells, bones, and remains of plants. In Ceylon, however, which yields very many precious stones, and in Brazil, these stones are chiefly found in the sands of rivers, in which they did not actually originate; and it is an interesting fact, that several of the different kinds always occur together, and the noble society is rendered still more brilliant by the company of gold and platinum.

In answer to the question how our chemical knowledge of the precious stones stands, an answer may be returned without hesitation, that we are tolerably advanced, that we know their constituents well, and are able even to find these elsewhere—namely, to extract them from quite common stones which sometimes contain them. But it would be erroneous to suppose from this that there would be no difficulty in making the precious stones artificially; it is with these as with a work of art and its material; though the latter may exist in abundance, it does not follow that the former is soon to be produced.

For instance, common potter's clay, of which earthenware is made, contains two earths, each of which furnishes a precious stone when in a crystallized condition. These earths are silica and alumina. Crystallized silica affords rock-crystal; crystallized alumina gives the sapphire and ruby or corundum. We know how to extract these earths in purity out of the clay, but we are unable to make them crystallize; at all events, all attempts hitherto made have been unsuccessful. Spinel is composed of alumina and magnesia. These earths, likewise, are uncommonly abundant in dolomite, as it is called, which occurs in vast masses, and we can prepare them very pure from this; but experiments to make spinel out of alumina and magnesia fail, again, from our inability to cause the compound to crystallize. The same is the case with the champion of the precious stones, the diamond. We know, beyond all doubt, that it consists of pure carbon, and that its material is contained in all coal or charcoal, of whatever kind, but we cannot crystallize this charcoal or carbon, and therefore we cannot make diamonds. We have a remarkable instance here how crystallization is capable of altering the physical properties of a substance. Uncrystallized carbon is black and opake, like common charcoal or coal; crystallized carbon is bright and transparent, like a drop of the purest water, and rich in the beauties of refracted light. Truly said the French crystallographer, Hauy, of this circumstance, "Jamais il n'a été si vrai de dire, que les extrêmes se touchent." (Never could it be so truly said that *extremes meet.*)

It is evident that there is an operation of the force of crystallization upon stones, analogous to that of the vital force in animals and plants. In the latter, the vital force bids the elements of the composition appear in the wonderful forms which we behold and marvel at; in the former, the force of crystallization arranges the particles in a manner equally incomprehensible. The composition of the emerald, chrysoberyl, the topaz, tourmaline, and the garnet, is still more complex than in the stones just mentioned, hence the hope of forming them artificially is still more slender; for it is evident that the pastes or glasses by which these stones are imitated, and which have in recent times been very beautifully manufactured, are not artificial gems in the true sense of the word, because, with the exception of an approximation to the colour and transparency, they are of totally different character, and, in particular, cannot produce the optical effects of brilliancy and fire.

From these general considerations I will now pass to a particular account of some of the most important and usually occurring precious stones, commencing with the prince of them, the diamond.

The diamond derives its name from the Greeks. Among the ancients, namely, it was called *adamas*, which signifies "the invincible," probably in reference to its hardness, which, moreover, was so understood by Pliny, who says a good diamond braves hammer and anvil. The diamond occurs in nature almost always in perfect crystals, with the faces frequently somewhat convex, and usually very numerous, so that the form often presents forty-eight of them. These crystals may be split in the direction of certain of their faces, and use is frequently made of this in cutting them. Its peculiar brilliancy, its remarkable refraction of light, and its hardness, are well known; it is much heavier than uncrystallized carbon, and three and a half times the weight of water; that is to say, if we took two balls of equal size, one of water, the other of diamond, the proportion of their weights would be as one to three and a half. Most diamonds are transparent and colourless, or only just tinted with yellow, green, red, blue, or brown; but they are also met with of deeper colour, and in some cases even with blackish spots and points, or moss-like markings, in the interior. The diamond is composed, as already stated, of pure carbon, and this is to us what we call an element, that is to say, it has not hitherto been further decomposed by chemistry. The diamond is not attacked by solvent substances, and it is strange how the belief could have originated among the ancients that it would dissolve in blood of a buck. Thus it is said by Pausanias: "But the Divinity is accustomed to endow the very insignificant with strength to overcome the exalted. For it happens that pearls are destroyed by vinegar, and moreover the diamond, the hardest stone, is dissolved by buck's blood."

Comparing the aspect of this wonderful gem with that of black charcoal, one might well imagine the conclusion of chemists to be erroneous, like children who cannot believe that sugar makes the teeth black, because it is *so white;* but that the substance of the diamond is really carbon is proved by unquestionable experiments. The history of the researches upon this point are not without interest, and I will therefore relate something of them.

In the year 1694, Cosmo III., Grand-Duke of Tuscany, caused experiments to be made at Florence, for the purpose of ascertaining the behaviour of the diamond when exposed to great heat. The diamond was placed in the focus of a burning-mirror, and the operators were not a little astonished to see it gradually disappear, and at length become totally dissipated by the heat, leaving no trace behind. This experiment was subsequently repeated in Vienna by the Emperor Francis I., who applied the heat of a furnace. The diamond was destroyed in the same way. D'Arcet, Rouelle, Maquer, and other French philosophers, then began to experiment upon it, and on the 26th of July, 1771, a fine diamond was burnt in Maquer's laboratory, and the extraordinary character of this fact was the talk of all the learned and unlearned of the Parisian world. That the diamond disappeared under intense heat was incontestible, but what became of it no one knew; opinions differed as to whether it became volatilized or burnt away, or was split up into invisible particles. It happened, however, that a celebrated jeweller in Paris, named Le Blanc, denied the destructibility of the diamond by fire, in the teeth of the authority of the learned, asserting that he had frequently exposed diamonds to a strong fire to purify them from certain spots, and that they had never suffered in the least from this; and adventuring a new experiment, he enclosed a diamond in a mixture of charcoal and chalk in a crucible, and placed it on the fire, convinced that it would come out again uninjured. The Academicians D'Arcet and Rouelle also devoted some diamonds, and these having vanished after three hours' exposure to the fire, Le Blanc's crucible was also opened, when, to his great astonishment, and to the triumph of the learned, his diamond likewise had disappeared. But the triumph did not endure long, for on another opportunity, in which the renowned Lavoisier conducted the experiments, another jeweller, Maillard, came, "with a zeal," says Lavoisier, "truly worthy of the gratitude of the learned," and delivered up three diamonds to the torture of the furnace, closing them up well, however, in his own manner, in charcoal powder, in the bowl of a clay pipe. A tremendous heat was applied to them, and when Maillard's pipe-head was opened, there lay the diamonds uninjured, in their charcoal powder. I pass over the further investigations which were then instituted with the great Tschirnhaus burning-glasses four feet in diameter, and with proper regard to the surrounding circumstances, which showed that the *access of air* was an essential condition for the disappearance of the diamond under the influence of heat, and finally, that a true combustion occurs, with the same products as in the combustion of charcoal.

It must at the same time be mentioned, as a remarkable result of scientific speculation, that Newton had concluded, in 1675, from the strong refracting power of the diamond, that it must be a combustible substance.

With regard to the mode of occurrence of the diamond, it has not hitherto been found in its original beds, but in iron-sand, gravel, and ferrugineous quartz conglomerates. The richest diamond mines in Hindostan are Roalconda and Golconda, Visapur and Hydrabad.

About 1000 labourers are employed in diamond-washing in the neighbourhood of Pannah. Diamonds are also found in Borneo. They were first discovered in Brazil by accident in 1728, for previously they had been thrown away with the gravel and sand from which gold had been washed, or had only been used as counters; an inhabitant, who knew rough diamonds, brought a quantity to Portugal, and acquired a large property by the sale of them. A subsequent similar case attracted the attention of the government, and in 1730 the diamonds were declared royal property. But the discovery of diamonds in Brazil caused the merchants who had hitherto imported them from the East Indies, to fear lest the price should be reduced through the new localities, and therefore they spread a report that the Brazilian diamonds were only the refuse of the Indian stones which were sent to Goa, and from thence to Brazil to be sold there. But on the other hand, the Portuguese reversed the matter, and exported the Brazilian diamonds to Goa, and thence to Bengal, where, given out for Indian, they fetched as good a price as the others. The Brazilian diamonds occur in company with topaz, beryl, chrysoberyl, gold, and platinum, in sand and alluvial deposits, principally in the districts of Tejuco and along the rivers Pardo and Jequetinhonha, in the "diamond districts," as they are called, and in many places in the province of Minas Geraës.

In 1829, they were discovered in the Ural, but only occur sparingly there, merely thirty-seven specimens having been found up to 1833. Diamonds are also stated to be found in the province of Constantine, in Algeria, and one or two have been found in Georgia and North Carolina.

The diamonds are obtained by washing the sand which contains them, and picking over the residue; and the districts are carefully guarded, especially in Brazil. The washing is performed by negroes devoted to this service; and was formerly so important, that from 1772 to 1775 nearly 5000 men worked at these washings. Any one who finds a stone of seventeen carats obtains his freedom, and his master is indemnified. In spite of the rigid overlooking, smuggling exists to a great extent, and is estimated to amount to one-third of the produce of the mines. About 13 lbs. of rough diamonds come annually from Brazil to Europe; these when cut make about 8000 carats.

The price of diamonds is determined by the purity (water), size, cutting, and colour. The perfectly colourless fetch the highest price. The mode of cutting varies, and the "brilliant" cutting is that applied to the most perfect stones. The "brilliant" form is doubly conical, with facets. In setting, the sharpest cone is placed downwards, and the blunter cone, which has its apex cut off, is turned upwards. Less valuable stones are cut as rosettes, with convex facets on the upper side, and flat below. Cardinal Mazarin was the first to have diamonds cut into the "brilliant" form, about 1650. The ancients wore them uncut. The great diamond which the Persian prince, Chosrhoes, the younger son of Abbas Mirza, gave to the Emperor of Russia, during his sojourn in St. Petersburgh, is likewise only partially cut, and has Persian inscriptions on the polished faces.

The cutting of diamonds with their own powder was first discovered by Louis de Berquem, of Bruges, in 1456; but diamonds were polished in Nuremburg as early as 1385. They are cut by means of revolving circular plates (or "wheels") of cast iron or steel, with the application of diamond-powder. For other precious stones, similar discs of copper, lead, or other metals, are employed.

Rough diamonds, fit for cutting, are sold at 1*l*. 13s. 4d. to 2*l*. the carat. A carat is rather more than three grains, and 156 carats equal one ounce troy. But if the stones are above one carat, the square of the weight is multiplied by the price of a single carat; so that, for example, a rough stone of three carats costs 3 × 3 × 2*l*., or 18*l*. It is similar with cut diamonds, and at present (1850) the purest brilliants of one carat fetch more than 8*l*., a brilliant of two carats 2 × 2 × 8*l*., or 32*l*. When stones are over eight or ten carats, however, this is altered, so that they are often valued still more highly. Diamonds of a quarter of an ounce weight are extraordinarily costly, but still larger are met with; and one of the largest known is that of the Rajah of Mattun, in Borneo, which weighs nearly two ounces and a half; that of the Sultan of Turkey weighs two ounces; one in the Russian sceptre more than an ounce and a quarter. The greatest diameter of the last is one inch, the thickness ten lines. The Empress Catherine II. purchased it, in the year 1772, from Amsterdam, and for it was paid 75,000*l*. and an annuity of 650*l*. Diamonds weighing an ounce exist also in the French and Austrian regalia. One of the most perfect is the French, known as the Pitt or Regent diamond. It was bought for Louis XV., from an Englishman named Pitt, for the sum of 135,000*l*. sterling, but has been valued at half a million. One of the stones most renowned in the East is the Koh-i-noor, or Mountain of Light, now in possession of the Queen of England. It came from Golconda to Persia, and while uncut weighed more than five ounces, but now, polished, only about two ounces.* It is valued at more than two millions of pounds sterling.

If we took only the common mode of estimating the value, a perfect brilliant weighing half a pound would be worth 20,000,000*l*. Some have stated that such a diamond exists among the royal treasures of Portugal, as large as a hen's egg; according to others this is only a topaz.

* It was so badly cut that the Queen has ordered it to be recut, since it was displayed in the Great Exhibition of 1851.

The other precious stones are also occasionally met with colourless, and sapphires of this kind bear the strongest resemblance to diamonds, but may be distinguished by greater specific gravity. The colourless beryl and topaz are far inferior in fire and hardness, and this is still more the case with *rock crystal*. I shall proceed next with the description of this last stone, not because it is the next in value to the diamond, for it is inferior to many others, but because it appears as a form of an earth, namely, silica, which constitutes the principal constituent of a series of precious stones capable of being referred to together in one group. Rock crystal occurs in extraordinary abundance, but only the purest varieties are valued, and it only becomes expensive when in large masses. The usual form is that of a six-sided prism, pyramidally acuminated. It occurs in cavities and vein-like spaces, principally in the primitive rocks. These are called in Switzerland crystal caves or chambers, and often contain a considerable abundance of such crystals, which sometimes occur perfectly pure, weighing several hundred-weight. In the year 1725, a cave was discovered at Zinkenberg, on the Grimsel, which contained five tons of crystal, among which occurred columns clear as water, weighing from 100 to 500 and 800 pounds. A similar cave was opened, in 1770, in the mountain of Hagdorn, near Fischbach, in which were found, among innumerable crystals, a column weighing 14 cwt., one of 8 cwt., and one of 6 cwt., of the greatest purity. Tyrol, Salzburg, Dauphiny, Hungary, Siberia, and Madagascar, furnish very beautiful rock crystals, which in many cases are coloured light-pinkish brown, and these are called *smoked topazes*, or yellowish, which are called *citrines*. The *Cairngorum* stone of the Scotch highlands is a brown or yellow rock crystal. In former times vases and bottles, and the like, were worked out of rock crystal, and the largest of these now existing are in the treasury of Vienna. But the variety of rock crystal most highly prized is that coloured violet, known as *amethyst*. Yet, in spite of its beauty, it is tolerably cheap, so that stones of one carat cost only eight to fifteen shillings, those of ten carats 5*l*. or 6*l*. Schemnitz in Hungary, Wiesenbach and Wolkenstein in Saxony, Mursinsk in Siberia, Oberstein in Zweibrücken, Ceylon, &c., furnish amethysts. Some are found in Ireland, near Cork. The stone was supposed by the ancients to have a virtue against drunkenness, and its name refers to this. Aristotle especially recommends it on this account, and prescribes that it be worn under the breast. Rock crystals containing other minerals in their interior also occur not unfrequently, and a very good effect is produced when fragments of rutile, asbestos, ferrugineous mica, or the like, are enclosed in the form of needles or little plates, just as ice sometimes encloses stalks and leaves of plants. These stones are called *hair-stones*. In many cases a rock crystal or mass of quartz is very intimately and uniformly mixed with a fibrous mineral, and such stones, when cut into a round form, exhibit a peculiar glance of light, and are called *cat's eyes*. They are worn as ring-stones, and occur especially fine in Ceylon and Malabar. Very often the mass of silica has little scales of mica intermingled in it, and stones of this kind bear the name of *avanturine*. Beautiful kinds of it occur in Siberia, but the artificial avanturine, a kind of glass which is manufactured of finest quality at Murano, near Venice,* is far more beautiful than the natural.

Silica also furnishes, when combined with oxide and silicate of iron, the *jasper*, which occurs of almost every colour, and is particularly esteemed for making seals. It is mostly opake, and is thereby distinguished from chalcedonies, which are transparent. Scotland, Bohemia, Saxony (Freyberg, Schneeberg, &c.), Hungary, Italy, Siberia, Egypt, &c., furnish beautiful jasper. The brown Egyptian kind, which is found as drift or alluvial deposit in the Nile, and the Siberian riband jasper, are valued most highly. Polished seal-stones, however, do not cost more than three to five shillings.

Silica occurs, moreover, in nature in an uncrystallized condition, although not so abundantly as crystallized, and it is frequently mixed with the latter, forming in this condition beautiful gems, which cannot be made artificially. Among these are the *opal*, *chalcedony*, and *agate*.

The opal is met with of various colours, but there exist varieties which exhibit, especially when cut into a globular form, a lively play of red, green, and blue; this is the noble

* It is now made equally well in England.

opal, which is very highly valued, so that stones five or six lines in diameter have been estimated at 80*l.* or 90*l.* This noble opal is found imbedded in small portions of the trachytic rocks, as they are called, of Hungary, in the southern promontory of the Carpathians, about Czerwenitza, between Kaschan and Eperies, and in Honduras. The imperial treasures at Vienna include the largest and finest opals known, and among others a piece weighing 1 lb., which is valued at more than 40,000*l.*

Chalcedony and agate occur frequently in amygdaloid, as it is termed, and in alluvial deposits. Cornwall, Scotland, Zweibrücken, Tyrol, Bavaria, Bohemia, Transylvania, Hungary, Iceland, the Feroë Islands, Ceylon, the Nile, &c., furnish some of the most variegated in colour and marking, occasionally even in lumps a foot in diameter. The chalcedonies which exhibit layers of black and white, brown and white, &c., are called *onyx*, and furnished the ancients with materials for cameos. The various colours of the layers were very cleverly used to give the reliefs, and indeed these stones are very valuable without any artificial work upon them. A plate of onyx three inches long and broad, with numerous regular layers, existing in the treasures of the "Green Vault" at Dresden, is valued at about 7000*l.*

Red chalcedony is called *carnelian* or *cornelian*, and the light apple-green kind is *chrysoprase*. The most beautiful cornelians come from Egypt, Arabia, Nubia, Surinam, and Siberia, but they also occur in Scotland, Bohemia, and Saxony. Chrysoprase has hitherto occurred only at Glaserndorf and Kosemüz, in Silesia, in serpentine, and in Vermont, U. S. The green colour is given by a trace of oxide of nickel, while the cornelian is coloured red by oxide of iron. Fine chrysoprases, one inch long and half an inch broad, cost from 3*l.* to 5*l.*, or even 10*l.* Fine seal-stones of cornelian are seldom estimated at more than 1*l.* 10*s.* to 2*l.* 10*s.* Chalcedony of a dark-green colour sprinkled with red spots, is also called *heliotrope*, and that of a leek-green with a waxy lustre, *plasma*. All these stones are transparent only in large pieces, and they often occur strangely intermingled in the *agates*, as they are called, whch occur in similar situations. These were highly prized by the ancients, and indeed were celebrated in several poems by Orpheus, who could not say sufficient of their virtues—how they made men agreeable to women, how they cured the sting of scorpions, how they were good and pleasant to drink with good wine, &c. They are made especial use of in the Florentine mosaics, their exceedingly varied colours rendering them particularly available for this purpose. They are also worked into boxes, dishes, and the like, and are not of very high price.

The *Woodstones*, as they are called, are composed partly of quartz and partly of chalcedony, and frequently exhibit very clearly the texture of the wood which they have penetrated or *petrified*, as it is called. They occur chiefly in alluvial deposits, and are cut into snuff-boxes and similar articles. Beautiful varieties are met with at Chemnitz in Saxony, in Zweibrücken, and in Siberia.

Looking over the list of these stones, with which almost every one is acquainted, it seems really astonishing that one and the same earth should furnish products so unlike and so beautiful, simply through the addition of traces of colouring metallic oxides. This earth, combined with others, namely alumina, lime, magnesia, zircon, glucina, and a few metallic oxides, also contributes to form the following precious stones: the emerald, chrysolite, chrysoberyl, topaz, hyacinth, garnet, lapis lazuli, and labradorite. Of these, *chrysoberyl* and *chrysolite* are not very valuable, and seldom occur of considerable size or beauty. They are transparent green stones, the chrysoberyl pale-yellowish green, the chrysolite blackish or olive green. Most of the chrysoberyl comes from Brazil, Pegu, Ceylon, and Siberia, and is rare; it is distinguished by the presence of glucina in its composition, with silica and alumina; chrysolite, on the contrary, is extremely abundant in all basalts, usually, however, in granular masses (*olivine*), which do not afford stones for rings; the stones available for this purpose come from Brazil, Natolia, and Upper Egypt. It is composed of silica and magnesia. It must be particularly mentioned in regard to chrysolite, that it also exists in Pallas's meteoric iron, which was found in Siberia, and in this case certainly we had chosen as precious a stone which has fallen from the skies, since it is assumed that all native iron is of meteoric origin; but the chrysolite of Pallas's iron is unfit for cutting, and only occurs in very small pieces.

Another stone of a green colour, at least in its finest varieties, is the *emerald*. It contains, together with silica and alumina, a peculiar earth, otherwise rare, called glucina. Its form is a six-sided prism. Its pure green colour, its transparency, and the beautiful polish it takes, render it one of the most valuable of precious stones. When wholly without blemish, the carat is valued at as much as 4*l.*; stones of six carats, from 60*l.* to 90*l.* The imperial treasury in Vienna possesses renowned emeralds, one of which is said to weigh 2205 carats, and is valued at 50,000*l.* Beautiful groups of crystals of it exist in Dresden, St. Petersburgh, and Eichstadt (in the Duke of Leuchtenberg's collection). The most beautiful emeralds come from the Tunka valley in Peru, New Granada, and Popayan, in America, and from Kosseir, on the Red Sea; but fine ones are met with also in the Catherinenburg province of Siberia, and moreover, though rarely, in Pinzgau, near Salzburg. They are usually accompanied by quartz, and micaceous and hornblende slates. Among the ancients, the emerald was sacred to Mercury; and Pliny narrates that the finest Scythian specimens grew in the gold mines, in which the griffins made their nests and watched them. According to Pausanias, the favourite ring of Polycrates likewise contained an emerald. In "name-rings," in which a name is indicated by the initial letters of different gems, the emerald is mostly used under its English and French name (*emeraude*) to stand for *e*, which would not otherwise be represented.* While on this point, it may be mentioned that a difficulty occurs also with *u*, but recent times has furnished a name which may assist, namely, a green garnet, containing chrome, from Siberia, has been baptized after the Russian minister Uwarow, and called *Uwarovite*.

The emerald, however, not only occurs green, but more frequently light-greenish blue, sky-blue, and yellow, and these kinds are called *beryl* or *aquamarine*. These are cheap, and cost about five to ten shillings the carat. Siberia furnishes them in great quantities, from Mursinsk, Miask, Nertschinsk; as do also Rio Janeiro and Scotland. They often occur in prisms nine inches long, and more than one inch thick.

* The German name is *Smaragd*.

Impure varieties are met with in many places, and in considerable masses. Thus a mass weighing 185 lbs. is known, from Acworth, in New Hampshire, U. S. The beryl also was accounted a stone of many virtues in the middle ages.

The *topaz* is one of the most familiar, and by no means a very expensive gem. It contains fluorine or fluoric acid, in addition to silica and alumina, and is harder than rock crystal. Its crystals are prismatic, and useful specimens are furnished principally by Brazil, Siberia, and Saxony, but the Saxon topazes are ordinarily of a pale colour. In the vicinity of Auerbach, in Saxony, there is a rock, the Schneckenstein, formed of topaz, mingled with quartz. Crystals from the Ural are known more than four inches in length and thickness. The usual colour of the topaz is of a wine-yellow, but it also occurs colourless, bluish-green, and reddish, and they may be coloured rosy red by exposure to a gentle glowing heat. The yellow stones are sold at ten to fourteen shillings the carat, the rosy and colourless specimens fetch a higher price. Rough Saxon topazes are cheap, and the ring-stones, as they are called, do not cost more than 4*l.* 10s. per pound.

The ancients called our chrysolite topaz, and *vice versâ*, and drank the powder of it mingled with wine, which was said to be good against fever and melancholy; perhaps it might be serviceable in the latter complaint even at the present time, in the same form of prescription.

The belief in the miraculous power of precious stones was altogether very great, and Albertus Magnus, of Lauingen, in Swabia, who lived in the thirteenth century, had so much to relate on this head, that a man would make excellent progress in the world with a small collection of precious stones, if half what he states were true of them. For instance, we find in his little work on the Virtues of Stones:

"If you wish to become invisible, take an opal and wrap it in a bay-leaf, and it is of such virtue that it will make the bystanders blind, hence it has been called the patron of thieves.

"If you would avoid all dangers, and overcome all earthly things, and possess a stout heart, take an agate. It causes danger and opposition to vanish, and makes a man strong, agreeable, and of good cheer. If you would sharpen the understanding, increase riches, and foresee the future, take an emerald. For prophesying, it must be placed beneath the tongue."

Of the eagle-stone (a kind of aluminous iron-stone) it was said that, worn on the left arm, it awakened love between man and woman; and mention is also made of a stone very serviceable to hunters, called juperius, obtained from Lybia, which attracted all kinds of game, &c.

The powers of the precious stones were increased by figures or various objects engraved upon them.

A great number of precious stones were to be found among the stores of the apothecary as late as the end of the last century.

The *garnet* is a red stone, which is likewise principally composed of silica, with alumina and lime, and also oxides of iron and manganese. This stone does indeed occur of other colours, but ordinarily only the red garnets are transparent enough to fit them for cutting as ornamental stones. The red has sometimes a bluish, and sometimes a brownish tinge. The crystallization of garnet is almost everywhere the same, and usually varies only between two forms. One, that most frequently met with, has twelve rhombic faces, the other has twenty-four trapezoid faces. This mineral is particularly widely diffused, and occurs in the primitive rocks of Scandinavia, in Carinthia, and Tyrol, frequently in crystals as large as a man's fist; but these garnets are rarely pure. The most beautiful are those called Syrian garnets, coming from the east, but useful garnets are also found in Bohemia and in Spain. The Bohemian, the *pyrope* of mineralogists, occur mostly in loose granules, in drift, near Meronitz, Podselitz, &c. They are but small, yet of fine blood-red colour, and are faced and pierced, and sold in strings. A *parure* of 1000 stones is sold for about 12*l*. or 14*l*. The Syrian garnets are much dearer, and one from the celebrated collection of the Marquis de Drée, in Paris, from six to eight lines long, and cut with eight angles, was sold for about 140*l*. The large, less pure garnets are worked into snuff-boxes, and the like, and were frequently used for flints in the old German firelocks.

The hyacinth-red garnets from Ceylon and Piedmont are usually sold under the name of *hyacinths*, and most of what are called hyacinths by jewellers are garnets of this kind. But the true hyacinth is a stone of totally different kind, containing a peculiar, and moreover rare earth, zircon, in addition to silica. It occurs in Ceylon, Norway, Carinthia, in the Ural, &c., but is rarely large and beautiful enough to be of use.

A less-known precious stone is the *tourmaline.* It belongs to the noble series of siliceous stones, and is distinguished by containing a small proportion of boracic acid. This remarkable stone was first mentioned in a book entitled "Curious Speculations in Sleepless Nights, by an amateur inclined to speculate: Chemnitz and Leipsic, 1707," and it is mentioned therein, that the Dutch first brought to Holland from the East Indies, in 1703, a stone coming from Ceylon, called Tourmaline or Tourmale, which had the property of attracting the ashes of peat. It was thence called by the Dutch *aschentreker* (ash-attractor). In reality, the tourmaline becomes electrical to a remarkable degree when warmed, and then, like other electrical bodies, attracts ashes, cuttings of paper, and other light bodies. Tourmaline is found of all colours, and is a very widely-diffused mineral, but rarely pure and clear. Such, of red colour, is chiefly obtained from the Ural; green and blue, from Brazil. The red is the dearest, and stones from four to five lines long often cost as much as 24*l.* The collection of the Duke of Leuchtenberg, at Eichstadt, contains a group of crystals of red tourmaline, more than six inches high, and four inches thick, and weighing five pounds and a half. This piece is valued at 500*l.*

Many other compounds of silica might be mentioned, which, although not so highly valued, form precious stones; but I shall only direct attention to the *Labradorite,* which exhibits gleams of blue, yellow, green, and copper-coloured reflexions, and comes from the coast of Labrador, in North America; and *lapis lazuli,* which is esteemed on account of its blue colour, and, unlike any other precious stone, is of high value even when pulverized. It furnishes in this condition the well-known pigment called ultramarine, which was formerly sold as high as 4*l.* or 5*l.* the ounce. It owes its colour to a peculiar compound of sulphur which it contains, and it is the only precious stone which the art of the chemist has hitherto prepared, so that the powder at least can be used in the same way as the natural product. Lapis lazuli mostly occurs in compact pieces of tolerable size, and is only slightly transparent. Ring-stones, snuff-boxes, vases, &c., are made of it; and it is in particular employed in the inlaying of ornamental tables, &c. It comes from Thibet, Little Bokhara, China, and Chili.

We come now to certain very highly esteemed precious stones, which contain no silica, but in the composition of which alumina plays an important part. These are corundum and spinel. The corundum of mineralogists includes the *sapphire* and the *ruby*, which are not different in nature, but only in colour, the sapphire being blue, the ruby red. As just stated, these stones are crystallized alumina. They are the hardest of all stones excepting the diamond, and they are four times heavier than water.

Fine varieties of the sapphire have an extremely lovely blue colour, like a bright sky or the blue corn-flower. The stones sometimes exhibit, when turned about, a white six-rayed gleam of light, if they have been cut into a round form, and these are called *star-sapphires*. The purest sapphires are found in the sands of the rivers and in drift, in Ceylon, in China, Siam, and Brazil, also, although sparingly, in Meronitz and Iserwiese in Bohemia, Hohenstein in Saxony, and imbedded in basalt at Cassel on the Rhine, and on the Laacher lake, in granite at Chamouni, and at Newton, New Jersey, United States.

With regard to the value, the average price of the carat is 1*l*. 5s.; but for stones which exceed six carats, the price often rises very considerably, so that such as weigh six or seven carats have fetched above 60*l*. The sapphire, also, was highly esteemed by the ancients. On account of its purity and loveliness, it is frequently used in poetical figures, and it is mentioned in the Song of Solomon: "His hands are as gold rings set with the beryl; his belly is as bright ivory, overlaid with sapphires." In the Revelations, it is one of the precious stones which adorn the foundations of the new Jerusalem. The first foundation was a jasper, the second a sapphire, the third a chalcedony, &c. (xxi. 19).

According to Dioscorides, it was sacred to Apollo; and the virtue was ascribed to it, that whoever wore it would obtain the favour of princes, and be secure from sorcery, bonds, and captivity. Red sapphires, or *rubies*, are prized far more highly than the blue ones. A perfectly pure deep carmine-red ruby often exceeds in price a diamond of the same size. The average price of stones of one carat is 2*l.* 10s.; of two carats, 7*l.* 10s.; of three carats, 20*l.*; of five carats, 40*l.*, &c. But a cherry-red ruby from the Dree collection, weighing two carats, was sold for 40*l.* The red colour depends upon the presence of a small portion of chrome. The rest of its properties and its native localities are the same as those of the sapphire. It is mentioned, with the sapphire, even in the books of Moses, and was one of the chosen stones to be used in decorating the priest's garments of Aaron. The others were the sardis, topaz, emerald, diamond, lyncurius, agate, amethyst, turquoise, onyx, and jasper.

Its brilliancy and fire were fabulously renowned among the ancients, and a Roman, Vartomanus, related of one possessed by the King of Pegu, that it emitted so much light that men could see as well in a dark place where it was displayed as when the sun shone; and the Bishop Epiphanius said of it, that it shone like a flame through clothes which covered it. Among the Greeks it was called *anthrax*, carbon, in the sense of *glowing charcoal;* hence the Latin *carbunculus*, and the English *carbuncle.* The *spinel* is not unfrequently deceptively like the ruby, and confounded with it; but it ordinarily occurs of a rosy-red colour. When of equal size, it is heavier than the ruby. The spinel is composed of alumina and magnesia, and has a different form of crystallization from the ruby. The jewellers distinguish varieties, the principal of which are the *spinel-ruby* and the *Balas-ruby;* the former are of deeper, the latter of lighter colour. Among the ancients it occurs under the name of Balassus, or Palatius, because it is the mother, dwelling, or the *palace*, as it was said, in which the carbuncle, or true ruby, is produced and dwells.

This beautiful stone occurs in the East, under the same circumstances as the ruby; valueless varieties are also met with elsewhere. It commands a high price, and when without defect, and over four carats in weight, it is about half the price of a diamond of the same weight.

There remain three other precious stones greatly esteemed, which are of totally different composition from the foregoing; these bear the names of *turquoise*, *malachite*, and *amber*. The *turquoise* is opake, and of sky-blue or greenish-blue colour. It has a waxy lustre, and is not very hard; it is usually cut only into roundish form, and not facetted. It has already been mentioned that a portion of what are called turquoises are composed of the bones and teeth of fossil animals, coloured by oxide of copper or phosphate of iron. These occur chiefly in Siberia. But the mineral turquoise comes from Persia (and Arabia), and is composed of phosphate of alumina, coloured by a compound of copper. It is met with in Persia, in narrow cracks in aluminous iron-stone, and in veins in siliceous rocks; also in loose gravel. Fine stones of this kind, as large as a pea, fetch twelve or fifteen shillings. According to the belief of the ancients, the turquoise had most excellent properties; one of the most important mentioned is, that it destroyed animosity, and, in particular, appeased discord between man and wife.

Malachite, which was included with the emerald by the ancients, is a true copper ore, and consists of hydrated carbonate of the oxide of copper. It is opake, and of a fine green, often exhibiting circular and clouded markings when cut. It occurs very abundantly, and in all places where copper ores present themselves; but Siberia furnishes the finest stones, especially Gumeschewsk in the Ural. The collection of the Mining Establishment, in St. Petersburgh, possesses a block from thence, three feet six inches in height and in width, valued at 525,000 roubles. It is cut into thin plates, and used for coating vases, tables, and the like. A large and very beautiful vase of this kind exists in the Palace at Munich; and the Demidoff collection of malachite ornaments exhibited at the Great Exhibition of 1851 is especially celebrated.

Amber is a substance of totally different origin, and does not originally belong to the mineral kingdom. It is a kind of resin, produced by pines growing in former geological epochs, and often contains little insects, spiders, and the like, imbedded in it. Its colour, transparency, &c., are well known. It is inflammable, and burns with an agreeably smelling smoke. The greatest quantity is found on the coasts of the

Baltic, partly in tracts of ground deposited by the sea, partly in the sea, and is sought for upon the shores after storms, and dug for in the sands. But amber has been found in Saxony, Spain, Sicily, England, and China, partly in sand and similar deposits, partly in the brown-coal or lignite. According to G. Rose, the amber in the vicinity of Konigsberg has been leased, since 1811, to Messrs. Douglas, for the annual sum of 1500*l.*; and when he visited the warehouses in 1829, he found a store of it amounting to 150,000 lbs. It is remarkable that the quantity of amber found yearly has remained the same ever since an account has been kept of it. The cost of digging for it amounts to 1500*l.* a year, yet the work pays. For the inhabitants of Konigsberg, and especially the fishermen living in its vicinity, the occurrence of the amber is connected with many inconveniences; for every one passing along the coast is subject to a visitation by the coast-guards and other officials. The fishermen can only put out to sea from certain points, and if they are found in other places, they must expect to be taken to Konigsberg or Fischhausen to be examined. The largest piece of amber known, existing in the Berlin collection, was found at a considerable distance from the coast, on the Schlappach estate, near Gumbinnen. It is $13\frac{3}{4}$ inches long, $8\frac{1}{2}$ wide, and 6 thick, and weighs more than 13 lbs. The owner of the estate received 150*l.* on delivering it up, which indicates that its value was estimated at 1500*l.*, since, according to law, the finder obtains a tenth of the estimated value of the amber which he delivers over. Among the ancients it was called *electron;* and they did not overlook the power it possesses of attracting light bodies when rubbed. The word *electricity* is derived from it. The Greeks obtained it from the Phœnicians, who probably even thus early visited the Prussian coasts; and at the time of the Trojan war the women wore neck-chains of amber.

It may be asked, whether the precious stones here enumerated, and in part minutely examined, are likely to retain the pre-eminence permanently, or whether there is a prospect of novelties? In answer to this I would observe that many other stones are known, for which there exists great hope of future ennoblement. Among such aspirants are, for example, andalusite, axinite, stanolite, epidote, rutile, azurite, &c., some of which possess the requisite hardness and transparency, others the colours, to enable them to advance to a place of honour whenever they occur in a tolerably favourable and undisturbed condition of crystallization. Something of this kind happened but a few years ago; a mineral previously very little regarded, diopside, was met with in one case, in the Ziller-thal, in Tyrol, so beautifully crystallized, that its name is at present inscribed in the book of gems.

And thus I close the brief review of these glories of the inorganic world, which glitter in the diadems of princes and in the treasures of the rich, not, however, casting into shadow the young opening rose which grows modestly in the humblest gardens, and furnishes an ornament to adorn the tresses of the poorest child.

Perhaps, however, the objection may be made that in this sketch of the precious stones, the noblest of all, the maker of gold and giver of immortality, namely, the *philosopher's stone*, has been unfairly forgotten; and therefore I will add, in conformity with the exact truth, that history does indeed tell much of how men have sought for it, but not that any one ever found it, and we are at present still further behind than our ancestors of a thousand years ago, for we refuse even to seek for it. We shall return, however, to this miraculous stone in the examination of the noble metals.

II.

ORDINARY STONES.

We might have spoken of *common* stones, in contradistinction to *precious stones*, but we have preferred to superscribe the present chapter with the title of "ordinary stones," since the word *common* includes, besides the idea of "frequently occurring," a fatal accessory meaning, and in the latter sense there is properly nothing *common* in nature, except perhaps man, when he is not what he can and ought to be. Ordinary stones, although they are devoid of the brilliant aspect, the fine and heightening colours of the precious stones, are of great interest, even merely from the fact of their forming the solid mass of that crust of the globe we are acquainted with. We have a right to say "crust of the globe," since all that we know of the material character of the earth relates only to a comparatively very thin layer of its surface, the unevennesses of which do not bear to the whole, a larger proportion than the dust does which lies upon the surface of a globe two feet in diameter. But so small are human beings in comparison with this dust of the actual globe, that it bears the relation of gigantic mountain-chains to them, as to the formation and origin of which they are continually disputing, and can never come to an agreement. It is well known that the sea occupies almost three-quarters of the surface of the earth, only one quarter being solid land, the highest elevation of which, at the peaks of Dhawalagari and Jawahir, in Himalaya, amounts to about 26,000 feet. Man has not penetrated down much more than 2000 feet into the earth; the mean depth of the ocean may amount to about 10,000 feet.

An exact examination of the earth's crust, shows us that it is partly composed of layers of various characters, deposited in succession one over the other, partly of unstratified masses of stone. The layers or *strata* may often be observed in mountain-chains and cliffs, and it is even observed that the strata mostly lie in inclined planes, and in many cases even stand vertically. It cannot be supposed that they were originally formed in this way, for in whatever way we imagine them to have been produced, whether by subsiding from an oceanic liquid, or by the cooling down of earths existing in a molten fluid, it would in any case be the most probable assumption that they were at first deposited or formed in a horizontal position. How have they come into these oblique positions? Evidently by having been elevated in certain places, or having sunk in at particular points. On this head nothing definite is known, and for this very reason has the question given rise to multiplied controversies, the strangest hypotheses having proceeded out of them. We will recount a few of them here. One hypothesis, formerly universally accepted, declared the earth to have been formed out of a great ocean, and the mountain-chains to have been deposited from this; the rocks were dissolved in this ocean like salt may be dissolved in water, and they were supposed to have been deposited just as such salt is when the water evaporates. The fact that water at the present time will not dissolve granite, mica-slate, and the like, was merely regarded as a proof that the primæval water was not ordinary water, or that water had at that time a solvent power which it no longer possesses. After the formation of the earth, the water became collected into the oceans, disappeared in great part into the interior of the earth; a very large proportion, however, went no one knows whither; for it has been calculated that all the water which can be supposed to exist upon the earth at present, is far from sufficient to dissolve the solid land, even if the latter were as soluble as common salt. Some hundreds of thousands of cubic miles of water more than actually exist would be required. This hypothesis rests upon the Genesis of Scripture, for it says: "And the earth was without form and void; and darkness was upon the face of the deep; and the spirit of God moved upon the face of the waters." But this statement of the then existence of water does not compel us to infer that all rocks were dissolved in it. The oblique positions of the stratified rocks were ascribed to subsidences and falling in of tracts of land. This hypothesis was baptized after Neptune, the god of the sea, and called *Neptunism;* while an opposite doctrine received the name of *Plutonism*, from Neptune's brother, Pluto, or sometimes of *Vulcanism*, because it was principally the god of fire who bore sway in it. The Plutonists assumed that the earth consisted of a fiery fluid when it first originated, the surface of which gradually grew hard by cooling, and thus the still-glowing nucleus was compressed into the centre. The rind formed all over it was then broken through and elevated at various points, by the fluid mass of the interior, and thus the previously-formed layers acquired an oblique position; while the substance which had flowed forth from below, formed rocky, unstratified masses between them. This seems at first sight to present no especial difficulties; for when we see how the slag removed from an iron-furnace hardens over the surface, and the glowing mass lying beneath lifts up the firm rind and breaks out, there seems no reason why the same should not have been the case with the earth and its crust. This view was supported by observations on the increasing temperature in deep pits, by the formation in smelting furnaces of many minerals similar to those exhibited by particular kinds of rock, by changes in the strata in the vicinity of the protruded rocks which had elevated these strata, &c. It was quite natural that the water hypothesis should precede the fire hypothesis, for formations and crystallizations from watery solutions have been known from time immemorial, while it is a recent observation that crystals may be formed from molten fluids, &c. Moreover, it is clear that the Plutonic hypothesis is far more firmly grounded, for in any case it does not so openly present untenable points—such, for example, as the assumption of a primæval ocean, which is rather a product of imagination than a solid scientific basis on which an admissible theory of the earth can be built. The Plutonists also attribute a Neptunian origin to a large number of stratified rocks, and only have recourse to fire when water is no longer capable of furnishing an explanation. Really this Plutonism has something alarming in it, for from the increase of temperature toward the interior of the earth, we have to expect, supposing it to rise constantly with the depth, that at a depth of a few miles everything is in a great glow of fire; and that at a depth of six miles the temperature is high enough to fuse granite, &c. We consequently revolve over a true "Inferno," still more terrible than that of Dante's epic, the fire of which only occupies a small portion of the interior of the earth, while Plutonism makes it burn and bubble everywhere; and volcanoes also warn us that this may come near the truth. A third theory has been added to these two, quite recently: it assumes that the original formation of the earth took place from a *watery gelatinous* condition of the rocks. The crystalline rocks have subsequently been formed from this, partly after certain kinds of stratified rocks had already covered the surface of the earth. Since, then, an uncrystallized, gelatinous (*amorphous*, or shapeless) mass will occupy a smaller space when it becomes crystallized, it follows that cavities must be produced beneath these strata, which would then give occasion to falling in of the surface, bringing the strata into oblique positions, and producing cracks, into which the internal mass, still partially fluid, penetrated, filling them up. Of course, elevations may have occurred at the same time. It is evident that this hypothesis is more closely connected with the Neptunian than with the Plutonic doctrine, without, however, requiring the primæval ocean of the former; it explains the appearances of the structure of the moderately crystalline rocks, without falling into the contradictions which Plutonism brings itself into on this point, and it removes the fire from the interior of the earth. It also agrees to a certain extent with the Scriptural account, although Father Cochem would rather hold with Plutonism, if hell is to be stationed in the depths of the earth, for neither he nor many others would own to a hell where there was no fire. With regard to the chief objections which have been offered against Plutonism, in the extent to which it has hitherto been carried, we shall confine ourselves to one. Granite is the most important of the rocks which are called Plutonic. It is composed of various siliceous compounds, and contains many minerals imbedded in it, some of which are almost infusible, and others very readily melted. Now, it is clear that the same which was more difficult to melt must also solidify soonest; and thus, for example, the quartz contained in granite, being the least fusible, must also be the first to solidify again, and to assume its peculiar crystallization. But very fusible granites, and the like, are found imbedded in such quartz when the latter is perfectly crystallized. How could they get into the interior of the masses of quartz, and be closely invested by it, if the latter become solid first? Under such circumstances, they could only have been found *between* the portions of quartz, and not inside them. In truth, it rather seems as if such minerals were crystallized first in the mass, and then became enclosed by the quartz subsequently crystallizing over them, much in the same way as jelly is made to enclose preserved fruits, &c., in confectionery. Each of these hypotheses has its strong and weak side, and to recapitulate in a few words, the primæval ocean of Neptunism is an assumption which cannot be supported by experience, while Plutonism presents a material contradiction in the case just mentioned; and the third hypothesis can be objected to, on account of the increase of temperature towards the interior of the earth, which has been observed, though truly, only at comparatively small depths. Therefore, what really occurred in the formation of the earth we know not, yet it is always of some value to know to some extent what could *not* have taken place. The well-known authorities for the three theories are Werner for *Neptunism;* Hutton, A. von Humboldt, Leop. von Buch, and Elie de Beaumont, for *Plutonism;* and Fuchs for the theory given last. Plutonism, with the theory of elevation, inverts the succession in age of the rocks which was assumed in Neptunism, in so far that the granite rocks are no longer to be held as primitive, but of later origin than many other, even fossiliferous, rocks.

Such a revolution from what seemed so simple and well-established a theory as that of the Neptunists, filled the poet Goëthe even with melancholy, and he expressed his opinion of it in the verses:

Scarce was the noble Werner dead,
When Neptune's kingdom was o'erthrown,
And all to Vulcan bowed the head.
So quickly can I not allegiance own;
Valuing results, I find it best to wait,—
And many creeds already have passed by.
For all new gods and idols set on high
I entertain an indiscriminate hate.
The King once vulnerable owned,
Granite of course must shortly be dethroned;
Gneiss, once the son, the learned papa call,
Yet he, alas! is nodding to his fall:
For Pluto's fork is stirring up the deep,
Whence revolution soon must upward creep,
And the black basalt, demon fell,
Break furious forth from out the depths of hell,
Rending the cliffs, the earth, and rocks, with busy hands,
Until Omega in the place of Alpha stands;
And thus poor earth to such a point is led,
It, Geologically, stands upon its head.

Of course there is no want of variations composed on the themes of these theories, and some have gone so far as to regard the whole earth as a kind of organic being, similar to an animal, and to combat Plutonism on the ground that the crust of the earth is its skin (epidermis), and, therefore, it is impossible to suppose a fire, as "arch-foe of all life abiding in material form," to exist beneath it. A fluid must, indeed, exist in the interior of the earth, it is said, since this follows as a physiological necessity from the vitality of the terrestrial globe; but this fluid is composed only of an aqueous solution at the boiling temperature, the vapours of which, "enclosed in the vast vaulted cavities in the under side of the crust of the globe, possess by inheritance the office of producing elevation, outbursts, and earthquakes, and have exercised it, hereditarily, since inconceivably remote epochs." Many curiosities of this kind are to be met with in Geology; but we may remark in reference to that just mentioned, if we go so far as to talk of a physiological vitality, and a skin of the earth, which cannot bear fire, the arch-foe of all life existing under material form, the formation of mountains might be explained much more simply, by saying that the skin of the said "earth-animal" had become *wrinkled* by time; for the calculations of G. Bischoff would show that this animal is no longer young, since he considers that the origin of the coal must have taken place 9,000,000 years ago, to which opinion, however, we cannot exactly subscribe. Of the interior of the earth one thing only is known with tolerable certainty, namely, that it must be specifically heavier than the surface, since the mean specific gravity of the earth, as a whole, is over 5 (5.44), while the specific gravity of the surface, ascertained from known rocks, does not attain even 3. Some have concluded from this that the nucleus is formed of metals; others, that the pressure from above has rendered ordinary rocks denser, and therefore of greater specific gravity, &c. But Leslie has calculated that all known materials of which the surface of the earth is composed would become so dense and heavy under this superincumbent pressure, that the specific gravity of 5 would be far surpassed.* Therefore there can only exist extremely light and elastic substances in the inte-

* See the conclusion of this chapter.

rior of the earth, never becoming denser and heavier than sp. gr. 5, in spite of the enormous pressure. According to his notion, this matter is *light*. Since light is usually regarded as *imponderable*, and in the highest degree elastic, it might indeed sustain a considerable pressure, and only become almost as heavy again as flint. But what would happen if this were the case, and an accidental experimental boring should pierce into a crack connected with this compressed light? The light would naturally expand with the greatest impetuosity, and stream out as a splendid fountain of fire, and there would be no night for a long time; but the terrestrial globe would soon become hollow and void; it would collapse into ruins, and the giants of our mountains falling in upon one another would form a fearful and monstrous chaos; or the earth would be rent into small planets, or fly off as a dismal hail-cloud of meteoric stones, Heaven knows whither! But let us return from the realms of fancy to the tangible crust of the earth.

In addition to the peculiarities of stratification and unstratification, rocks have another character, which divides them into two main groups. In one of them no petrifactions of plants or animals are ever found; in the other these do occur, often in small, and often in enormous quantity. To the non-fossiliferous rocks belong the *primitive* and the *volcanic rocks*. The primitive rocks lie beneath the rest, and form mountain-chains, leaning against and between which the later rocks are found deposited; and the name which they bear can in any case be accorded to them, since in all instances they have taken, either in a fluid or solid condition, a very early share in the formation of the crust of the earth. We behold the volcanic rocks, in some cases, rising before our eyes out of the interior of the earth, but with regard to others we know not to what period of the earth's formation we can in any way refer them.

The most important of these rocks are the following: granite, gneiss, mica-slate, syenite, clay-slate, porphyry, serpentine, and primitive limestone. We will examine these rocks more closely, in order, and mention incidentally a few of those minerals occurring with them which are of interest.

Granite is not a simple mineral, but a crystalline mixture of *three* minerals, called quartz, felspar, and mica. Of quartz (crystallized silica) we have already spoken under the head of the siliceous stones, its pure varieties forming rock-crystal, amethyst, &c. The ordinary quartz of granite (easily distinguished by giving sparks readily with steel) is only slightly translucent, and mostly of a greyish-white colour; it does not exhibit any regular cleavage, and has a shelly fracture. The *rose-quartz*, as it is termed (from Bodenmais in Bavaria and Siberia), is a beautiful variety. *Felspar* is a compound of silica, alumina, and potash, or soda, and especially characterized by its capability of being split in two directions, at right angles to one another. It is not so hard as quartz, and occurs white, or pale flesh-colour, or yellowish and greenish. A variety of a beautiful green colour is met with in small quantities; this is cut into ring-stones and similar objects, and is known as *amazon-stone;* other varieties exhibit a golden glitter, and are called *sun-stone;* and some have a whitish or bluish lustre, especially when cut into a round form, and these are called *moon-stone.* The first two varieties of felspar occur particularly fine in the Ural; the moon-stone is found in Ceylon, and also in Greenland. *Mica* has mainly the same constituents as felspar, but in different proportions, and is easily distinguished by being very perfectly separable into laminæ in *one* direction. It has mostly a silvery or golden colour and a metallic lustre; hence it is often called in popular language *cat's silver* and *cat's gold,* but it cannot be confounded with silver and gold, since it cannot be beaten out and extended by hammering, not to speak of its lightness, transparency, &c.

In granite, then, these minerals are collected into a granular aggregation, often very uniform, often with predominance of one or other of the constituents. Occasionally, also, one of these is separated into large independent masses, and an occurrence of quartz in this way is especially important, because it can be used in the manufacture of glass. Mica, too, is very useful when it occurs in large transparent plates, as is the case in many places in Siberia, as also in Norway. Such plates, which are met with twelve inches and more in diameter, are used for window-panes (Russian glass, Marien glass), and are especially advantageous on account of their elasticity, and because they can bear great alterations of temperature without injury; hence they are sought after also by bakers for the lanterns which they use for lighting their hot ovens, &c. Of felspar, which likewise appears pretty frequently in masses in granite, use is made in the manufacture of porcelain; but it is by *weathering* or exposure to the rain and air, in which the potash and a portion of the silica are removed by means of water, that it furnishes the proper, principal material for porcelain, *porcelain-clay*, which, however, is also frequently produced from other minerals besides felspar by weathering. In the manufacture of porcelain, the porcelain-clay is mixed with a portion of felspar, both finely ground, and formed by various operations into a plastic material, which, when shaped, is burnt in a powerful furnace, whereby the felspar is reduced to a glassy fluid, and penetrating into the infusible porcelain-earth, produces the well-known dense substance. Among the notable localities furnishing porcelain-earth, are Aue, near Schneeberg, in Saxony; Halle; St. Yrieux, near Limoges; Passau; Cornwall, &c. The earliest porcelain was made by the Chinese, and already long before our era. The Portuguese first brought it to Europe, and in 1695 unsuccessful attempts were made to imitate it in France. The European discovery of true porcelain originated with the German alchemist, Böttícher, about 1707, and saved his life, after he had finally been compelled to confess that gold-making was a vain pursuit.

Granite is one of the most ornamental kinds of rock when the component minerals, especially quartz and felspar, occur equably and not in too large fragments, and when the felspar is of a reddish or yellowish colour. The red Egyptian granite, of which most of the old obelisks were made, is renowned, as also the granite of Baveno, on the Lago Maggiore, from which were hewn the columns of the restored church of St. Paul, in Rome; the granite of Ingermannland, of which the pedestal of the statue of Peter the Great, at St. Petersburgh, consists (a mass weighing 1250 tons); the granite of the Vosges, Scotch granite, &c., &c. In many kinds of granite the crystals of quartz and felspar are interposed and combined into longish, irregular masses; and such granite, when cut in the direction of the cross fracture, exhibits markings like Hebrew characters, whence it is termed "letter-granite," and is cut into objects of all kinds.

As a building-stone, granite is excellent as far as regards solidity and permanence, but its hardness renders it difficult to work.

Granite is met with in enormous extent in the Alps, in the Black Forest, the Odenwald, the Thuringian mountains, Fichtel-gebirge, Böhmerwald, and the Riesen-gebirge, in the south-east of France, the Pyrenees, in Great Britain, in the Ural and Altai, in Africa, Brazil, &c.

The stone called *gneiss* is formed of the same constituents as granite, only in a granular, slaty state of aggregation; and in *mica-slate*, the constituents, mica and quartz, are present with very little or no felspar. These two kinds of rock frequently occur in company, and exhibit intermediate conditions. To these is allied *clay-slate*, a stone mostly evidently slaty, composed of extremely finely divided mica, quartz, felspar, and aluminous particles, but particularly characterized by the clayey odour it emits when breathed on or moistened with water. There are several kinds of clay-slate, and some of its forms also belong to a later period than the primitive rocks. This is rather a soft stone, and is of grey, brown, brownish red, or greenish or black colour. The property of splitting readily into plates, and the moderate degree of hardness, render some of its varieties useful for many purposes, for roofing, and writing-slates, pencils, whetstones, &c. There are important slate-quarries in the north of England and North Wales, in France, at Angers, Charleville, and Grenoble, in Belgium near Liege, in the Hartz at Goslar and Hüttenrode, in Thuringia, Bayreuth, in the Rhine district, &c. They frequently contain slaty quartz, *siliceous schist*, as it is termed, enclosed in the form of large beds. All these rocks are here and there rich in metals and ores. The celebrated silver-mines of Kongsberg in Norway, and of Freiberg in the Saxon Erz-gebirge, lie in mica-slate and gneiss, those of Wittich in Baden in granite, the gold mines of Schlangenberg in Siberia, and some of the Mexican, in clay-slate, those of New Granada in granite, the copper-mines of England in clay-slate and granite, the Swedish in gneiss and mica-schist, &c. Iron, tin, lead, and other ores, are also found in the rocks of this group. *Talcose* slate, used for pedestals, slabs, or roof-slates, is also found in huge beds in these rocks. *Talc* is a compound of silica and magnesia, and forms a very soft mineral, feeling, as it were, greasy to the touch, often laminated like mica, or forming in solid condition *steatite* or soap-stone, which when burnt is used for pipe-heads, for writing upon cloth, &c. In many cases *hornblende* (amphibole) is associated with the constituents of granite; it is a blackish-green mineral, which will split in two directions, forming an obtuse angle (124°), and is composed of silica, lime, magnesia, and protoxide of iron. Thus arise transitional conditions leading to what is called *syenite*, which consists essentially of felspar, also with labrador and hornblende, and when the component particles are very finely divided forms the stone called *diorite or greenstone.* These stones are also frequently slaty. Syenite in particular, which derives its name from the town of Syene (now Essen or Assuan, in Upper Egypt), is a beautiful stone in many of its varieties, and was used by the ancients for obelisks and columns. The Egyptian Labyrinth was decorated with columns of syenite. Syenite is not very generally diffused, but is met with in the mountain-chains of the Berg-strasse and of the Odenwald, in the Saxon Erz-gebirge, in Hungary, Sweden, Norway (with zircon), &c.

Hornblende occurs independently in stratified masses, as *hornblende rock* and *hornblende slate*, in gneiss, mica-slate, &c. Such stone is frequently used as a flux in glass-melting. Nearly allied to hornblende, differing only in containing a smaller proportion of iron, or none at all, is *tremolite*, which is not met with particularly often, but deserves mention, because the fibrous varieties furnish most of the *asbestos* (*amianthus*), as it is called. Who has not heard of the incombustible linen of the ancients, made of asbestos? Pliny tells us much about it, but he strangely mentions it under the head of flax, and says that there exists a kind which is not consumed by fire: "it is called asbestos by the Greeks, and grows in the deserts of India, which are guarded by serpents, in those sun-scorched deserts where it never rains." He says that he had seen tablecloths of this linen, which were not washed, but thrown into the fire, whence they came out beautifully white; that the bodies of kings were wrapped in such cloth when burnt, so that the ashes might not become mingled with those of the fuel. This linen was scarce and difficult to work, and its price equalled that of pearls. Asbestos really does occur sometimes in very long and delicate fibres, much of it resembling the finest silk, and it may be spun and woven with the addition of a portion of flax, which is subsequently burnt out; but the manufacture of textile fabrics from it is at present very limited, and is carried on rather to furnish objects of curiosity than of real use, although clothes for firemen, gloves, &c., have been made of it. Paper has also been manufactured from asbestos, but its greatest application has been in the light-boxes, now discarded, in which the inflammable substance of the matches was dipped in sulphuric acid. The little bottles were filled with asbestos, which was soaked with sulphuric acid, and thus the matches were prevented from dipping too far into the acid. Much asbestos came into the markets from Tyrol for this purpose, under the name of white feather-stone. The ancients also made lamp-wicks of asbestos, and it is still used for these in Greenland. Varieties with long fibres are met with in Savoy, Piedmont, Tyrol, Upper Hungary, Siberia, &c. Dolomieu found such quantities of it in Corsica that he used it instead of tow or hay for packing minerals. He also states that it is advantageously used there, kneaded up with clay, in the fabrication of earthenware. To asbestos belong also the cottony masses which have been called rock-cotton, rock-leather, and rock-cork.

Porphyry is a stone in some cases formed out of granite, in other cases of a very peculiar nature, and it is found in very different formations. Under this name is comprehended every stone which consists of a solid general mass in which crystals occur embedded as if kneaded into a paste. The general mass, as well as the crystals, is formed in what is ordinarily called porphyry, of felspar and labradorite, and quartz in crystals or shapeless as what is called *hornstone.* The red porphyry, with little white crystals of felspar, obtained from Egypt, between the Nile and the Red Sea, and from the district of Mount Sinai, is very celebrated. There are in Rome many antique columns, baths, vases, and the like, made out of such porphyry. In the Vosges, Hungary, Corsica, the Morea, &c., are found beautiful porphyries of various colours, brownish, red, black, and dark-green. The stone called by the Italians *Verde antico,* as forming the material of antique works of art, is partly porphyry, partly serpentine.

Serpentine is a close-grained stone, which is distinguished from all those at all similar to it by its softness, for it may be scratched readily with a knife, and can also be turned in a lathe. It is generally dark-green or brownish, blackish, &c., and it is frequently marked with streaks and spots. Serpentine is a homogeneous rock, and displays no stratification. It is composed of silica, magnesia, and water, with a *little* protoxide of iron. It contains twelve per cent. of water. This is the first time we have mentioned a stone containing water as an essential constituent. This water cannot be perceived in any way by the senses, or be pressed out mechanically, for it is chemically combined with the other constituents. But it is easy to ascertain the presence of water, by placing a fragment of serpentine in a slender tube of thin glass several inches long, and heating the part where the serpentine lies to redness, by means of the flame of a blowpipe directed against the outside. The water is separated by this, and is seen to become deposited in dew and in drops on the further end of the tube, which remains cool. If a hundred-weight of serpentine were operated on in this way, seven quarts of water might be obtained from it. Since serpentine forms large beds and masses of rock, and even small mountain-chains, especially in the Alps towards Italy, in Saxony and Silesia, in France, England, and Scotland, the amount of water which lies hidden in this stone is very considerable. What is termed *Chlorite* contains a similar proportion of water, and in addition to the other constituents of serpentine, also alumina; coloured green by protoxide of iron, it resembles a finely laminated green mica, and is known as *chloritic-slate*, which forms large beds and small mountains in the Carpathians, Tyrol, Bohemia, Norway, &c. Many other stones and salts contain a still greater quantity of water than these, and a common mineral, gypsum, contains 21 per cent.; alum, 45 per cent.; soda, 63 per cent., chemically combined with the other ingredients.

Serpentine is manufactured into pedestals, small columns, various kinds of vessels, snuff-boxes, inkstands, pipe-bowls, &c., and there has long existed at Zoblitz, in Saxony, a particular guild of serpentine-turners. Among the ancients it was esteemed as a remedy against the bite of serpents, and serpentine vessels were supposed to deprive all poisons of their destructive properties. Both *serpentine* and the old name of *ophite* refer to snakes, but it is uncertain whether on account of the supposed powers, or on account of the streaked and spotted markings of this stone.

Meerschaum, which frequently occurs with serpentine, is of somewhat similar composition. It is an uncrystallized mineral of earthy fracture, very light and soft, and greedily absorbs water. It is cut into the well-known pipe-bowls, which are used either in the original condition, or after having been boiled in wax, milk, and oil. The principal locality of its occurrence is Kiltschik in Natolia (Asia Minor), but it is also found in many places in Greece, Spain, and Moravia.

We have next to speak of a kind of stone, *limestone*, which occurs in the oldest rocks, as primitive carbonate of lime, of crystalline or granular structure, but also constitutes, in compact masses or in the form of an earth, a large proportion of the rocks subsequently formed. The rocks hitherto mentioned, it must be remembered, form the foundation on which all others rest, even though they often rise up between the latter. The rocks subsequently deposited over them, which are named according to the relative ages, transition, sedimentary, and tertiary formations, are composed principally of *limestones* and *sandstones*, which lie one above the other in varied arrangement, up to the most recent stones on the immediate surface of the earth, still in daily course of formation.

Limestone sometimes occurs in beautiful and varied crystals (calcareous spar), all of which are derivable, as indeed are the crystals of other minerals, according to fixed laws from *one* form, this form being concealed, as it were, in every crystal of calcareous spar; for it may be discovered when we split such a crystal with a knife or a chisel, in the directions in which it is found to give way readily. This form resembles a cube which has been squeezed aside in the direction of one of its corners, and is called a rhombohedron; and from the above-mentioned circumstances it is termed the *cleavage-form* (nuclear-form). Many crystals possess this capability of splitting, in various ways, often only in one direction, as for example, mica; often in several directions, as in calcareous spar, lead-glance, rock-salt, fluor-spar, &c.; so that in these last it is frequently possible to split out a shape bounded on all sides by flat faces, which, moreover, is often externally evident. In limestone, however, the external form is usually different, for instance, a six-sided prism, a six-sided pyramid, with inequilateral triangles, &c. The number of different forms of crystallization, and the multifold modes of union (*combinations*) in this mineral, far exceed those occurring in any other, extending to more than 700. A character of multiformity like this, occurring in minerals, is not found in any other kingdom of nature. All the plants and animals of one particular kind or species have, in the main, one particular shape, and this is the most important recognizable and distinctive character; but the same mineral may exhibit the most diverse forms, just as with one kind of building material, for example, with the same bricks, we may build walls of different forms; the bricks are the same, but the external figure which they combine to form may vary to almost any extent. The smallest particles of a crystal are to be compared with such bricks, the crystal itself with the building. But Nature builds up the crystals according to fixed laws, which reveal an inner connexion of the created forms; and these laws have been made out to such a point that we are able, for example, to calculate perfectly from the single stated form of cleavage (or splitting), of calcareous spar, all the other forms of crystallization in which it occurs, and we can affirm what these are, even though we have never seen them. This is a triumph of scientific mineralogy, and none other of the natural sciences possesses a similar knowledge of the laws of form.

Limestone is not very hard, and it may be scraped with a knife. It is composed of carbonic acid and lime (44 parts of carbonic and 56 of lime in 100 parts), and may be readily recognised by the lively effervescence which ensues, when muriatic acid is dropped upon it. This effervescence depends upon the muriatic acid combining with the lime, and consequently setting free the carbonic acid from the latter. Carbonic acid is always a gas when not chemically combined, under common atmospheric pressure, and the disengagement of this gas causes the effervescence. When limestone is violently heated also, the carbonic acid is expelled, and the lime remains behind as ordinary *quick-lime.*

If water is added to this burnt lime, it combines in a certain proportion with the lime, giving out in the operation great heat, as is observed in what is called *slaking* lime. Mortar is made by mixing with the slaked lime, sand, which contains quartzose particles, and this is the mixture used in building. The hardening of mortar arises partly from the silica of the sand combining with the lime, and partly by the latter gradually attracting from the atmosphere carbonic acid, which replaces that lost in the burning. This property of burnt lime, and the formation and application of mortar, were well known to the ancients, and Pliny speaks of them and mentions lime-kilns, at the commencement of the Christian era.

Limestone, as it occurs in vast masses, is in many cases, as already stated, of distinctly crystalline structure, but it very frequently appears quite compact in texture, or even earthy. What is called *primitive limestone* is of granular crystalline character, and in a few varieties looks very like fine white sugar. Such kinds are highly valued as material for sculpture. Among the principal quarries of this limestone, which, like every other limestone available for sculpture and decorative purposes, is technically termed *marble*, are those of Pentelicus, near Athens, those of Paros, and those of Carrara, in the Gulf of Genoa. The masterpiece of ancient Greek architecture, the Parthenon at Athens (a work of Phidias), was built of Pentelican marble; the renowned sculptures of Praxiteles, Apollodorus, Cleomenes, and others, were likewise executed in the primitive limestone of Greece; and the glorious creations of Canova and Thorwaldsen were formed out of Carrara marble. The ancient quarries of Pentelicus, where the primitive limestone forms a vast bed among mica-slate, have been re-opened in recent times, and the costly material of this stone is the more sought after and used by sculptors, because the Carrara marble now quarried frequently contains greyish spots which are offensive to the eye. Parian marble also is now coming into use again. Inferior varieties of the primitive limestone are also found at Wunsiedel in Bayreuth, at Schlanders in Tyrol, in the Pyrenees, in Sweden, and other places.

Most marbles consist of those varieties of *close-textured limestone*, presenting no evident crystallization, though often traversed by crystalline veins, which are coloured and capable of receiving a polish. Many of them possess particular names: for example, the black variety is called *Lucullan* (*nero antico*), from the Roman Consul Lucullus, who valued it highly, and first caused it to be brought to Rome (probably from Egypt); the shelly marble, containing fossil molluscous animals, is called *Lumachel* (from *lumaca*, the snail); a variety occurring in France and Spain, composed of varied fragments cemented together by limestone, is called *Breccia-marble*, or *Brocatello*. The *rosso antico* from Egypt, and the *giallo antico* from Macedonia and Sienna, have received their names from their red and yellow colours, and are greatly prized in Italy. The churches of Rome are decorated with the most costly kinds of marble, many of which have been derived from ancient and unknown localities.

Although marbles are by no means rare, only a very small proportion of the compact limestone is of such quality as to be serviceable as marble; for the greater part of the limestone is of unattractive colour, and devoid of uniformity in its substance, while the numerous fissures prevent its being worked in large masses, although it is used as a building material in many parts of the world. Thus almost all Paris is built of the limestone of the environs; Lyons likewise, and Marseilles, part of Rome, and many cities of Upper Italy, the pyramids of Egypt, &c. Ordinary limestones frequently contain fossils, and these differ to some extent according to the age of the formations. Tracing them upwards from the primitive rocks, the following principal limestone-formations succeed each other in position and age, in the order they are enumerated.

1. The *Transition limestone* (Silurian limestone), with fossils of peculiar crustacea (trilobites), Mollusca (orthoceratites), corals, &c., occurring in England and Wales, the Hartz, Westphalia, Bohemia, &c., also in Russia, North America, and elsewhere.

2. The *Mountain or carboniferous limestone*, with coal-formations (England and Belgium), in which occur ferns, equiseta, palms, marine mollusks, and some of the earliest fishes.

3. The *Magnesian limestone*, in which some of the same fishes are found (England, Mannsfeld, the Hartz, &c.).

4. The *Muschelkalk*, a limestone with abundance of sea-

shells, radiata, and remains of animals similar to crocodiles (Wurtemburg, Lower Franconia, the Vosges, &c.).

5. The *Lias*, with skeletons and bones of crocodile-like animals, fishes, mollusks, &c. (England, Middle Franconia, Wurtemburg).

6. The *Jura limestones*, with the "roe-stone," or *oolite*, containing numerous ammonites, belemnites, mollusks, amphibia, crustacea, fishes, the earliest insects, dragon-flies, &c. (Jura, the Swabian Jura, the Bavarian Alps).

7. The *Chalk*, likewise containing many fossils, some of which are peculiar to it (England, France, &c.).

8. The *Calcaire grossière*, and 9, the *Fresh-water* limestones, tertiary beds (in the environs of Paris, Vienna, in the Netherlands, &c.), in which occur both marine and fresh-water shells, also fresh-water fish and the earliest traces of mammalia and birds (the former sometimes of gigantic size, as the mammoth, mastodon, &c.), which are still more abundant in the beds of sand, clay, and drift lying over them, and known by the name of *diluvium*. Millions of marine animals lie buried in the various limestone-formations and the sandstones interposed between them, giving us evidence of the former existence of oceans whose waves swept over the whole earth. During the course of the long periods of the formation of these remains, there must have been epochs in which islands were formed, these speedily acquiring a peculiar flora. The coal-beds give us evidence of this, and moreover it is seen from the nature of the coal-plants, that the climate of that age resembled that of our tropics. Such portions of land have been repeatedly submerged, and beds of rock have been deposited upon them, to form new and more elevated tracts of land, which, clothed once more with plants, became by degrees the dwelling-place of amphibia, and finally of the proper land-animals. The formation of the lias and Jurassic limestone must have constituted a very remarkable period in these by-gone ages. At that time the islands, overgrown with a strange vegetation, presented bays inhabited by frightful animals, such as the imagination can scarcely picture, even in conceiving the dragons which figure in the old romances. They resembled the crocodile in some respects, and attained a length of forty-five feet, many possessed a neck resembling the body of a serpent; some must

have looked like hideous vampires. We find the skeletons of these animals, which are known under the names of Icthyosaurus, Megalosaurus, Plesiosaurus, and Pterodactylus, still well preserved in particular beds of these formations, and among the most renowned localities for them may be mentioned Lyme Regis in England, Boll in Wurtemburg, Banz in Franconia, Solenhofen in the district of Eichstadt, &c. The calcareous slate of Solenhofen, Pappenheim, and Eichstadt, is remarkable for its especial richness in fishes and crustacea, and the occurrence of dragon-flies, beetles, and rare pterodactyles. This calcareous slate is also interesting in another respect—the fact that it furnishes lithographic stone. It can readily be split into plates, and these are trimmed up with small hammers and rubbed to a smooth face. In the process of lithography the drawing or writing is made upon the stone with a resinous, greasy ink or crayon, and then the stone having been slightly corroded with an acid, and coated with gum, the rollers of printing-ink only leave the ink upon the lines drawn with the greasy material. The Solenhofen (Killheimer) calcareous slate, with which the inventor of lithography, A. Sennefelder, made his first experiments at Munich in 1795, has up to the present time proved the best fitted of all stones for the art in question, and is exported to all parts of the world. It is also used for pedestals, tables, roofing, as a building-stone, &c. The quarrymen attend carefully to the fossils, which not unfrequently fetch a very high price, and while this stone employs thousands, and has made many artists rich, in lithography, its fossils have been often hailed as the discovery of a treasure. Many a poor mason, who builds in a slab of Killheimer stone, buries, without knowing it, his own good fortune, while many gain by a single stroke of the hammer, bringing to light, for instance, a fine crustacean or a pterodactyl, more than they could earn by the toilsome labour of many weeks.

Ordinary limestone is frequently mingled with clay, and many kinds contain as much as 20-30 per cent. and more. Among these aluminous or *argillaceous* limestones are the *hydraulic limestone* and *marl.* Before going any further with the characters of limestone, it will be advantageous to say something about *clay.* Clay is a chemical compound of two earths, silica and alumina, with a certain proportion of water.

It is uncrystallized, soft, greasy to the touch, exhales a peculiar odour, and becomes hardened (contracting also) when burnt. Most kinds of clay can be kneaded into a plastic mass with water, and in this state form the material of pottery. The vessels are shaped out of the moist, well-kneaded earth, dried and then burnt to make them hard and solid. Many clays are white, many yellowish, greyish, or even of variegated colours. The yellowish is tinged by an admixture of ferrugineous ochre, which is a compound of peroxide of iron and water. When this is burnt, the water is expelled, and the anhydrous oxide of iron remains as a colouring matter, but since this is of a red colour, the yellowish clay becomes red by burning, as may be seen in many kinds of bricks, &c. *Clay** is universally diffused, and occurs especially in recent formations and in flooded lands. It mostly forms beds in large masses, often attaining a thickness of from 300 to 500 feet. The same use to which it is put now-a-days was known to the ancients. Pliny speaks of walls and houses built of clay and branches. Baked bricks are mentioned even in Genesis, and the walls of Babylon are said to have been built of broad bricks cemented with bitumen, and this is now proved clearly to have been the case with Nineveh. The potteries of Samos are mentioned as famous in antiquity, and we also read of clay utensils as articles of luxury. The Emperor Vitellius had a dish made, which cost a million sesterces (above 2750*l.*). Clay-pipes for conduits, stoves for heating baths, and also sarcophagi, were made of burnt clay by the ancients, and the sculptors also modelled their works in clay, as is done at the present day. It was also used for moulds in casting metals, and we read in the Bible, that Solomon caused vases to be cast from the purest ores in an earth of this kind. It has already been mentioned that porcelain-earth is a kind of clay. The finest kinds of clay are used in the manufacture of what are called Cologne pipes.

Limestone, containing the proper proportion of clay, acquires when gently burnt the remarkable quality of hardening directly with water, without the addition of anything else,

* *Loam* is an impure clay, mixed with sand and carbonate of lime. Among the finer kinds of clay which are not plastic are *bole*, lithomarge, and fuller's earth.

and it thus furnishes a mortar which is particularly excellent for the strength with which it holds under water. On this account it has been called *hydraulic* limestone. There is a peculiar compound of clay and lime formed during the burning, which has the power of taking water into chemical combination, and this is why it holds so well under water. The generality of what is called marl may be regarded as a hydraulic limestone of earthy formation, it is often slaty on a large scale, *marly-slate*, and this accompanies, in beds and stratified layers, the various, and particularly the more recent limestone formations. Marl usually betrays the clay it contains even by the odour when breathed upon, and it is easy to ascertain the existence of clay in a limestone by pulverizing the stone and adding muriatic acid until all effervescence ceases. The calcareous matter is dissolved, and the clayey left behind. Marl is frequently applied in agriculture for the improvement of the soil, and especially serves as a means of giving substance to a poor calcareous or sandy soil. Among the earthy varieties of limestone we must mention *chalk*, used so much for drawing, as also for whitewashing, &c., for which purpose it is often rubbed down in water, and the finer particles separated by stirring the whole and pouring off the liquid as soon as the coarser particles have settled, the finer particles being left to settle from the liquid in another vessel; this purified chalk is called *whitening*. Chalk occurs very extensively in the south-east of England, in the north of France, in the Danish Islands, in Rhenish Prussia, the Netherlands, &c. It very frequently contains a very well-known mineral embedded in it, namely, *flint*, which consists essentially of uncrystallized silica. It forms nodules and irregular lumps, which in the manufacture of gun-flints are first cut into thick plates and then broken up into the elongated fragments. A clever workman can chop out 1000 flints in two or three days. Formerly many communities in France were engaged in this branch of industry, but now the introduction of percussion-caps and phosphorous matches has greatly diminished the use of flints. Both in many flints and in many kinds of chalk, as also in the impure varieties of earthy quartz called *tripoli*, adhesive slate, *polishing-slate*, &c., have been found those remarkable infusoria, which in many cases form rocky strata sometimes fourteen feet thick. These animalcules, or rather their remains, are so small, that a calculation of the contents of a cubic inch of the said adhesive slate gives 41,000,000 of them.

The most recent of all limestone formations, still in course of production, is that of the calcareous stalactite or *calcareous tufa*. This stone, called *travertine* in Italy, originates through the deposition of carbonate of lime by water, in which it is dissolved by excess of carbonic acid. When such water comes to the surface, it gradually loses this solvent carbonic acid, and the carbonate of lime is precipitated. When this takes place by the water oozing through upon the roof of a cavern, each drop deposits a little lime, and in the course of time these form cones like icicles, the *stalactites*, as they are called. When the limestone is deposited over any object as an envelope, it is called *incrustation*. The Muggendorf caverns in Franconia, those of Antiparos and Thermia in the Greek Archipelago, the Adelsberg Grotto in Illyria, the Baumann's Höhle in the Hartz, the Kirkdale Cavern in Yorkshire, and Montserrat in Catalonia, are renowned for their multiform stalactites. In connexion with these caves, may be mentioned, as an example of the way in which mad fancies try to find a place even in natural science, that a certain cosmogonist has explained them to be the fossillized skulls, windpipes, &c., of ancient animals. These animals must, consequently, in many cases have been large enough to cover a space of sixteen square miles or more; the Guacharo Cave in America, which is 2500 feet long, being the petrified windpipe of a long-necked and gigantic bird! &c. The quantity of tufa sometimes deposited by cold and hot springs is extremely great. The hot springs of San Vignone, near Florence, have formed beds of travertine 250 feet long, and as much as 200 feet thick; the three warm springs of San Filippi, which empty themselves over a marsh, have in about twenty years deposited there a mass of travertine thirty feet thick; similar formations are found at Terni, and in the neighbourhood of the hot baths of Viterbo, in the Papal States, in the Greek Islands, at Carlsbad, &c. Enormous masses of calcareous tufa have also been formed by the springs of Canstadt, near Stuttgart. Travertine is a good building-stone, and a part of St. Peter's, the Colosseum, and many ancient Roman works, were built of Roman travertine.

Two other minerals have still to be mentioned in connexion with the preceding, one of which consists, like limestone, of carbonate of lime, but in a different form of crystallization, while the other is composed of carbonate of lime in combination with carbonate of magnesia. These minerals are *Arragonite* and *Dolomite.* Arragonite is only essentially distinct from limestone through its crystallization, its crystals cannot be split according to a rhombohedroid shape like calcareous spar, but form rhombic and unequally-angled six-sided prisms, and often occur long and slender, and needle-like, or heaped together in masses like collections of little rods. On the whole, arragonite is not found in large masses, although it occurs in many localities, in particularly fine varieties at Molina and Valencia in Arragon, Dax in France, Bilin in Bohemia, Leogang in Salzburg, the Tyrol, &c. To this also belongs what is called *iron-bloom,* which occurs in shrub-like and coral-shaped masses of white colour and remarkable beauty in the Schatzkammer at Erzberg, near Eisenerz in Styria. *Dolomite,* called after the French geologist *Dolomieu* (bitter spar, bitter limestone), resembles calcareous spar in crystallization, cleavage, &c., but may be readily distinguished from it by the absence of effervescence when it is wetted with hydrochloric acid. The effervescence does not take place until it has been reduced to powder. This mineral is met with crystallized, and also of compact texture in large masses, sometimes in connexion with primitive rocks, or with various calcareous formations, particularly with the Jurassic limestone, as at Bamberg, Muggendorf, Streitberg, where it forms the cavern already mentioned. It is also very remarkably exhibited in the Passa Valley of Tyrol, at St. Gothard, &c., and the mountains and cliffs formed of it mostly have a strange tower-like form, the peaks often looking like ruined walls or castles. Like limestone, dolomite is used for building, for the manufacture of mortar, hydraulic lime, &c., and moreover for the preparation of Epsom salts In reference to the scientific explanation of its formation, this stone may be truly called a "stumbling-block," for geologists have been contesting about it for four-and-twenty years, and are not yet agreed. The strife turns chiefly on the assumption that dolomite is a limestone metamorphosed through volcanic action, but it is not evident how the carbonate of magnesia could get into it in this way.

It has been stated above, that the portion of the crust of the earth lying above the primitive rocks is composed principally of limestones and sandstones alternating with each other, and we have briefly discussed the most important of the calcareous formations. The kinds of rock which are known by the name of *sandstone* consist essentially of coarser or finer granules of quartz, felspar and mica, with little fragments of granite, clay, slate, &c., these granules and sandy portions being connected together by a quartzose or aluminous, or sometimes calcareous cementing substance. When the component particles are large, they form what is called *Breccia* and *Conglomerate*, which frequently exhibit transitions into sandstones. The sandstones include as many formations as limestone, and are distinguished by their position. The most important, beginning with the oldest, are as follows: *Grauwacke*, usually a coarse mixture of quartz, siliceous schist, clay-slate, &c., rich in metalliferous veins (Scotland, Scandinavia, the Hartz, Taunus, Thüringer-Wald, &c.); the *old red sandstone*, carboniferous sandstone, or the *dead-red sandstone* (*rothtodtliegendes*, so called because the appearance of this sandstone is a sign to the miners of Mannsfeld that they have reached the limit of the metalliferous rock) (Devonshire, Scotland, Thuringia, Kur-Hesse); *variegated sandstone*, *keuper sandstone*, *lias sandstone*, *quader sandstone*, and *molasse* or *lignite sandstone*. The hard kinds of sandstone are used for building and for mill-stones, those of particularly fine texture for whetstones and hones. Among the conglomerates must be especially mentioned the nagelfluhe, which is composed of limestone, sandstone, granite, porphyry, &c., cemented together by a calcareous substance. This rock is used as a building-stone.

In the various limestone and sandstone formations we find comparatively small quantities of many other minerals, some of which, however, are of very great value in the arts. Among these are the *coal* and *lignite* (or *brown coal*), *rock-salt*, *gypsum*, *sulphur*, and others, which we will now speak of more in detail.

Coal and *lignite* are incorrectly included among minerals, since they are of organic origin, and may be compared to a

certain extent with branches, fragments of roots, &c., which are buried in a peat-bog. They lie in the province rather of the study of putrefaction, which constitutes a branch of organic chemistry, but since their occurrence in the stratified rocks is of importance in many respects, they usually find a place in mineralogy and geology. These coals are the remains of a vegetation which no human eye saw in its prime; for in the time when it flourished there existed no human beings; only monstrous creatures allied in form to sharks and crocodiles, or in the later formations, prototypes of our rhinoceroses and elephants, can have known them and dwelt among their sedges and thickets. In the true coal-beds are found gigantic kinds of horse-tails, arborescent ferns as much as fifty feet high, club-mosses sixty or seventy feet high, palms, &c.; in the lower beds of the lignite, palms, with trees of tropical character, and various conifers; and in the upper beds appear pines, firs, maples, poplars, &c. In the lignite of Friesdorf, near Bonn, a fossil trunk was found in an upright position, measuring eleven feet in diameter, and in which 792 annual rings were counted. This gives us a striking illustration of the vast periods of time which have passed by on earth, and although chemistry is capable of strengthening and concentrating active forms, in a high degree, and although this magical science can often bring about in a few minutes things that require many years to effect in the ordinary course of nature, the contemplation of the enormous sum of years of past times, warns us not thoughtlessly to over-estimate the experiments of the laboratory, when we are investigating great geological phenomena; for by continued action through thousands of years very weak agents are capable of producing results which at first sight we should imagine to be impossible.

We are sufficiently well acquainted with the composition of wood to perceive what changes occur when it passes into the condition of lignite or of true coal. Three elements, carbon, hydrogen, and oxygen, are the constituents of woody fibre; as soon as the life of the plant ceases, a gradual process of decay commences, in which these three elements enter into combinations which did not previously exist in the wood, and with the formation of these compounds begins a condition of carbonization. A portion of the carbon com-

bines with the oxygen to form carbonic acid, another portion with the hydrogen to form carburetted hydrogen, and a portion of the hydrogen with the oxygen to form water. Carbonic acid and carburetted hydrogen pass off in the state of gas, and if there were enough hydrogen and oxygen to combine in this way with all the carbon, the wood might, under favourable circumstances, gradually become wholly decomposed into such gases; but this is not the case, and therefore carbon remains behind. Even if we did not know by the position of the strata that the true coal was older than the lignite, we could be certain of it, from observation of the fact that the process of decomposition has advanced further in the former than in the latter; it contains, namely, more carbon and less hydrogen and oxygen; while the lignites, especially in the varieties which are called *bituminous wood* and exhibit a very distinct woody texture, stand much nearer to recent wood in their chemical composition. There exists a kind of coal called *anthracite*, which occurs in older formations than the ordinary coal. This kind may be regarded as the final result of the process of change just described, and it often contains only traces of hydrogen and oxygen. Anthracite has a metallic aspect and an iron-black colour. It makes a good fuel with the aid of a blast or a powerful draught, and is especially used in the United States, where the amount quarried in 1835 amounted to about 5,500,000 tons.

Ordinary or black coals are frequently so like lignite that they cannot be distinguished in small fragments; for although many kinds of lignite (or brown coal) are of a brown colour, very many of them are as black as ordinary coal. Their behaviour with solution of potash affords a good means of distinction. When pulverized ordinary coal is boiled in solution of potash and filtered, the fluid acquires a pale, slightly yellow colour; when lignites are treated in the same way, they give a brown, mostly a dark-brown solution.

It has been said already that the true coals are more at home in the older rocks than the lignites are. In conjunction with the carboniferous sandstone, shale, and red sandstone, they constitute one great formation, and occur alternately with these rocks in layers or beds three or four feet thick, sometimes many lying one upon another. Coal has been found at Sta Fe de Bogota up to a height of 8000 feet,

and near Whitehaven, in England, down at a depth of more than 1800 feet below the level of the sea. The carboniferous formation is very widely diffused, and not only Great Britain, but Germany, the north of France, and Belgium, have abundance of rich coal-mines. They occur also on the left bank of the Rhine, near St. Ingbert, Saarbrucken, Eschweiler, Aix-la-Chapelle, &c.; in Westphalia, the Hartz, Bohemia, Thuringia, Saxony, Silesia, &c.

The formations of Aniche, Anzin near Valenciennes, Mons, Charleroi, Namur, and Liege, are likewise very rich. The Belgian pits yield annually about 3,200,000 tons, the Prussian 2,000,000 tons, those of the Austrian dominions 350,000 tons. But the most important are those of Great Britain. The pits of Newcastle alone annually furnish 10,000,000 tons, and there are also mines of vast extent in South Wales, Scotland, the Midland Counties of England, &c. The yearly product of the coal-mines of Great Britain exceeds 20,000,000 tons, and occupies more than 100,000 persons. The annual value is said to amount to 9,000,000*l.* sterling. Portugal, Spain, and Italy, contain little-known coal-mines, as also do Sweden, Norway, and Russia; China is said to be very rich in them, and they are very extensive in North America.

Coal is of the highest importance for fuel and material for illumination, and many pits which yield this peculiarly carbonized wood of the ancient world have become really gold-mines. In Europe it has been used for fuel about one hundred years, while, according to Marco Polo, the Chinese burnt coal even in his time (1270). It is either used in the natural state, or after the volatile constituents have been removed and made use of for gas-illumination. When coal is heated in a close vessel furnished with a delivering-pipe for the gas (in a *retort*), various volatile matters are set free, and among them a carburetted hydrogen gas, which, when properly purified, burns with a white light. This gas is collected in great receivers, over water (gasometers), and then conveyed away in pipes for general consumption. The residuum of the carbon left in the retort is called *coke*, and consisting chiefly of carbon, with merely a few earthy ingredients, forms an excellent fuel. Under this treatment the best kinds of coal undergo a kind of fusion, and the coke then consists of porous masses swollen up as it were, and of a grey metallic aspect. The first attempt to apply the carburetted hydrogen of coal to illumination was made, but simply experimentally, by Lord Dundonald, in 1786. The invention of practicable and profitable gas-lighting is due to Murdoch, about 1789; but the gas-lighting of streets was not effected till 1812 in London, and 1815 in Paris. The Saxon chemist, Lampadius, and the French, Lebon, had much earlier called attention to this application. How enormous the consumption of coal for gas-lighting is, may be deduced from the following statements:—The lighting of London for one year requires 2,646,000,000 cubic feet of gas, and the production of this consumes 18,150 tons of coal; in the longest nights 13,000,000 cubic feet of gas are burnt, which are obtained from 895 tons of coal. There are more than 180 gasometers, and the cast-iron retorts weigh more than 2250 tons. When we reflect upon the present diffusion of gas-lighting, and the application of coal and coke for fuel, and the thousands of human beings who obtain labour and support by it, we see what a value these mummy-like corpses of the lost vegetation of a former epoch possess in regard to the arts and to the necessities and conveniences of life. But the earth seldom offers a good without asking for a sacrifice, and perhaps few of those who admire the radiant gaslights of theatres and festive halls, think that a similar gas is the terror of the poor miner in the dark pits and galleries of the coal-mines, and not unfrequently scatters death and destruction among them. For the pit-gas, as it is called, becomes liberated from the coal-beds, and accumulating in cavities, often rushes out suddenly, mixing with the atmospheric air, and becomes inflamed by the lights of the workmen, when fearful explosions ensue, often blowing up parts of the mines and burying everything in ruins. These are the dreadful "fire-damps" which, from 1827 to 1842, killed or crippled some 9600 workmen in the pits of England, France, and Belgium. In spite of the Davy safety-lamp, the coal-working of these countries costs more than 600 human lives annually. This lamp, the invention of the celebrated chemist Sir Humphrey Davy, consists of a little lantern enclosed by very fine wire-gauze. When explosive gas is present, it enters the lamp and burns inside it, but the cooling metallic gauze prevents the flame from passing

and near Whitehaven, in England, do
than 1800 feet below the level of the s
formation is very widely diffused
Britain, but Germany, the north
have abundance of rich coal-min
left bank of the Rhine, ne
Eschweiler, Aix-la-Chapelle,
Bohemia, Thuringia, Saxon

The formations of A
Mons, Charleroi, Namu
The Belgian pits yield &c.
Prussian 2,000,000 t Alps.
350,000 tons. But y matter than
Britain. The pit n so good a fuel as
10,000,000 tons, similar ways. Certain
South Wales, S e of these were formerly
&c. The year e of mourning ornaments, &c.
exceeds 20,0 or gagat, as it is called, which is
persons. T e from the river Gagas, in Lybia. It
sterling. , in Hesse; at Zwickau, in Saxony; and a
coal-mine rance and England.
is said t and lignite beds sometimes take fire and burn
in Nor surface of the earth for many years. Such fires

Coa own at St. Etienne, near Lyons; at Duttweiler, in
illum bruck; in Bohemia; Upper Silesia, &c. The inflamma-
bo is ascribed to the decomposition of sulphuret of iron
m (pyrites) contained in the coal, and the combustion goes on
very slowly at a certain depth, because there is mostly a
deficient access of air. The burning coal of Duttweiler has
been on fire for 130 years; the Fanny-pit, in Upper Silesia, has been burning since 1823. This natural heating of the soil has been made use of, in Saxony, for example, in favourable spots, for the formation of hot-beds and the cultivation of southern plants; and thus it is the strange destiny of the carbonized remains of many palms, which flourished ages ago in a long-lost tropical climate, in the present day to force pine-apples.

In connexion with these coals must also be mentioned *bitumen* and *asphaltum*, which substances are in some cases contained in black coal, and probably derive their origin from it. Bitumen is a very thin, volatile, and readily inflammable fluid (the thinnest transparent varieties are called *naptha*). It floats upon water, is unctuous to the feel, of aromatic odour, and sometimes colourless and clear, sometimes yellow and brown. It is composed of carbon and hydrogen. It mostly springs forth with water from crevices in limestones, marls, or sandstones, and is met with in great quantity on the island of Tschelekae, and near Baku, on the Caspian Sea, in the Burmese empire, in Zante, &c. It is used for purposes of illumination, as a varnish, as tar, for the solution of caoutchouc, &c. At Baku it is volatilized from orifices in the ground, in such abundance that it is set on fire, and the flame used for cooking. Asphaltum is a soft and tough substance, of a pitchy black or brown colour, with a greasy lustre, and of a slight bituminous odour. It is easily fusible, inflammable, and composed of carbon, hydrogen, and oxygen. It is met with in limestone and sandstone formations, occasionally in considerable quantities, as on the island of Trinidad, and in the Dead Sea, which casts up the asphaltum upon its shores, where it is collected and sold under the name of Jew's pitch. It occurs also in Sicily, Tyrol, Neufchatel, in France, and England, and is used as tar, and also in combination with gravel, &c., for pavements.

Under the head of the precious stones, pure carbon was spoken of as appearing crystallized in the diamond, but there is another mineral composed essentially of carbon, yet not having the slightest resemblance to the diamond, nor standing in any closer connexion with coal. This mineral is *graphite* (known also as *plumbago* or *blacklead*), the name of which is derived from the Greek word γραφειν, signifying *to write*, because it can be used for writing. Graphite has a metallic lustre, and an iron- or steel-grey colour, and it is very soft and unctuous to the touch. It ordinarily forms finely-scaled masses in granite, gneiss, primitive limestone, &c. The finer kinds are manufactured into blacklead-pencils, and the graphite of Borrowdale, in Cumberland, is particularly well adapted for this; the coarser kinds are used for blacking stoves, or rubbed up with grease to smear over machinery, and also for coating moulds in electrotype operations. Much graphite is found near Haffner-zell and Griesbach, in the district of Passau, and is used, mixed with clay, in the fabrication of "Passau crucibles," used for melting metals, and exported to great distances.

Rock-salt constitutes a formation subordinate to the limestones and sandstones, of not less importance than the coals. When we reflect upon the consumption of this salt, as a condiment, for salting meat, fish, and vegetables, how it is used in the manufacture of hydrochloric acid, chlorine, and soda, and thus has become of so much importance in bleaching, in the manufacture of soap, &c., the thousand applications it finds in glazing earthenware, the manufacture of glass, dyeing, &c., we cannot but regard it as one of the most valuable gifts of nature, far more valuable than the whole of the precious stones, with all their glory. In the traditions of the oldest nations we find it taxed on account of its value; it is mentioned by Moses as an essential addition to the meat-offerings, and it was the symbol of permanence and of wisdom. So necessary an element is salt, says Pliny, that its name has even been applied to intellectual pleasures, and no better word can be used to express the sweetness and highest joyfulness of life, than the name of salt.* It was also renowned among the alchemists, and by many of them was named as one of the three principles of the great art (salt, sulphur, and quicksilver).

Rock-salt is often met with in cubical crystals, which can also be obtained very well marked by dissolving a large quantity of common salt in water, and allowing the solution to evaporate spontaneously. The crystals may be split parallel to the faces of the cubes. Rock-salt is soft, transparent, translucent, of the specific gravity 2.2, and easily fusible. It is composed of two elements: chlorine, 60.7 per cent., and sodium, 39.3 per cent. It has often a granular fracture, more rarely it is fibrous, and it is found colourless or of various hues, such as yellowish, red, blue, &c. At Hallstadt, near Salzburg, especially, isolated pieces are found of the most beautiful sapphire-blue colour. The miners there carve

* The various salts, soda, saltpetre, sal-ammonia, Glauber's salt, Epsom salts, and borax, important in the arts, and to some extent also in medicine, also occur in nature (some of them dissolved in water), but they are for the most part prepared artificially, and we pass them over here, since they belong more especially to the domain of Chemistry.

crosses, picture-frames, and similar articles, out of white salt, and inlay them with little pieces of the blue salt. Rock-salt is constantly accompanied by gypsum, anhydrite, and clay. Gypsum is a sulphate of lime with water; anhydrite is a sulphate of lime containing no water. Salt occurs with these minerals often in large and tolerably pure masses, and often in small portions imbedded in clay. The salt-formation frequently fills up a trough-like depression in limestone or sandstone rocks, and the salt is got out in two different ways, according to the condition in which it is found. When it exists in large masses, it is quarried and obtained in fragments and blocks, but when it is mingled with much clay, it is dissolved out in water, and the solution or brine, called in Germany *soole*, is boiled down to remove the water. In order to effect this solution of the contents of the rocks, vast chambers are excavated in them, into which water is conducted. The water dissolves the salt out of the walls of the chambers, and when it has become sufficiently saturated (containing 26 per cent. of salt), the brine is conducted into the pans and boiled down. The largest bed of salt known, is in Galicia, near Wieliczka, and Bochnia, at the foot of the Carpathians. It extends about 460 miles, is over 90 miles in breadth, and is 1200 feet thick. The rock-salt is quarried and sent away in masses, sometimes weighing 330 lbs. (called *Balvanen*). The mine of Wieliczka, in which the pits, galleries, and passages, if placed end to end, would extend about 400 miles, employs 800 or 900 persons, and annually yields about 50,000 tons. Tradition says that the pious Polish princess, Cunigunda, wife of Boleslaus V., caused the discovery of the mines of Bochnia in 1252, and of Wieliczka in the following year, through her prayers. A miracle is related in reference to this; it is said that a ring which she had thrown into a salt-spring in Hungary, was found again in a piece of rock-salt in Bochnia. In the salt-mines, caves like vast halls have been made, partly lined with blocks of salt, as with masonry, and decorated with statues, altars, and the like, carved out of rock-salt. One of these chambers alone, that of Michalowic, has exclusively furnished occupation to the salt-miners for forty-four years. Rock-salt is quarried in a similar way in Cheshire, where it often occurs clear and colourless; at Cardona, in Catalonia, where it comes out on the surface, and is worked like a stone-quarry; at Kerman, in

Persia, where it is used to some extent for building; at Santa Fe de Bogota, in the Gulf of Mexico, &c. There are large works in what is called the Alpine limestone, belonging to the Jurassic limestone formation, at Hallein and Berchtesgaden, near Salzburg; at Ischl, Hallstadt, and Aussee, in the Salzkammergut (Austria), and at Hall, in Tyrol. The greater portion of the salt of these mines is obtained by washing it out by water, since it occurs in streaks and little fragments mingled with clay and gypsum, which mixture is also called "hazel-rock." The chambers and sinkings which are formed to receive the water are often of considerable size, as may be imagined from the fact that the brine from one such chamber not unfrequently yields as much as 7500 tons of salt. From 25,000 to 30,000 tons of salt are obtained annually in this way from the Durren mine, near Hallein. The salt-mine of Berchtesgaden furnishes a similar proportion. The Reichenbach conduit, for conveying the brine from Berchtesgaden over Reichenhall to Rosenheim is very celebrated. It extends over a mountainous country to a distance of nearly fifty miles.* Near Wimpfen, in Wurtemburg, water is admitted into the bed of salt by a boring, and the saturated *brine* is pumped out again. Natural brine of similar origin is met with in many places, flowing from the earth in springs more or less impregnated with salt, such as the Reichenhall spring, with 23 per cent. of salt., the Luneberg, with 25 per cent., the Schönebeck, with 13 per cent., &c. But few of these springs are sufficiently rich in salt to repay actual boiling down. The brine is therefore concentrated by allowing it to percolate through piles of brushwood in a free current of air, by which means a considerable part of the water is evaporated. This operation is called *graduation* (thorn-graduation). Sea-salt contains about 2½ per cent. of common salt, and it has been calculated that if the ocean was evaporated until the salt crystallized, the latter would form a layer 700 feet thick all over the bottom of the sea, or the surface of all the solid land of the earth could be covered with a layer of this salt 2000 feet deep. Salt is also obtained from sea-water by allowing it to evaporate spontaneously in

* The object is to convey the brine into the vicinity of forests supplying fuel for the evaporation. The pipes once laid, the liquid makes its own way, while the carriage of wood through such a country would be very costly.

the *salines*, or salt-works, on the sea-shore. Rock-salt also occurs in great abundance as an efflorescence from the soil of the steppes, on the Caspian sea and the Lake of Aral, and at Dankali in Habesch, where the soil is covered with snowy, shrub-like growths for the space of four days' journey. It likewise occurs in Brazil and Chili. On Lake Mingo, in Texas, it is deposited on the shore as a crust, so thick and hard that it can be quarried into blocks; the crust is renewed again in a few days. This salt (which is volatilized at a white heat) is also met with in the sublimates of volcanoes, and many beds on Vesuvius exhibit a coating or patches of it in their cracks and crevices.

It has been mentioned that *gypsum* and *anhydrite*, in particular, universally accompany rock-salt, associated with clay, and that gypsum is composed of sulphate of lime (sulphuric acid 46.6, lime 32.5, and water 20.9, in 100 parts), contain water, while *anhydrite* is totally free from it (sulphuric acid 58.8, lime 41.2 per cent.). The latter often forms crystalline masses, which may be split in three directions, at right angles; hence it has acquired its name, *dice-spar*. It is harder than gypsum, and is found of various colours, greyish, yellowish, red, violet, &c.; but it is not met with in masses of great size, like gypsum. Gypsum presents itself either in a fibrous or granular state of aggregation, or solid, or in prismatic crystals, which are often quite transparent and colourless, and occur grouped in brilliant clusters in the cavities and fissures of the rock. These crystals may be split very perfectly, almost like mica, in one direction, but the laminæ are not elastic and pliable like the latter. Gypsum is very soft, and may be scratched with the finger-nail, and this peculiarity enables us to distinguish it readily from many similar minerals, such as limestone, and it does not effervesce with acids, is fusible, and, to a certain extent, soluble in water. The granular and compact homogeneous gypsum often forms vast beds by itself in various geological formations, constituting even hills or little mountains, and it is very generally diffused. It has numerous applications in the arts, and was well known to the ancients. According to Pliny, beehives were made out of transparent plates of gypsum, in order to see the bees work; and it was also used instead of

certain extent with branches, fragments of roots, &c., which are buried in a peat-bog. They lie in the province rather of the study of putrefaction, which constitutes a branch of organic chemistry, but since their occurrence in the stratified rocks is of importance in many respects, they usually find a place in mineralogy and geology. These coals are the remains of a vegetation which no human eye saw in its prime; for in the time when it flourished there existed no human beings; only monstrous creatures allied in form to sharks and crocodiles, or in the later formations, prototypes of our rhinoceroses and elephants, can have known them and dwelt among their sedges and thickets. In the true coal-beds are found gigantic kinds of horse-tails, arborescent ferns as much as fifty feet high, club-mosses sixty or seventy feet high, palms, &c.; in the lower beds of the lignite, palms, with trees of tropical character, and various conifers; and in the upper beds appear pines, firs, maples, poplars, &c. In the lignite of Friesdorf, near Bonn, a fossil trunk was found in an upright position, measuring eleven feet in diameter, and in which 792 annual rings were counted. This gives us a striking illustration of the vast periods of time which have passed by on earth, and although chemistry is capable of strengthening and concentrating active forms, in a high degree, and although this magical science can often bring about in a few minutes things that require many years to effect in the ordinary course of nature, the contemplation of the enormous sum of years of past times, warns us not thoughtlessly to over-estimate the experiments of the laboratory, when we are investigating great geological phenomena; for by continued action through thousands of years very weak agents are capable of producing results which at first sight we should imagine to be impossible.

We are sufficiently well acquainted with the composition of wood to perceive what changes occur when it passes into the condition of lignite or of true coal. Three elements, carbon, hydrogen, and oxygen, are the constituents of woody fibre; as soon as the life of the plant ceases, a gradual process of decay commences, in which these three elements enter into combinations which did not previously exist in the ·d, and with the formation of these compounds begins a ·ition of carbonization. A portion of the carbon com-

bines with the oxygen to form carbonic acid, another portion with the hydrogen to form carburetted hydrogen, and a portion of the hydrogen with the oxygen to form water. Carbonic acid and carburetted hydrogen pass off in the state of gas, and if there were enough hydrogen and oxygen to combine in this way with all the carbon, the wood might, under favourable circumstances, gradually become wholly decomposed into such gases; but this is not the case, and therefore carbon remains behind. Even if we did not know by the position of the strata that the true coal was older than the lignite, we could be certain of it, from observation of the fact that the process of decomposition has advanced further in the former than in the latter; it contains, namely, more carbon and less hydrogen and oxygen; while the lignites, especially in the varieties which are called *bituminous wood* and exhibit a very distinct woody texture, stand much nearer to recent wood in their chemical composition. There exists a kind of coal called *anthracite*, which occurs in older formations than the ordinary coal. This kind may be regarded as the final result of the process of change just described, and it often contains only traces of hydrogen and oxygen. Anthracite has a metallic aspect and an iron-black colour. It makes a good fuel with the aid of a blast or a powerful draught, and is especially used in the United States, where the amount quarried in 1835 amounted to about 5,500,000 tons.

Ordinary or black coals are frequently so like lignite that they cannot be distinguished in small fragments; for although many kinds of lignite (or brown coal) are of a brown colour, very many of them are as black as ordinary coal. Their behaviour with solution of potash affords a good means of distinction. When pulverized ordinary coal is boiled in solution of potash and filtered, the fluid acquires a pale, slightly yellow colour; when lignites are treated in the same way, they give a brown, mostly a dark-brown solution.

It has been said already that the true coals are more at home in the older rocks than the lignites are. In conjunction with the carboniferous sandstone, shale, and red sandstone, they constitute one great formation, and occur alternately with these rocks in layers or beds three or four feet thick, sometimes many lying one upon another. Coal has been found at Sta Fe de Bogota up to a height of 8000 feet,

[illegible] with [illegible] investigating [illegible] through [illegible]

[illegible] acquainted with the composition [illegible] changes occur when it passes into [illegible] of true coal. These elements [illegible] are the [illegible] constituents of woody [illegible] fossil process [illegible] ents enter [illegible] just in the [illegible] ls begins [illegible] carbon con- [illegible]

bines with the oxygen to form carbonic acid, another portion with the hydrogen to form carburetted hydrogen, and a portion of the hydrogen with the oxygen to form water. Carbonic acid and carburetted hydrogen pass off in the state of gas, and if there were enough hydrogen and oxygen to combine in this way with all the carbon, the wood might, under favourable circumstances, gradually become wholly decomposed into such gases; but this is not the case, and therefore carbon remains behind. Even if we did not know by the position of the strata that the true coal was older than the lignite, we could be certain of it, from observation of the fact that the process of decomposition has advanced further in the former than in the latter; it contains, namely, more carbon and less hydrogen and oxygen; while the lignites, especially in the varieties which are called *bituminous wood* and exhibit a very distinct woody texture, stand much nearer to recent wood in their chemical composition. There exists a kind of coal called *anthracite*, which occurs in older formations than the ordinary coal. This kind may be regarded as the final result of the process of change just described, and it often contains only traces of hydrogen and oxygen. Anthracite has a metallic aspect and an iron-black colour. It makes a good fuel with the aid of a blast or a powerful draught, and is especially used in the United States, where the amount quarried in 1835 amounted to about 5,500,000 tons.

Ordinary or black coals are frequently so like lignite that they cannot be distinguished in small fragments; for although many kinds of lignite (or brown coal) are of a brown colour, ...ry many of them are as black as ordinary coal. Their beha...our with solution of potash affords a good means of distinc...n. When pulverized ordinary coal is boiled in solution of ...sh and filtered, the fluid acquires a pale, slightly yellow ...r; when lignites are treated in the same way, they give ...n, mostly a dark-brown solution.

...has been said already that the true coals are more at ...in the older rocks than the lignites are. In conjunc... ...boniferous sandstone, shale, and red sand... ...tute one great formation, and occur alter... ...rocks in layers or beds three or four feet ...many lying one upon another. Coal has ...Fe de Bogota up to a height of 8000 feet,

certain extent with branches, fragments of roots, &c., which are buried in a peat-bog. They lie in the province rather of the study of putrefaction, which constitutes a branch of organic chemistry, but since their occurrence in the stratified rocks is of importance in many respects, they usually find a place in mineralogy and geology. These coals are the remains of a vegetation which no human eye saw in its prime; for in the time when it flourished there existed no human beings; only monstrous creatures allied in form to sharks and crocodiles, or in the later formations, prototypes of our rhinoceroses and elephants, can have known them and dwelt among their sedges and thickets. In the true coal-beds are found gigantic kinds of horse-tails, arborescent ferns as much as fifty feet high, club-mosses sixty or seventy feet high, palms, &c.; in the lower beds of the lignite, palms, with trees of tropical character, and various conifers; and in the upper beds appear pines, firs, maples, poplars, &c. In the lignite of Friesdorf, near Bonn, a fossil trunk was found in an upright position, measuring eleven feet in diameter, and in which 792 annual rings were counted. This gives us a striking illustration of the vast periods of time which have passed by on earth, and although chemistry is capable of strengthening and concentrating active forms, in a high degree, and although this magical science can often bring about in a few minutes things that require many years to effect in the ordinary course of nature, the contemplation of the enormous sum of years of past times, warns us not thoughtlessly to over-estimate the experiments of the laboratory, when we are investigating great geological phenomena; for by continued action through thousands of years very weak agents are capable of producing results which at first sight we should imagine to be impossible.

We are sufficiently well acquainted with the composition of wood to perceive what changes occur when it passes into the condition of lignite or of true coal. Three elements, carbon, hydrogen, and oxygen, are the constituents of woody fibre; as soon as the life of the plant ceases, a gradual process of decay commences, in which these three elements enter into combinations which did not previously exist in the wood, and with the formation of these compounds begins a condition of carbonization. A portion of the carbon com-

bines with the oxygen to form carbonic acid, another portion with the hydrogen to form carburetted hydrogen, and a portion of the hydrogen with the oxygen to form water. Carbonic acid and carburetted hydrogen pass off in the state of gas, and if there were enough hydrogen and oxygen to combine in this way with all the carbon, the wood might, under favourable circumstances, gradually become wholly decomposed into such gases; but this is not the case, and therefore carbon remains behind. Even if we did not know by the position of the strata that the true coal was older than the lignite, we could be certain of it, from observation of the fact that the process of decomposition has advanced further in the former than in the latter; it contains, namely, more carbon and less hydrogen and oxygen; while the lignites, especially in the varieties which are called *bituminous wood* and exhibit a very distinct woody texture, stand much nearer to recent wood in their chemical composition. There exists a kind of coal called *anthracite*, which occurs in older formations than the ordinary coal. This kind may be regarded as the final result of the process of change just described, and it often contains only traces of hydrogen and oxygen. Anthracite has a metallic aspect and an iron-black colour. It makes a good fuel with the aid of a blast or a powerful draught, and is especially used in the United States, where the amount quarried in 1835 amounted to about 5,500,000 tons.

Ordinary or black coals are frequently so like lignite that they cannot be distinguished in small fragments; for although many kinds of lignite (or brown coal) are of a brown colour, very many of them are as black as ordinary coal. Their behaviour with solution of potash affords a good means of distinction. When pulverized ordinary coal is boiled in solution of potash and filtered, the fluid acquires a pale, slightly yellow colour; when lignites are treated in the same way, they give a brown, mostly a dark-brown solution.

It has been said already that the true coals are more at home in the older rocks than the lignites are. In conjunction with the carboniferous sandstone, shale, and red sandstone, they constitute one great formation, and occur alternately with these rocks in layers or beds three or four feet thick, sometimes many lying one upon another. Coal has been found at Sta Fe de Bogota up to a height of 8000 feet,

also usually contains granular chrysolite (*olivine*) imbedded in it, and many siliceous compounds, some containing water (*zeolites*), are found in little cavities and bubble-like hollows. Basalt frequently displays a columnar structure, or rather a columnar mode of disintegration; the columns, which sometimes attain a height of 200-300 feet, either stand parallel to each other or are heaped up irregularly. The columnar basalt of Fingal's Cave, in the island of Staffa, is renowned, as also that of the Giant's Causeway, on the northern coast of Ireland, where a wall of more than 30,000 columns is seen projecting more than 30 feet out of the sea, and forming a tolerably flat platform above. Basalt forms conical mountains, which frequently resemble extinct volcanoes, and exhibit traces of former craters; it also breaks through rocks of the most diverse kinds, in vein-like masses, and then spreads out over the surface, as if it had overflowed, in the form of a fungus or of a sponge. It occurs greatly diffused on the Rhine, in the Eifel, at the Seven Mountains, and at Westerwald, also on the Vogelsgebirge and on the Rhön, in Bohemia, Saxony, Auvergne, Scotland, Ireland, &c. What can the Rhine have looked like when these black masses burst forth out of the earth, and its volcanoes were still active? Although these volcanoes do not appear to have been exactly of the same kind as those now active, they exhibit products which very closely resemble the modern lavas, and among these is especially to be classed the "mill-stone basalt," as it is called, of Niedermendig, a stone which receives its name from the purpose to which it is applied, and in which a considerable trade is carried on. So far as we can conclude from experiments of fusion and exposure to intense heat, the basalts appear to owe their formation to a slower cooling than usually takes place in ordinary lavas, perhaps arising from the simple cause that the latter never present themselves in such large masses. The ancients were acquainted with basalt, and the name occurs in Pliny, who states that this stone was found in Ethiopia. It was used as a touchstone, and also applied in the plastic arts. Basalt is rather a hard stone, furnishes an excellent building material, which, however, is certainly difficult to work. It is also used for paving, grindstones, mortars, &c., and also in glass-making, in the manufacture of dark-green bottle-glass, and likewise in iron smelting, &c.

The name *lava* is applied to very varied stones, and is used in reference to all those which are emitted in a state of fusion, as a semi-fluid mass, from active volcanoes. Many kinds of lava present a homogeneous appearance, many bear evidence of a fine intermixture of various minerals, among which augite, felspar, and leucite, principally occur, and are frequently met with in large crystals.

Leucite is a siliceous compound with alumina and potash, and principally to be distinguished by its crystallization. The crystals are bounded by twenty-four trapezic surfaces. Leucite is mostly greyish white, or light-grey and reddish. Such crystals of leucite are often intermingled in thousands in the lava, which is ordinarily porous and slag-like, but also in some cases compact and of greyish or black colour, or brown. With the lava are also found molten glass-like masses, such as obsidian, and glasses of this kind are found, when no great pressure was imposed above, blown up in froth-like masses, forming what is called *pumice-stone*. It is a remarkable phenomenon that the lavas of all volcanoes, however distantly situated and different in character, agree in the fact that augite and felspathic minerals (also leucite and magnetic iron-ore) are above all prominent in the composition of their masses. Augite, in particular, is at home in this stone, and the simple fact that this mineral has never been found in granite proves that the latter must be of different origin from the volcanic rocks. The quantity of lavas and allied stones upon the earth is very considerable, for, leaving out of consideration the many extinct volcanoes which are composed of them, there are about two hundred known which are active, and emit lava-streams from time to time. The distribution and position of these volcanoes, their activity and its effects, and their possible causes, are among the most interesting subjects in the study of nature. Most volcanoes lie in the vicinity of the sea, or on islands, and among these the groups of islands on the south and east of Asia, the Sunda Islands, the Moluccas, the Philippines, and the Kurile Islands, are remarkable instances of continuous lines of burning mountains. In like manner the Antilles in the West Indies, and the Azores, the Canaries and the Cape de Verd Islands off the coast of Africa, are volcanic groups. The Lipari Islands, off that coast of Sicily on which the celebrated Etna itself stands, are volcanic, as also are the islands of the Greek Archipelago. Iceland is a great centre of volcanic activity. Such islands are often the actual summits of volcanoes arising from the bottom of the sea, and projecting above it. In the active volcanoes, however, the peaks and craters alter from time to time, through falling in or protrusion, and thus also volcanic islands have even been known to sink beneath the surface of the ocean, as well as to rise above it. Such a phenomenon occurred in the vicinity of the island of St. Michael, one of the Azores, where, on the 4th of July, 1811, a black island of slags rose 700 feet above the surface of the sea, enveloped in steam and smoke, and glancing with lightning-flashes, and in the course of half a year afterwards disappeared again below the flood. A similar event happened in July, 1830, on the south-west coast of Sicily; another in 1796 in the Aleutian isles; in the year 1693, the island of Sarca, in the Moluccas, sank out of sight after a violent eruption of its volcano; and many elevations of islands are recorded in history as having occurred in the Greek Archipelago. The most numerous volcanoes on the mainland are in America, the principal being in the chains of the Cordilleras and on the plateau of Quito. There Cotopaxi, Pichincha, and Antisana, rise more than 18,000 feet above a volcanic basis of more than 12,000 square miles. In Central Asia, also, in the Celestial mountains in Tarfan, there are still active volcanoes, which are the more remarkable that their distance from the sea amounts to from 1000 to 2000 miles. New mountains are formed on the continents, just as islands are produced in the sea, by volcanic elevations. Among known examples are: Monte Nuovo, in the Gulf of Baia, which was formed in 1538, in seven days, by an outbreak of lava, after the continuance of earthquakes for two years previously; this measures 440 feet in height; Jorullo, in the interior of Mexico (1580 feet above the plain, 3700 feet above the sea), which rose up out of a fissure in the earth on the 29th of September, 1759, and was accompanied by a protrusion of a tract of land some four square miles in extent, in the form of bubbles, with thousands of little peaks and cones, emitting columns of vapour rising twenty or thirty feet high. The earthquake preceding this eruption lasted sixty days.

Subterraneous noises and earthquakes are indeed the constant forerunners of volcanic eruptions, and sometimes act at great distances—nay, even, occasionally, shake whole continents. Volcanic eruptions also frequently occasion the falling in of mountains, and there are many examples of the subsidence of a volcano itself, frequently resulting in the formation of a lake in its place. At the subsidence of one of the largest volcanoes of Java, in the year 1772, a district of many miles sank in, and forty villages were swallowed up and buried in the stones cast out. In general, volcanic eruptions are accompanied by catastrophes, often so frightful that one might almost believe the old elements of fire, earth, air, and water, had conspired together to rage amid terror and destruction. Level land and mountains tremble, and are torn into gaps and crevices, whence ascend smoke and flames; the sea exhibits a menacing disturbance, rising from its depths and overflowing with mighty weight, then retreating as though the bottom had sunk down; at the volcano itself subterranean thunders groan, black clouds are poured forth from the crater, and glowing stones are hurled into the air, where they burst in pieces with loud reports; from the gaping throat streams the fiery flood of lava, rushing down heavily and irresistibly, burning up and destroying everything in its way; day and night darkened by showers of dust and ashes, storms and whirlwinds driving amid horror and devastation of the trembling fields and woods! Several of the eruptions of Vesuvius have been accompanied by such mighty and terrible phenomena, the most celebrated of which was that of the year 79, which engulphed Herculaneum in a lava-stream and buried Pompeii in earthy cinders, which, according to cotemporary historians, were carried as far as Rome, and even to the coasts of Africa and Syria; another example was given in the eruption of the same volcano in the year 1794, before which the whole surface of Campania fluctuated like waves of water, and which terminated in the destruction of Torre del Greco; the eruption of Tomboro, in the island of Sumbava, east of Java, in the year 1815, in which thousands of the inhabitants lost their lives, and the entire vegetation of the north and west sides of the island was destroyed; the eruption of Kötligia, in Iceland, in 1823, &c. Volcanoes which, like those of the Andes chain, lie above the limit of the eternal snow, often cause great mischief by their eruptions suddenly melting large quantities of snow, the resulting streams often causing terrible floods. Volcanoes also frequently throw out large quantities of water (sometimes with dead fish) and mud. Nothing definite can be assumed concerning the duration of the activity of a volcano and in reference to its extinction, for we have many examples of volcanoes remaining quiet hundreds of years and then suddenly bursting out, often with so much the more violence; and it is by no means impossible that what are called the extinct volcanoes on the Rhine, in Auvergne, and Vivarais, may one day re-open their craters and abysses. Where solfataras, hot springs, and emissions of gas, occur, activity still exists, although it is, as it were, slumbering. The lava, which mostly burst out from cracks formed in the sides of the volcano, and seldom overflows from the crater itself, usually flows slowly as a viscid mass, rarely advancing more than 1200 feet in an hour, although streams have been observed which made their way onwards more than 3000 feet in an hour. It rapidly cools down upon the surface, so that persons caught between lava-streams have saved themselves from destruction by running over the still flowing lava; and this even when it has been some sixty feet broad, and at a distance of scarcely sixty feet from the source whence it was flowing out. But the glow of a lava-stream often endures in the interior for years, according to its thickness; and instances are known of very large masses smoking freely after forty-five years, and converting brooks of cold water, which had made a way into their cracks, into hot mineral springs. The lava has often flowed from Vesuvius in enormous masses into the sea; and, although it at first heated this to boiling, produced clouds of steam, and killed the fish for a long distance; there were not such grand phenomena as might have been expected, because the surface of the slowly flowing lava rapidly hardened, and thus the contact between the water and the glowing portions was prevented. The vapours produced by active and half-active volcanoes are mostly watery vapour, with sulphuretted hydrogen, vapour of sulphur, sulphurous acid, hydrochloric acid, carbonic acid, &c. Sulphuric acid is also frequently produced, and corrodes the surrounding stones, whence originate a variety of compounds, one of the best known being *alum*—a salt composed of sulphuric acid, alumina, and potash, or ammonia, with water, and characterized by its octohedral crystals and its sweet, astringent taste. This salt, which is weathered out of the stones, is dissolved in water, and the ley boiled down. Alum, obtained from this alum-stone, as it is called, or prepared artificially, is principally used in dyeing and tanning, as also in pharmacy, &c.

No answer can at present be given to the inquiry as to the cause of volcanic fire; and it need only be mentioned here, that the observation of a rise of temperature toward the interior of the earth indicates that it may be, at a great depth, as already stated above, so hot that stones may be molten, a condition which is so far in accordance *with the specific gravity of the earth*, that it would allow only of very slight compressibility and condensation, because liquids are almost incompressible. If such be the condition, earthquakes and volcanic eruptions would be readily explicable by the entrance of water into such *fire-floods*. The formation of granite has been opposed as an objection to Plutonism, because many circumstances connected with it are incompatible with the molten fluids, as was observed in an earlier passage; but the views might be made to combine, by admitting the *primitive fiery fluid* of the earth, then regarding the granite, &c., as the first product of a succeeding period of formation, in which the *aqueous-gelatinous* condition was predominant, and further, allowing the proper *Neptunian formations* to be brought into place; a proposition which if taken note of by the contending parties, if it did not bring peace, might perhaps lead to an armistice, in the geological warfare, in which repose and collection of new force is very necessary in many respects.

So much for ordinary stones, of which it need only be added that they chiefly constituted those with which Deucalion and Pyrrha repopulated the world after the great flood, as we learn from the mythology. What would have happened if this surviving couple of human beings had possessed regular mineralogical knowledge, and had thrown only *precious stones* over their shoulders?

III.

THE PRECIOUS METALS.

We opened our sketches with the examination of the precious stones; we are now about to speak of the noble metals, which are indeed far fewer in number than those stones, but possess a greater interest from the fact that they not unfrequently energetically influence the great affairs of life; so much so, alas! that often more depends upon gold than upon moral force and virtue. We have seen how a certain scarcity of occurrence and splendour of colour can place stones amongst those which are conventionally regarded as precious, without, in the generality of cases, much care being taken to learn how far they are precious in their absolute nature; and we have learnt that matters are often mismanaged in this respect, and preference is accorded from manifold accidents, nay, ordinarily, that rank depends entirely on such causes. The matter may be tolerably well compared to what would happen in human life, if only the *beautiful* children of honourable and long-descended families were received into the ranks of nobility, while those less gifted with beauty became incorporated with the citizen or peasant class. It is somewhat different with what are called the noble metals; and it must be said to the honour of humanity, they have here, whether intentionally or not I will not decide, gone to work with far more circumspection. For example, there exists but one single precious stone, certainly the most valued among the fraternity, which demands a certain respect from its intrinsic nature, setting aside its outward characters. This is the diamond, which has been said already to consist solely of carbon, and this carbon to be an element for us. The word element is understood, now-a-days, as indicating every substance which the chemist cannot decompose or separate into other component parts. From carbon, boil it and roast it as much as we may, nothing can be brought out except carbon. We can indeed combine it with other substances in many ways, as for instance: united with another element (oxygen), it effervesces in champagne and beer; as it combines with iron to form steel, &c.; but we are unable to separate it into diverse constituents.

All the metals, the choice as well as the common, have this property conferred upon them by our investigations, that, so far as we can tell, they are elements. Lest, however, any one should think that the chemists do not know very much about it, and that they may be very ready to call anything an element, it may be remarked in passing, that they have made out everything upon the globe, even including the invisible air, to be compounded from only about sixty elements, which is certainly a small number when we think of the millions of natural and artificial products. The metals, when they occur independently, have, moreover, the advantage of always possessing equal beauty to the eye; and while, for example, a precious stone is greatly depreciated in value, or is worth nothing at all, when not perfectly pure, because it cannot be subjected to any refining process, a child of gold, silver, copper, &c., meets with no such misfortune, for even though it be born with faults, these are always improvable, and they can sustain a great deal of trial, and go through much purification with advantage, while the same things would totally destroy the precious stones.

The metals in general having thus already a higher interest than the most distinguished among the ennobled stones, it may be readily conceived that the noble metals, as they are called, must be still more especially gifted. And this is the fact in many respects. It is well known that *gold*, *silver*, and *platinum*, are included in this class. Some few others might be added, but common opinion ordinarily concerns itself only with these three. These are pre-eminent above the others from the fact that they do not love the common every-day elements, but prefer to shine in their inborn glory; and when the chemist has, as it were, cunningly brought them into a *mésalliance*, or an association where there is disparity of birth, they not unfrequently break loose with violence, and seek their freedom regardless of all consequences. Thus they love freedom; certainly a noble characteristic!

I will explain this a little more fully. One of the commonest and most widely diffused of the elements is a constituent of the air we breathe; and this constituent, which has the form of a gas or air when in a separate condition, is called *oxygen*. It is so named because it imparts to many of its compounds the character of an acid. This element combines readily with the metals, and in so doing becomes fixed, and transforms them in such a manner that they can be no longer recognised. Compare, for instance, a clean steel blade with a rusty one; how different they are! In the former we see a dazzling metallic lustre, solidity, and elasticity; in the latter, a dull red or yellow earthy aspect, friability, and brittleness. And the cause of this is nothing else but the combination of the oxygen of the air with the iron, water also becoming associated with them. Rust of this kind is formed on all metals, and destroys their lustre and beauty. The noble metals most obstinately resist this enemy of their glory, and even when they have been forced to unite with it, they very soon break away again from it. Chemists, who might well be termed the tyrants of the elements, have, for instance, compelled gold and silver to combine with nitrogen, with hydrogen, and with oxygen, with elements which naturally dwell in the atmosphere and in water, and are consequently very common-place; but the slightest cause, a slight blow, often a mere touch, is sufficient to excite a revolution in the noble metals, and they free themselves again with a frightful explosion, shattering everything around; and the life of many a workman has been sacrificed under such circumstances. These combinations are well known under the names of *fulminating gold* and *fulminating silver*.

The virtues of the noble metals are, moreover, of such a nature that they inspire respect even in those who do not seek these qualities in higher spheres, but ask after the common and every-day usefulness of a thing; and if gold, for instance, cannot agree in these things with iron, yet it agrees with the whole fraternity of the precious stones, which, in this respect, must be regarded rather as constituting the actual court or centre of luxury and fashion.

And this utility is intimately connected with the tendency and the opposition to the above-mentioned combinations.

Ornaments of iron, tin, or copper, would very soon lose their lustre and their beauty; ornaments of gold, silver, or platinum, suffer no change under ordinary conditions, although, it is true, silver is inferior to the other two in this respect. For the same reason, vessels of gold and silver, and still more of platinum, have great superiority over others; they are not attacked by the fluids and solids used in the preparation of food; nay, gold and platinum so strongly resist all solvents, that hardly more than *one* is known which overcomes them, and this, a mixture of hydrochloric and nitric acids, has hence obtained from chemists the distinguished name of *aqua regia*. The ancient Greeks believed in another solvent, and ascribed such a power to the water of the Styx, in Arcadia. So states Pausanias, in spite of the opposite opinion of the Lesbic Sappho, who, clearly better instructed, celebrated the incorrodibility and unalterableness of gold in her verses.

In consequence of this resistance against foreign influences, the precious metals very frequently occur in nature, and gold and platinum almost always, in a pure condition, that is, free from admixture of other elements, while directly the contrary is the case with the common metals. There may, indeed, have been a period in the creation of the earth in which iron, lead, tin, and the like, existed pure upon the globe; but the globe is now pretty old, and the iron has gradually become rusted, while lead and tin, and other metals, have passed into similar conditions. But the noble metals have defied time, and since they are native originally only of the older rocks, which in part existed before the creation of the animal and vegetable worlds, they have truly weathered many a storm, and yet in manifold instances maintained their elementary independence uninjured. Consequently the modes of obtaining these, at least gold and platinum, are much simpler than is the case with the other metals. We have mentioned that most iron occurs in nature as rust, that is, combined with oxygen; and when we wish to obtain metallic iron, we are obliged to adopt a process by means of which we can remove the oxygen; and this is a complicated labour, for the oxygen cannot be separated by mechanical means. Ordinarily the iron ores are smelted with charcoal or coal in large furnaces, and through the enormous heat produced by the aid of the blast of air, the oxygen is induced to leave the iron, and to combine with the carbon into a kind of gas, which passes out from the chimney. The same takes place with tin-ores, many copper-ores, lead-ores, &c. The mode of obtaining gold and platinum consists frequently merely in collecting and gathering them where they occur in small particles, spangles or laminæ, in stones or in the sands of rivers, and in alluvial deposits. They are usually extracted by mechanical means, by pulverization and washing with water, which separates the light particles of the stone from the heavy ones of the metal. Washings of this kind furnish most gold, and as yet all platinum.

The noble metals have, moreover, an advantage over the others, very important for the facility of obtaining them, namely, that they are not volatile, and, generally speaking, are unalterable by exposure to heat, while most of the common metals are volatilized at a high temperature, or if the atmosphere has access, combine with its oxygen, and undergo manifold alterations. Much use is made of this prerogative in the extraction of gold and silver, since in cases, for example, where the washing is not applicable, agitation with quicksilver, or fusion of the ore with lead, is used, and thus a mixture of gold or silver with quicksilver or lead is obtained. Quicksilver, then, being volatile when heated, can be separated by this means from the gold or silver with which it is combined, since these, wanting the volatility, remain behind; and when lead in which gold or silver exists is heated with free access of air, it combines with the oxygen of the latter, and as it slags off in the form of what is called *litharge*, it leaves the noble metal pure upon the hearth in all its peculiar lustre, because the oxygen of the air has no power over it. These two operations are known under the respective names of *amalgamation* and *cupelling*. Thus it is much easier to obtain the noble metals pure than any of the common ones, and there is only difficulty when it is attempted to extract every little atom that a stone may contain; but even this is carried to an extraordinary perfection. We have a striking evidence of the truth of the remark just made, in the fact that the ancient Peruvians did not discover iron, although there were opportunities of their so doing, and the like occurred with the ancient inhabitants of Siberia. But in the East, iron was known before the Noachian Deluge; and since the eighth man from Adam, Tubalcain, is mentioned as a worker in ores and iron-work, metallurgy must have been pursued at a very early period; and it is, as we see from Scripture, about of equal age with instrumental music, since fiddlers and pipers are said to be the followers of Jubal, the brother of Tubalcain.

Penetrating further into the analysis of the peculiarities of the noble metals, their great ductility, which characterizes the king of metals, gold, beyond any other existing substance, deserves especial mention and commendation.

It is the great glory of the sun that it possesses the power to spread and unfold its rays so widely that it not only illuminates stately halls, but also throws a friendly light into the poor man's hovel, and quietly and secretly penetrates through the chinks of the wall to alleviate the pains and horrors of the dungeon. The application of this image to gold might appear almost exaggerated, but in reality, the extraordinary ductility of this metal admits of a diffusion which allows even the poor and the poorest to rejoice in the sight of its lustre and its sunny colour. There are, doubtless, thousands of persons who have never seen a diamond, a sapphire, or other precious stone, but there is hardly *one* who does not know what gold looks like. When we reflect upon its wide diffusion in gilding and gold-painting, on innumerable familiar objects, in rings, needles, ornamental chains, and stuffs, on glass and porcelain, in printing and painting, in spangles and other little ornaments, we see at once that it has in this respect been long common property of all the world. It is a common saying that a horse and its rider can be gilded with a ducat; but the extensibility of gold is far greater than this, and, in fact, is almost without a definable limit. A grain of gold, which is not even as large as the head of a common pin, can be drawn out into 500 feet of wire, and gold is beaten into leaves which are not more than a two-hundred-thousandth part of an inch in thickness. But this is exceeded when a silver wire is gilt and then drawn and rolled out. By this means the gold may be obtained as so delicate a film that its thickness does not exceed the twelve-millionth part of an inch. The ductility of gold was known, naturally enough, to the ancients, and they were acquainted with the practice of beating out gold into leaves and gilding therewith wood, stone, and other substances, as is related by Pliny; the gold-beaters of the present day, however, carry the fineness of the leaves to three times the extent the Romans could. Silver is highly ductile, though far less so than gold; platinum is inferior to silver.

With these properties of the precious metals are associated, in the cases of gold and silver, the well-known beautiful colours, and in that of platinum an infusibility in ordinary fires, of which we shall speak hereafter.

The noble metals are likewise heavier than most of the ordinary sorts, gold and platinum being more than nineteen times heavier than water, and silver somewhat more than ten times. To explain this differently, a vessel of water weighed, and then filled up with gold instead, would weigh nineteen times more in the latter weighing. This considerable weight facilitates the collection of these metals when they have to be separated from stones and sand by washing, for few of the earths and stones are more than three times as heavy as water, and they are readily washed away by the water, while the noble metals remain lying at the bottom.

Taking all these characters together, it will be perceived that the precious metals are gifted with pre-eminence in many respects, and since, while very generally distributed, they never run in too great quantity, they have in this way acquired a still more exalted value. When we ask as to the antiquity of these nobilities, gold and silver at least shine in this respect, for they are the oldest metals, or, to speak more correctly, are the metals which have been the longest known to man. They owe this especially to their antipathy to rust, the tendency to appear in a state of independence, or to the easy manner in which the metal is obtained.

A piece of gold or silver, pure as it so frequently occurs, could not remain unnoticed by mankind; the property of malleability and ductility would readily lead to its being worked; and if Adam took even a little trouble about the mineral kingdom, he must have become acquainted with gold, for it is especially mentioned in the history of the Creation.

Silver is also of the highest antiquity, and a weighed quantity of silver was used as a trading medium even in Abraham's time; and both metals are many times referred to in the histories of the ancient Egyptians, Phœnicians, Indians, Chinese, Greeks, and Scandinavians. On such occasions they are always spoken of as standing in honour and respect. Thus the Greeks made the drinking-cups from which they poured the libation in swearing their oaths to the Greek deities, of gold; and the shield of Hercules, celebrated by one of the oldest Greek poets, Hesiod, was made with great art of gold and silver. In the songs of Orpheus, of the army of the Argonauts (whose Golden Fleece is as well known as the Golden Calf of the Bible, or the Golden Roof in Innspruck), in these songs, the wrestler Anchæus wins a golden drinking-cup in a match; Hercules gains a silver pitcher, as a boxer; and Castor, a golden horse-equipage, for his skill in riding; the Gods wore golden crowns; the apples of the garden of the Hesperides were of gold; Jupiter himself appeared once under the form of a shower of gold, &c. Sappho called gold the son of Jupiter, and said that it possessed absolute rule over men, which is certainly very true. It is also mentioned as sacred to Apollo.

Among the ancient Persians the seven gates of heaven were of metal, the sixth being of silver, and the seventh of gold. They were also frequently compared with the planets and the planetory signs attached to them. Hence gold obtained the mark of the sun, silver that of the moon; and of the common metals, lead was denoted by the sign of Saturn, tin by Jupiter, copper by Venus, iron by Mars, and quicksilver by Mercury.

The noble metals, and especially gold, are mentioned in an interesting way in the Northern Sagas and poems. In the song of the old Edda, called Völuspa, the Seeress Vala says that strife first arose among men when they dug up gold and burnt it in the high hall, and they burnt it three times without destroying it. This evidently indicates a fusion and refinement of the gold, and it is easily conceivable how strife could arise through this. Adding to the foregoing that the ancients distinguished a golden, silver, brazen, and iron age, and the first was most celebrated in poetry, we have another proof of the honour in which gold was especially held; and it is truly noteworthy, that according to all Ovid's descriptions, the golden age was that in which mankind really troubled themselves least about gold, which agrees with the passage quoted from the Edda, inasmuch that there also strife and hostility among men were supposed to have originated with gold and money. But it is well known that the estimation of gold and silver increased greatly in later times; and since the experiments of the Seeress of Prevorst showed that in her magnetic condition she had an unmistakeable inclination for gold, which caused her to experience most agreeable sensations, the avarice of those who heap up gold in the form of sovereigns becomes to a certain extent justified; and if the law were not so narrow in its views, and only took notice of such experiments, a thief who stole a gold snuff-box would be punished much more lightly than one who stole pinchbeck, for he would soon learn to explain that he had taken the box in a magnetic moment.

The great value of gold, and the authority it has possessed at all times, is most clearly illustrated in the endeavours which have been made, from the earliest antiquity, to make it artificially, and alchemy is of equal interest in the history of gold and in the history of men. I will therefore relate here some passages concerning it.

Fancy how a man would rejoice if he could make fine pearls by transformation of pease! A sackful of pease would buy one a principality, and even when *all* pease could not be made into pearls, one would be rich enough with a *few* well-disposed ones, and would no longer have to trouble about getting on in the world, would no longer have to work, or at most have only to do a little pearl-manufacture now and then. This would be a glorious state of things, and in order to make it still more so, there must be a restriction that only certain persons could do the same; there must be a fairy-tale mystery in the matter, revealed in a happy hour by an angel who had a sympathy with one, who in his good nature never considered what becomes of a man who is given up to nothing but speculation, idleness, &c. Or it must be arrived at by unheard-of labours, by fasts, prayers, and self-denials, through which one passes finally to rest upon one's laurels, or pearls, and enjoy one's happiness. It is only needful to speculate a little in this way, and apply such dreams to gold, and we may soon form an idea of the attractiveness of alchemy, for what I have just supposed with regard to the making of pearls was actually believed in with regard to gold-making. The exciting task was to convert common or cheaper metals, such as lead, copper, tin, quicksilver, &c., into gold; mystery and miracle could of course not fail to form part of the means to such an end, and the imagination wandered over a region which it was as unwilling to leave, as a poor enthusiast in a fairy-tale is to part from a beloved princess, even when there is no prospect of gaining her. "It might be so for all that; who can call it absolutely impossible?" &c. With this kind of argument hope was kept actively alive, and the great work was pursued only the more actively when opposed.

The first traces of gold-making, or, to speak more respectfully of it, alchemy, or the hermetic or spagiric art (from *σπαειν*, to separate, and *ἀγειρειν*, to unite), appear to be of Egyptian origin, and a fabulous Hermes Trismegistos is said to have been the founder of it, about two thousand years before the birth of Christ. But the earliest distinct accounts of it date from the fourth century of our era. The art came from the Egyptians to the Greeks and Alexandrians, and subsequently to the Arabs. In the thirteenth century it was already diffused in Spain, France, England, and Germany; and in 1700 it was pursued everywhere, although becoming more and more suspected and attacked by the science of chemistry, then budding forth. A story is told, also, of a Danish king who lived before the Christian era, that he had two handmaids, one of whom could make gold, the other silver. The most important point in the alchemical creed was, that there existed a substance having the power of converting the base metals into gold; this substance was called the Philosopher's Stone, the Great Elixir, or Magisterium, and of course the first object was to make this. Wonders were not wanting respecting this stone; it was also an universal medicine, and made the old young again; and Solomon Trismosin assures us, in a treatise entitled "Aureum Vellus" (1490), that it would be easy for him to keep himself alive by the help of this stone, long enough to behold the last day. He certainly has not done so, but the power of the stone was made good so far that several persons are said to have lived to an age of 300 or 400 years by its help. Other qualities of the stone are also mentioned, and it is certainly a praiseworthy characteristic, that when only an inferior sort was obtained, incapable of making gold, it still had the power of producing a transformation into silver. The actual operation of the transformation was very simple;

the most that was required was the fusion of the base metals, then a little of the stone was thrown upon it, and all was finished. The stone had exceeding strong power of transmutation, for one part by weight of it would ennoble a million parts of metal, nay, according to some, very much more.

But how was this wonderful stone obtained? from what materials, and how was it fabricated? The alchemists assure us that there were many difficulties in its preparation. Many of the older of them lay down a divine call and destination as a fundamental condition, the possession of which, however, no one doubted, who wished to make gold; it was further assumed that the stars exerted an influence over the work, and in spite of the pre-conditioned piety, they not unfrequently availed themselves of the assistance of lesser demons and devils, whom they knew how to catch and imprison, in some way or other. The majority, however, especially in the later times, relied more upon earthly means, and smelted, boiled, and distilled with the most diverse materials, in every conceivable way, in order to arrive at the stone. There were, indeed, many "Guides" to the fabrication of it, but unfortunately, those of them which were written clearly never yielded an available stone, and those that were written mysteriously, of course, were not understood. Nevertheless, the latter were highly valued, for it was thought, *whoever* could understand them would gain the stone; and so the black mystic leaves would here and there grow brighter, and a bud of hope glance out, stimulating to fresh study. The titles of such works give an idea of the obscurity of the contents. In 1649 appeared "A Master-key to the opened Fatherly Heart of Philosophy," and at the same time a "Childbed of the Philosopher's Stone;" others in 1700 bore the titles of "Philosophical Field-sports and Nymph-catching;" the "Brightly-shining Sun in the Alchemical Firmament of the German Horizon;" "Chymical Moonshine" (Frankfort, 1744); "The Chymical King in his Robe of Purple" (Frankfort, 1725), &c. Many of these little treatises were very cheap, and did not cost more than a sixpence.

These books, while recommending the method of one alchemist, took the opportunity to launch out against the proceedings of others. Thus, in the "Hermetic Garland," Artephius is recommended; while of others it is said:

Many a process Lully gives, but when they're all completed
No end we gain, but all in vain, of time and means we're cheated,
While Geber* gives us little enough that can be turned to service, &c.

Then we find such passages as "If you are not altogether too stupid, or do not wish to climb too high, this little book will teach you." The mysterious way of writing arose partly from the belief that it was sinful to publish these things openly, or indeed might be the cause of death, or that it would not have the true consecration. Hence Wilhelm von Schröder, a distinguished alchemist (1684), says, in his "Necessary Instructions for Gold-making," that when philosophers speak clearly and openly, a deceit lies behind; but when they speak enigmatically, they may be depended on. Philosophers have kept this maxim to heart in some degree up to the present day, so as to avoid such suspicions.

In the full descriptions of the mode of preparing this stone, numerous preparatory processes are mentioned. Thus a philosophic quicksilver, or mercury, must be made, and also a philosophic gold. These were mixed and exposed to a gentle heat, in vessels of particular form; they then yielded a black substance, called the *raven's head;* a continuation of the heat caused this substance to assume a white colour, and it was now called the *white swan;* and if the heat was kept up, the substance would become yellow, and finally red, and then the stone was made in its highest perfection. Of course the first material, the philosopher's mercury, was sought for before anything else, and many thought it was contained in quicksilver, others in antimony, in Roman vitriol, in dew, in snow-water, &c. Others again sought after it in toads, snakes, lizards, in plants of all sorts, and in the human body, in hair, blood, &c. The matter became still more unholy through the intermingling of mystical views, in which some went so far as to regard the metals as endowed with life, and even a soul was attributed to gold. But the spirit of alchemy was chiefly maintained and diffused by numerous instances

(* Gebir was a renowned Arabian chemist of the eighth century: there is a play upon the name in the original: Geber is jingled with *geben*, to give.—Ed.)

of gold-making of this kind, which became known from time to time. Thus, money was soon made of alchemical gold, such as the English rose-noble, the gold for which was made by Raymond Lully, in the thirteenth century; and the Danish ducats of 1647, the materials for which were made under the orders of King Christian IV., by his court alchemist, Caspar Harbach. So under the Emperor Ferdinand III., 1648, a large medal was struck in such gold which had been obtained in the emperor's presence by the transmutation of quicksilver. This transmutation was effected by means of a red powder, which had been given to the emperor by a person named Richthausen. In like manner ducats were struck under the Landgrave, Ernest-Lewis of Hesse Darmstadt, out of gold said to have been obtained by the transmutation of lead; and the species dollars of 1717 were of such silver.

The principal followers of alchemy were physicians and monks, and they soon found believers among princes, especially among those who could spend money, and these were numerous. In the thirteenth century, Alphonso X., King of Castile, was called an alchemist; Henry VI. of England (1423) issued several decrees encouraging the study of gold-making, in order to obtain means to pay the debts of the state. Edward IV. of England, in 1476, accorded to a company a four years' privilege of making gold from quicksilver. The Emperor Rudolph, who ascended the throne in 1576, was an especially active patron of this art, as was also the Elector Augustus of Saxony, who lived about 1560, and had a laboratory of his own in Dresden, which was called by the people the Gold-house; this taste was shared by his wife, Anne of Denmark, Duke Ernest of Bavaria (in the seventeenth century), Henry Julius of Brunswick, the Emperor Leopold I. (1658—1705), and some others. The degree to which crowned heads attached themselves to this subject is well shown, among other evidences, by the fact that an Austrian, named F. von Rain (about the year 1680), deduced that those who doubted the existence of the Philosopher's Stone were guilty of lèze-majesté. At the same time, there were others who did not lay so much stress upon the matter, and Pope Leo X., to whom an alchemist, Augurelli, dedicated a poem on gold-making (in 1514), sent the latter, in recognition, an empty purse, with the intimation that a man who was master of such an art, could only be in want of a purse to receive the gold he made. In the commencement of the seventeenth century, societies and unions were formed for gold-making; among them was the brotherhood of the Rosicrucians, which endured for more than a hundred years, and counted members in Germany, Holland, France, England, and Italy; also the Society of the Rose, in the south of France; the Nuremberg Alchemical Society, of which the celebrated philosopher Leibnitz was an active member, &c.

Now, although there are sufficient examples of gold being made, in which no deceit could be discovered, or which no one was able to expose, there are incomparably more cases in which deceit was exposed; and notwithstanding that a few alchemists were able to hold out, at least for a time, and became distinguished in various ways, like the above-mentioned Richthausen, who was created *Baron of Chaos* by the Emperor Ferdinand III., most of them made but a poor work of this business. The fate usually undergone by those who were convicted of deceit, was that of being hung in a dress covered with tinsel; others, from whose art something was expected to be gained, were seized and shut up, to make gold, and since they produced nothing, and their captors often had a more implicit belief in gold-making than themselves, they were tortured and ill-treated in every conceivable way, in order to make them exercise or reveal their art. This treatment fell to the lot of a certain Setonius, under the hands of the Elector Christian II. of Saxony, in 1603, and about the same time, the Emperor Rudolph II. behaved in a similar manner to one Güstenhöfer, a goldsmith of Strasburg, who had made a specimen of gold with a stone given to him, and was totally ignorant of the mode of fabricating the stone. Frederic I. of Prussia and the Elector Augustus II. of Saxony (King of Poland) pursued and imprisoned in a similar way the well-known Bötticher, who only at last saved himself by the invention of the Meissen porcelain; and even as late as 1746, a supposed alchemist, named Sehfeld, was imprisoned and tortured by the orders of the Empress Maria Theresa, to make him disclose his mystery, but he at last escaped, and disappeared without leaving a trace. Hence, alchemists were almost always moving from place to place under changing names, making a little gold here and there, selling their stone at as high a price as possible, and hurrying away to do the same elsewhere. Numerous instances are also recorded of the murder of alchemists who were supposed to have possession of the miraculous stone, in order to rob them of the treasure, &c. But the majority of them reduced themselves to poverty, by their quiet and secret labours, and sunk miserably to the grave; and when we trace out the entire history of the strange spirit, which endured more than a thousand years, and see how self-interest, passion, deceit, stupidity, madness, and superstition, have abode with it, it presents itself as a gloomy picture, but one altogether unique of its kind. It would lead me too far to enumerate here all the different errors and deceptions which must have arisen from so powerful a faith in alchemy; I will merely mention that conversion of the metals, generally, was regarded as possible; that gold was supposed to be made when it was obtained from other metals which actually contained it, without any one reflecting, or being willing to suppose, that the deceiver had the cleverness to introduce gold in some way or other into the crucible containing the metal to be ennobled; and that much deceit must necessarily remain undiscovered, from want of chemical knowledge. Thus it might, indeed, have been a true statement, when Hortulanus said of the production of the philosopher's stone: its father is the sun, that is to say, *gold;* its mother is the moon, or *silver*. Dr. H. Kopp has given a detailed history of alchemy in his history of chemistry.

It may be asked, however, whether it is really quite made out that gold cannot be made artificially. My answer to this is: that the impossibility of making gold out of substances which do not contain it, only holds on the assumption that the elements at present known are actually incapable of chemical decomposition; but the improbability that we shall arrive at other elements, and these such as may enable us to make gold, is so very great, that a man may as well go hunting over hill and dale for a bag of sovereigns, and will find one sooner than he will this art.

In the foregoing we have spoken of some of the general characteristic peculiarities of the noble metals, and we will now enter into their more special description; proceeding, in the first place, with gold.

The form in which native gold appears is rarely a distinctly regular crystalline one, but its crystals are mostly indistinct and blended with little plates, spangles, and threads; or it occurs in compact rounded fragments or lumps. It is soft like silver, softer than copper, and fusible without difficulty. When it exists in its original matrix in the primitive rocks, such as mica-schist, gneiss, syenite, clay-slate, &c., or in the superincumbent transition formations, or porphyritic and grauwacke-like rocks, it appears in slits and veins traversing the rocks, mostly only sparingly, in thick laminæ and moss-like efflorescences; or it is sprinkled through the substance of the rock, often so finely that it is imperceptible to the eye, and the contents of the rock are first brought to light by the stamping and washing, or by the process of amalgamation mentioned above. Sometimes also it is mingled with other ores and gravel; it is besides almost always accompanied by quartz, pyrites, and brown iron-ore. It occurs thus in Hungary and Transylvania, and has been collected in certain places for several centuries, chiefly at Kremnitz, Schemnitz, Posing, and Magurka; but also at Nagvag, Salathna, and Offenbanva. These mines yielded more than 3000 lbs. of gold in 1838. Besides these, other mines in Europe, as in the Hartz, in Salzburg, Zillerthal, Piedmont, Sweden, and Ural, yield gold, though in comparatively very small quantity; the Hartz, for example, yielding only about 5 lbs., Sweden only about 8 lbs. annually. Small quantities are found in Cornwall, Devon, North Wales, Scotland, and in the Wicklow mountains in Ireland. The greatest quantity of gold is found in alluvial land, and in the sands of rivers, both in Europe and in other quarters of the globe, and from them it is obtained by washing and decantation. The occurrence of gold may be said to be universal; but with the exception of the Ural, few gold-washings of Europe give much profit. The collection of gold in the sands of the Rhine has been carried on since the seventh century, and yields at present, between Basle and Mannheim, about 1800*l.* worth of gold. But in the Ural, in the province of Catherinenburg, about Schabrouskoi, Beresovsk, Nischne-Tagilsk, &c., the gold-washing yielded, in the year

1842, 632 *pud*, or more than 18,000 lbs. of gold. At the same time, the auriferous sand is often so poor, that the richer beds do not yield more than 1 lb. to the ton. But the simple way in which it is separated ensures an abundant return, since the value of the gold amounts to twice the cost of extracting it. Sometimes it happens also, in these washings, that a large lump is found, which more than covers all losses. In the collection of the mining corps of St. Petersburgh are kept lumps of gold weighing 9½ lbs., 11½ lbs., and 18 lbs.; and in 1842, when they were removing the washing-sheds in Tzarefva-Alexandrofsk, to pitch them in another spot, as the soil beneath them was being thoroughly turned over, a labourer struck his pickaxe into a lump of gold, in which the iron remained sticking, and thus was discovered a mass weighing 64 lbs. A pound of gold is worth about 50*l*.

The gold-washing of Russia is carried on partly by peasantry, who voluntarily apply themselves to it, and partly by prisoners and criminals, the less guilty of whom are compelled to dwell in villages, and support themselves by their daily labour. The owners of the land make contracts with them in the presence of the magistrate, and they are then transported to the place of their destination. In 1842 there were no less than 11,000 of these unhappy creatures in Eastern Siberia alone.

The gold which the labourers collect on the Friday of each week belongs to themselves, but they are compelled to deliver it up to the landlord at a fixed price, which is below the actual value. Opportunity is thus afforded of paying over as ransom-money gold which has been concealed in spite of the rigid supervision; and thus, in any case, it is not lost. The hope of finding rich beds of auriferous sands gives rise to a continual despatch of expeditions, which sometimes have to contend with great hardships, and in very many instances return home poorer than they set out. Thus, in the years 1841 and 1842, 350 expeditions were sent out in the department of Jeneseisk into the *Taigas*, as the dark forests covering the flat plains are called, and not one of them met with a single bed of auriferous sand. When one is discovered, notice must be given to the government, and then the finder receives the right to work it for twelve years under certain conditions. The hardships and dangers of this cold desert, contrasted with the sight of the gold acquired, very often excite in the contractors and their officers such inclination to indemnify themselves for their sufferings, that a reckless way of living prevails at these mines, and in the year 1844, 150,000 bottles of champagne were consumed in the department of Jeneseisk alone. The labourers too, on their part, when paid and dismissed, mostly dissipate their wages in brandy, in the first spirit-shop they find, and often return to their work in the greatest misery; thus does a more or less considerable degree of luxury develop itself even at those lonely sources of the gold which gives rise to it. The auriferous alluvial deposits of the Ural were discovered in 1819; those of Siberia in 1829. The return rises from year to year, and being in 1829 only 314 *pud*, in 1847 it amounted to 1772 *pud*. The produce of gold from the Ural and Siberia, since the discoveries in 1819 and 1847, has amounted to a total of 14,335 *pud*, which is nearly equal to 250 tons. To this must be added the gold from the mines of Altai.

The annual product of America amounts to more than 17½ tons, and Mexico, Columbia, Peru, Chili, and Brazil, are amply celebrated for their wealth in gold. The gold is partly found imbedded in rocks, but for the most part in sandy ground; and it is said that a mass weighing 45 lbs. was found at La Paz, in Bolivia, in 1730; and one of as much as 2560 lbs. (?) at Bahia, in Brazil, in 1785. A lump weighing 38 lbs. was found in the alluvium of the Alleghany, in North Carolina, 1821. The East Indies, China, and Japan, likewise yield much gold, as also Nubia and Senegambia.*

History gives us many testimonies of gold having been much more plentiful in former times, and many countries were famed for the richness in gold which now produce little or none at all.

(* The discovery of gold in California, and still more recently in Australia, has thrown all other gold districts into the shade, at all events for the present, and has given rise to much discussion as to the probable influence on the value of the metal as a standard of currency. It would lead us too far to enter into the many accounts of these discoveries and their results; moreover, there is much difficulty as yet in drawing any general conclusions respecting the facts. We shall not dwell upon them here; and this is rendered the less necessary by the fact, that almost all that could be said here has become familiar to every one from the general attention which the matter has excited.—Ed.)

It is stated that David collected more than 15,000 quintals of gold for the Temple at Jerusalem, and that Solomon obtained [illegible] quintals annually from the rich mines of Ophir, which some suppose to have been Ceylon, others Pegu. The Roman treasury then contained more than 15,000 quintals of this precious metal, under the Consuls; and Spain, in particular, is mentioned as an inexhaustible mine of gold and silver. These metals attracted the Phœnicians thither, from 1100 B.C., who soon founded colonies there; and these treasures gave rise to the long-enduring wars, and the subjugation by the Carthaginians and the Romans. In those times the Spaniards were the victims of the same ill which they inflicted upon the Americans in 1500; and when we read the horrors of the discovery of America, we are struck by the strange fatality, that the forefathers were compelled to atone beforehand for the sins of their descendants.

Italy was also celebrated for the gold of its rivers, and Greece, Egypt, and Arabia, were famed for gold. There was such superabundance among the Persians, that it was sang of them that their weapons, their shoes, and the *bridles* of their horses, were of gold.

Such abundance in past times is explained, like its disappearance in the present day, partly by the manner in which it occurs, and partly by the extensive means which were applied to the collection of it. The rivers and sandy plains were then searched for the first time, and thousands of men were employed upon the work. The soil in which it was hoped that gold might be found, was investigated in every possible way, hills and mountains were undermined and made to fall in, by excavating so as to leave supporting masses which were subsequently removed, when, as Pliny relates, the mountain fell in with a great crash and rushing of wind, and the ruins were then searched for gold. Rivers were frequently diverted several leagues in artificial channels, for washing the rock. Brushwood was placed on the terraces down which the water was caused to flow, in order to retain the gold, and then was afterwards burnt. We have many instances of the melancholy fate of prisoners and criminals under the kings of Egypt, by whom they were condemned to such labours, compelled to seek and search the rock, day and night, chained in gangs, without regard to age or sex, sickness or infirmity, under the stripes and ill-usage of their overseers; and we know how they longed for death to end their sufferings. Among the Greeks, also, the slaves worked in chains at the mines, and the Romans treated theirs no better in Spain; and when we reflect how the thirst of gold, accompanied by barbarity and cruelty, has made its home in the Old and in the New World, how this metal has served for countless bad as well as good purposes, we may fairly say that it has certainly been cursed and detested by quite as many as have longed and prayed for it.

The Greeks were so greedy of gold, that the Athenians, when they heard, once upon a time, that gold had been seen in Hymettus, watched by quarrelsome ants, hurried towards the mountain to commence the combat; but in this campaign they found nothing, and were ridiculed, on their return, by the more sensible. Next to them, the Romans were the most covetous of it, and every country, every obscure corner, was considered hostile, and must be conquered, if its earth contained gold.

Gold, as it is met with in nature, is seldom without an admixture of silver, and the proportion of the latter varies from a few tenths to 36 per cent. and over. It is, of course, important to separate this metal accurately, and I shall speak of this separation under the head of Silver. There remain a few points to be mentioned concerning the applications of gold in the arts. The working of the pure metal, gilding by the application of plates or beaten leaves of gold, was more or less generally known among the ancients, as already stated; they were also acquainted with the practice of recovering the gold from old embroidered clothes, which were burnt, and the gold removed from the ashes by quicksilver; the use as a means of commercial exchange is likewise of the highest antiquity, but the earliest money occurs only 600 years before Christ, and the older coins of Greece and Asia Minor are of gold and silver, while the oldest Roman are of copper. The subsequent and still-existing methods of gilding glass and porcelain, consist in laying on gold, which has been prepared in a finely divided state by chemical means, in combination with suitable flux, and burning it in, the gold is then polished by means of burnishing. The gilding of silver, copper, brass, &c., is mostly effect means of the compound of gold and quicksilver, called gold amalgam, which is spread over the metal after it has been well cleaned, and heat being applied, the quicksilver is evaporated, and the gold adheres to the metal. This is called fire-gilding, and the vapours of quicksilver produced in the operation are pernicious to the workpeople. There are other methods, in which finely divided gold is mechanically applied and polished, and galvanic gilding in particular has recently become of especial importance. By this means articles of silver, brass, copper, &c., can be gilt in a few minutes, and by no other means can so thin a coat be given; this coat, forming, as it were, a mere breath of gold, is soon worn off, but when the objects are not exposed to friction, it answers the purpose completely.*

The preparation of gold called "gold-purple," or "purple of Cassius," is of important use in the painting of glass and porcelain. It was first described by Andreus Cassius, in 1685, and applied by an alchemical chemist named Kunkel to the manufacture of red glass. It is formed as a purple precipitate when diluted solutions of gold and tin are mixed; but the preparation of a good article requires many precautions. Ruby glass, which has again been manufactured recently of exceeding beauty, owes its colour to this compound of gold.†

Gold may be easily united with other metals by fusion, but only the combinations and alloys with silver and copper are of importance. These metals, when added in certain proportions, give gold a greater hardness, without injuring its colour, and such alloys are used both for coin and for goldsmiths' work. The proportion of gold is expressed in carats. A mark is divided into 24 carats; and if 24 parts of the gold (alloy), for example, contain 10 parts of the foreign metal and 14 parts of gold, the gold is called 14 carats fine; if it contains two parts of the foreign metal and 22 of gold, it is 22 carat-fine gold, &c. Alloys of gold with copper

* It is stated by Mr. Hunt, that the consumption of gold-leaf in the arts in Birmingham alone, amounts to 1000 oz. weekly, and in London to 400 oz., of which it is said that not one-tenth is recovered. For gilding by electrotype, or water-gilding, more than 10,000 oz. are used annually.

† The consumption of gold in the Staffordshire potteries, for gilding and making crimson and rose colours, varies from 7000 oz. to 10,000 oz. per annum.

are of deep yellow or reddish colour, those with silver, pale-yellow, greenish yellow, or whitish. Alloying with copper is called red carating, with silver white carating, with both metals, mixed carating. Ordinary gold-plate, &c., is 14 carat (with copper alloy), inferior kinds often only 6-8 carat gold. English gold coin is 22 carats fine, the Dutch ducats are 23½, the Austrian 23¾.

Other metals added to gold in very small quantities, change its colour or malleability, as, for instance, platinum, bismuth, lead, brass, &c.; with iron it yields a malleable alloy of grey or whitish colour.

In roughly estimating the carating or proportion of gold in alloys, the metal is tested on the touchstone, with what are called the trial-needles. The touchstone is a black siliceous stone, ground smooth, across which the needles are scratched; the needles are made of various alloys, with silver and copper, of known composition. A streak is made in the touchstone with the gold to be tried, and streaks are then drawn beside it with various trial-needles, and similarity of colour is taken as the proof which needle the tested gold alloy approaches nearest in composition.

Silver, when it occurs pure in nature, is found in similar forms to those exhibited by gold. They, however, are but rarely distinct crystals, mostly presenting themselves in variously twisted and combined threads, little plates, moss-like patches, and little fragments imbedded in the rock. Capillary pure silver often occurs in considerable abundance, filling crevices and little hollows; and from some of them, several yards long, more than 20 lbs. of capillary and wire-like silver have been taken out, as at Schneeberg in the Erz-gebirge, where capillary silver is sometimes extracted by what is called the "barrel-process," a mode of amalgamation with mercury, by means of agitation in large barrels. Stout wires of silver are met with 12 to 16 inches long, and dendritic, or shrubby masses, as much as 10 inches high.

Pure silver mostly occurs in undisturbed primitive rocks, in granite, gneiss, mica-schist, &c., and not like gold, in sandy tracts; at least it is seldom found in such places.

The preparation and smelting of silver from its pure ores is also very simple, and the extraction is only connected with difficulties when the silver ores are mingled in small quantity in other ores or in quartz. The richest silver-mines in Europe are those of the Erz-gebirge, of the Hartz, Kongsberg in Norway, and Spain. The most celebrated mines of the Erz-gebirge are those of Freiberg, Schneeberg, Johann-georgenstadt, &c., and masses of pure silver weighing as much as 100 lbs. have been found in these. The value of a pound of silver amounts to 3*l.* 11s. 6d. Very pure silver is met with at Kongsberg, and masses of it weighing even 560 lbs. have been met with. The Altai is likewise very rich, in the celebrated Schlangenberg. The average quantity for the last fifty years amounts to more than 350 lbs. per annum. But the produce of Europe, together with Asiatic Russia, is far surpassed by that of South America. This continent furnishes annually, from Mexico, Peru, and Chili, about 5000 tons, while the former do not give one quarter of this quantity. The wealth of these countries in silver appears to be so great, that to all appearance there remains still much more untouched than has yet been obtained. A silver vein in the mines of Zacatecas, in Mexico, called the Veta Grande, has yielded more than the value of 6,000,000*l.* in silver, and is not yet exhausted. The mining operations in these countries are by no means carried on by rules of art, which, however, sometimes has its advantages; for example, the Conanza mine of Sombrerete was discovered through an error in the levelling, and the new vein yielded to its owners, the family Fagoaga, a product of many millions of dollars in a few months. A probable calculation shows that America has yielded a booty of gold and silver, from 1521 to 1842, of the value of 4,000,000,000 of dollars (about 800,000,000*l.*).

Silver likewise occurs frequently in combination with sulphur and other metallic sulphurets; and in this it is distinguished from gold, which very rarely occurs otherwise than pure.

Sulphuret of silver, which is also called *argentite*, is of a dark leaden grey colour, and may be cut and flattened out like lead, which renders it easily distinguishable from other similar ores. It is composed of 13 parts of sulphur and 87 parts of gold, and globules of silver may be readily fused out of it with the aid of soda, or charcoal before the blowpipe. Compounds of sulphuret of silver with sulphuret of antimony, and with sulphuret of arsenic, are likewise met with; and to these belong *stephanite*, or brittle sulphuret of silver, and the *silver-blendes*, or *pyrargyrites*.

Stephanite is of iron-black colour, and retains this colour in powder. It is soft, but is not cleanly cleavable like argentite. It is composed of sulphur 15.7, antimony 14.0, and silver 70.3 parts. The antimonial silver-blende or dark pyrargyrite, varies from dark crimson-red to lead-grey colour, but the powder is crimson-red, and it is thus easily distinguishable from stephanite. It contains 17.5 sulphur, 23.5 antimony, and 59.0 per cent. of silver. The arsenical silver-blende, or light pyrargyrite, is of a brighter cochnical-red colour, and is sometimes met with in very transparent crystals. When fused on charcoal, it emits the garlic-like vapour of arsenic. It is composed of 19.5 sulphur, 15.1 arsenic, and 65.4 silver. These ores occur in crystalline masses, with pure silver, and beautiful varieties are found, especially in the Erz-gebirge, at Markirch in Alsace, in Schemnitz and Kremnitz in Hungary. Sulphuret of silver often exists in small quantities in lead-glance, or sulphuret of lead, as in Saxony, in the Hartz, &c. Stephanite is one of the most important silver-ores of America.

It has been mentioned already that silver-ore is obtained from argentiferous lead, by refining. The ores of silver just named are fused with argentiferous lead, or the silver is extracted from them by amalgamation. In the first instance, they are mixed with common salt, and heated in a reverberatory furnace with the access of air, by which means the greater part of the sulphur, antimony, and arsenic, are removed, and chloride of silver is formed. The ores roasted in this way are next pulverised, and whirled round in barrels with water and metallic iron for several hours, during which operation the chlorine becomes united with the iron, and the silver is separated in a very finely divided state. Quicksilver is then added, and the barrels again made to revolve rapidly for fourteen or sixteen hours, through which means the silver is taken up (amalgamated) by the quicksilver. The quicksilver is then made to pass through bags made of ticking, which retain the richer amalgam, from which the silver is then separated, as was mentioned above, by the application of heat. This process is carried on in such a manner that the quicksilver is not lost, but collected and used over and over again. The chloride of silver spoken of in these processes is also met with in nature, occurring in large masses only in Mexico, Peru, and Chili. It has not at all a metallic aspect, but sometimes resembles translucent horn; hence it is also called *horn-silver*. It is cleavable, and may be readily reduced on charcoal before the blowpipe. It remains to be mentioned of this compound that it is always prepared artificially, when quantities of silver are to be estimated in solutions. Solution of common salt or hydrochloric acid is added to the liquid containing the silver, and as both these substances contain chlorine, a white precipitate of fixed composition is obtained (24.7 chlorine and 75.3 silver), which is chloride of silver. Freshly prepared chloride of silver has the property of rapidly assuming a blue colour, subsequently gradually becoming black, under the influence of light, which has been taken advantage of in photography.

Spain was still more extolled by the ancients for its silver than even for its gold, and it was said of the river Guadalquivir, that its sources sprang from silver roots. The Phœnicians found such a mass of it there on their first voyage, that the ships would not hold it; and so, in order to carry as much as possible away, they made even their anchors of silver. Spanish silver enabled Hannibal to carry on the sixteen years' campaigns of the second Punic war against the Romans; and when the latter were masters of Spain, the mines of New Carthage (Carthagena), which were worked by 14,000 men, yielded a daily produce of 25,000 drachmas. The Romans had an especial preference for silver, and Pliny relates that there were in Rome more than 500 silver basins, each of which weighed 100 lbs., and that a certain Drusillanus possessed one weighing 550 lbs. He speaks of silver cooking utensils, couches, cars, and statues. The ancients were also able to apply a silver coating over copper money, and thus were in a certain way acquainted with the modern art of plating.

It has been stated already, when treating of gold, that this almost always contains more or less silver; and experiment has taught us that silver not unfrequently contains small quantities of gold. Silver from the ores of the Ural and Altai contains ½ to 3, and more, per cent. of gold. Several methods are used to separate and collect this gold, of which I will mention simply the separation by sulphuric acid as the most advantageous. The silver is heated with this in cast-iron or platinum vessels, and dissolves, leaving the gold behind; for silver is not so refractory as gold to this or nitric acid. To recover the silver from the solution, copper-plates are placed in it, and then the copper of these plates takes the place of the silver, that is to say, it combines, as an oxide, with the sulphuric acid which held the silver in solution, and so the latter is set free, and falls as a metallic precipitate. The solution is then evaporated, and a sulphate of copper or blue vitriol obtained from it, used, among other purposes, for recovering metallic copper, by means of the voltaic current. The same alternation of the plates is also made use of in coating one metal with another, and a great deal of gilding, silvering, or platinizing, depends upon it. This is, of course, connected with the conditions in which one metal exhibits a greater tendency or affinity to the solvent substance than the other; and it is especially remarked, that the noble metals readily give up such solvents to the baser metals, and set themselves free. When, for example, a small quantity of solution of silver is added to a solution of common salt, and a clean copper-plate is laid in the mixture, it becomes silvered in six or eight minutes, the surface of the copper becoming dissolved, and the silver of the solution taking its place. When the blade of a knife is dipped in solution of sulphate of copper, the steel is instantly coated with copper; and by an exactly similar process, the iron passes into solution, the copper being precipitated in its place. Such phenomena passed for transmutations of the metals in the days of alchemy, and certainly might be taken for such at first sight, when no inquiry into the circumstances and no minute investigations were made.

The advantages of the mode of separation just described have caused an enormous quantity, especially of old silver, to be treated in this way, and the gold extracted from it; in Paris alone, quantities worth 200 millions of francs were at first annually exposed to this operation, or affined, as it is called. More than 140,000 marks are separated annually in the mint of St. Petersburgh, and more than 100,000 also in Munich.

Of recent silver money, scarcely any now coined will retain gold. Thus has the search for and collection of gold increased; and many thousands of the *käsperle*, as they are called, have in this way been deprived of the gold they contained, which formerly rendered them worth something more than they actually passed for. This mode of separation is carried so far in Munich, that the atom of gold contained in the Coburg six-kreutzer piece, has been separated and made a profit of, although there exists only 1 lb. in 5000 lbs. of these "sechsers."

As silver, like gold, is too soft when pure to be enduringly useful in the form of coin or silversmiths' work, it is always combined, or as it is called, alloyed, with a proportion of copper. The proportions of silver in such alloys are indicated in the same way as in the alloys of gold. A certain amount of copper is contained in all silver money, varying in different countries; and in the silver for silversmiths' work is a certain alloy fixed by law, below which degree of fineness it is not stamped as *standard silver* by the public authorities.

The approximate valuation of alloys is effected, as with gold, by trying-needles on the touchstone; but accurate estimation is performed either by the "cupellation" with lead, already mentioned, on a small scale, or by chemical examination in what is termed the "wet way."

Silvering of metal, porcelain, wood, &c., is done, generally speaking, in the same way as gilding, by applying silver-amalgam, silver-leaf, or silver-powder in a suitable way. But when a thick coat of silver is to be placed on metal, it is done by *plating*, that is, a plate of silver is applied on the common metal, and a fusion of the contiguous surfaces effected in a strong fire, and then the piece of plated metal is rolled out and worked.

Some idea of the consumption of gold and silver in articles of luxury may be formed from a calculation given by Jacob, who estimates it for Europe at an annual value of about five millions and three-quarters sterling. How much of these precious metals must disappear by wear, leaving no trace! Would it be surprising to find traces of gold and silver in the soil of all human dwellings in the course of time? It is remarkable how a change of place, a circulation, as it were, is appointed for the inanimate or naturally immovable things upon the earth; and how new conditions, new creations, are continually developing themselves in this way. I will not enter here into the evaporation of water, for instance, from the widely-spreading ocean; how the clouds produced by this pass over into foreign lands, and then fall again to the earth as rain, and how this wandering water is, partly at least, carried along new journeys, returning after various voyages to its original home; the mere mechanical phenomena, such as the transfer of seeds by the winds or by birds, or the decomposition of the surface of the earth by the friction of the elements, suffice to illustrate this.

Whoever goes to Rome or to Loretto, sees plenty of brazen images, which, kissed by pilgrims, are soon worn away by this light contact of the lips, so as to be perfectly irrecognizable. In such statues it has been necessary many times to renew a foot, for instance, which it is the custom to kiss, and the sacred marble staircase of St. Salvatore, which was ascended by pilgrims sliding along on their knees, would perhaps have been demolished long since, if it had not been protected by a covering of wood. How circulating coin must be continually worn away by friction, the elements of the gold and silver being scattered throughout the whole world in invisible particles! What chemical or galvanic magic may one day collect them together again, to decorate the crevice of some rock with their brilliancy, or to raise some bed of sand to honour, we know not; but we are certain that they are not destroyed, although they may be lost to us.

With most other metals than copper and gold, silver forms brittle alloys, of which no use has yet been made. When a proportion of about one-five-hundredth is added to steel, it imparts great hardness and excellent quality.

Among the salts which can be prepared chemically, nitrate of silver, known by the name of *lapis infernalis*, or *lunar caustic*, deserves particular mention; it is used as a caustic, for indelible ink, and for dyeing the hair black. Silver is also used in many other processes, for example, in photography, in analytical chemistry, &c., which, however, we cannot afford space to enter into here.

We pass therefore, concluding this small series, to the third of the noble metals, *platinum*. It seems really not improbable that this metal was known to the ancients, for they mention a greyish-white metal as heavy as gold, when speaking of gold-washings, but they certainly were not accurately acquainted with it, for we have at the present time no certain accounts of its occurrence in any of the countries whence they derived metals. The first distinct mention of it was made by a Spanish geometer, named Don Ulloa, who met with it in Peru, during a scientific journey, in 1735, and by an English metallurgist, named Charles Wood, who brought it from Jamaica in 1741. It was next minutely examined by Scheffer, in 1752, who found that it stood next to gold in noble properties, whence he called it white gold; but the Spanish name, *platinum*, from *plata* (silver) and *platinja* (silver-like), has kept its ground. This remarkable metal, which is even heavier than gold, does not certainly equal the preceding metals in outward beauty, for it is of a light steel-grey colour, but it is distinguished in the highest degree by two qualities, one of which is, that, like gold, it is unaffected by most chemical agents, and the other, that it is infusible in the strongest heat of our furnaces and forges. In this last property it has even a great advantage over gold, for the chemist is very often obliged to expose substances he is testing to a fierce fire, and he would be unable to work accurately, or would even be at a stand-still, without he had a platinum crucible. When I speak here of chemists, and of the high value of platinum to them, I must observe, that this is in itself good ground for calling a metal precious; for, in truth, a multitude of new discoveries in the arts are connected with the fact that the knowledge and application of platinum have not only facilitated chemical analysis, but enabled it to arrive at far greater accuracy.

Platinum occurs in nature, like most gold, and always in its noble company, in sandy ground and in the sands of rivers; it has rarely been found in undisturbed rocks. It is chiefly met with in the form of little laminæ and grains, but occasionally in roundish pieces of considerable weight, and is collected, like gold, by washing. The greater part of this metal is furnished by South America and the Ural. In Brazil, New Granada, St. Domingo, and Peru, it has never been found in very large pieces; the largest, which is at Madrid, does not weigh quite 1½ lb. But plates of it weighing 10, 19, and 20 lbs., have been found in the sand-beds of

Nischne-Tagilsk, and since 1819, when platinum was discovered in the Ural, the quantity obtained, which at first was very inconsiderable, has risen, in many of the years, as in 1843, to 200 pud, or nearly 3 tons, and the total product since the discovery may be assumed as about 30 tons. From 1824 to 1834, platinum was already in use as coin in Russia, to a value of about 400,000*l.*; for this purpose the government were compelled to buy the greater part from private persons, as their own mines yielded but little. The estates of the Demidoff family are those which contain the greatest wealth in platinum. Perhaps this circumstance of the poverty of the imperial mines may have contributed to cause the recent abolition of platinum coin. Besides the countries already named, Borneo has been found to contain platinum, and it is said to have occurred in small quantities, sprinkled in other rocks, in France (Dep. de la Charente) and in Spain. But according to recent researches, platinum is pretty generally diffused in very small quantities; for almost all silver, or rather the gold which occurs with this, contains traces of platinum.

Platinum being so infusible, great difficulty attends the working of it, and had it not the capacity of being welded like iron, by the hammering together of fine particles at a great heat, little use could be made of it. The chief point, therefore, in the manufacturing of this metal, is to obtain it in a finely divided condition, and this is effected by a series of chemical operations which I will pass over here. When it has been finely divided, into the form termed spongy platinum, it is alternately pressed, heated to incandescence, and hammered, till it forms a coherent mass, which may then be rolled, or drawn into very tough wires, and is readily workable. The difficulties attending this treatment increase the price of worked platinum so much, that it is double that of the crude metal. A pound of native platinum costs about 10*l.*, and the value of silver, platinum, and gold, bear about the proportion of 1 : 3 : 15. Platinum is not only used for chemical utensils, such as crucibles, basins, retorts, and apparatus for distilling sulphuric acid, but also for watch-chains and such articles, and in the same way as gold and silver for coating or platinizing copper, glass, porcelain, &c. It is also used in the very remarkable instantaneous light apparatus invented by Dobereiner, very generally known as the Dobereiner lamp.

Thus, then, I believe I have presented the most essential and important facts relating to the noble metals, and shown that they rightly bear their title. Their history shows this unequivocally, and bears witness that under no change of outward aspect does inward value pass unobserved, but asserts it worth. It is true that under favourable circumstances, one can make a piece of paper prepared from old rags as valuable as a ducat, and a coward may be decked in knightly harness, and pass for a *preux chevalier;* but when it is required *to be* that which one seems, it is a very different matter, and such a paper or such a knight will not pass muster, but will soon show that the value of a thing or a person is not an illusory affair; and it cannot be regarded as a mere conventional arrangement when we call gold, silver, and platinum, *noble metals.*

IV.

THE ORDINARY METALS AND ORES.

What would our life be like if we had no iron, copper, lead, tin, zinc, &c., those metals which are excluded from the number of the noble? It would be a life such as is now only to be seen among the savages of a few obscure islands. This sounds strange, for accustomed as we are to the idea of the progress of the intellect, it is commonly forgotten that material means are necessary conditions of this progress, even as mould and insignificant earth are necessary for germination and development of the seed of a plenty-spreading grain or of a fair-blossoming flower. The possession of metals is a vital question, not only for science, industry, and commerce, but for the security and establishment of society, and for the embellishment of its existence. Without these metals, where would be our machines and instruments, our weapons, our agricultural and building implements, navigation, mining, and a thousand other things which have for centuries engaged, and do incessantly occupy, the activity of scientific intellect and industrial speculation? Poets alone free themselves from this constraint of material things; they alone break the fetters which chain all beings to the earth and its common-place economy; but the human race lives its time even as the individual does, and there are sufficient indications that its poetical spring-time has long since passed away, and that it has arrived at a ripe age, in which prosaic reality bears rule; hence in the great body of society the poets now mostly pass unheeded, like solitary flowers which have overlived their time; for other interests occupy the masses, interests only too intimately connected with actual, not dream-born matters, many of which are based upon these very metals under consideration. If the time has been in which these metals, as all poetry would have it, did not possess the high value we attribute to them, that time has gone by, and the requirements of the present direct us into the realm of those heavy, shining, ringing elements, and we devote our cares to the investigation of their properties and powers.

The description of the noble metals pointed out the peculiarities which distinguish them from the ordinary ones, namely, the fact that the latter more readily enter into combinations with the other elements, particularly with oxygen, from which it is often very difficult to separate them again; that for this reason they cannot so firmly resist air, water, and fire, but lose more or less of their elementary character under the influence of those agents. The number of these metals is greatly superior, and the present sketch shall treat of the most important of them, and their modes of occurrence in nature.

Iron may open the series, not, indeed, because the judgment of the chemist would place it next the noble metals, but because it is distinguished by so many virtues, and has made good so many noble proofs of its value.

Iron rarely occurs *pure*, and all the native iron which is found here and there upon the globe is of meteoric origin, and comes from the distant space of the ether in which the stars revolve. We have abundant evidence of this. Native iron is never found otherwise than in solitary fragments and blocks, not in the interior of the earth, but solely on the surface, having no relation with anything in its vicinity; so that no indication whatever is given of a terrestrial origin. Native iron always contains an admixture of nickel* (four to sixteen per cent.), a metal which certainly is a native of the earth, but never occurs in any of the numerous iron-stones which are embedded in the stratified rocks. It forms variously shaped masses, sometimes perforated with holes and branched, which occasionally enclose chrysolite; or it is found sprinkled in meteoric stones, and this circumstance, together with the other, that many masses of iron are known to have fallen from the skies, place the meteoric origin beyond doubt. Thus, about six o'clock in the evening of the 26th of May, 1751, at Agram in Croatia, a mass of iron was observed to fall with a loud crash, as a fragment of a fire-ball. It weighed 71 lbs., and is now preserved in the Imperial Mineralogical Museum

(* This is at least questionable; a number of instances of native iron *without* nickel are given by recent mineralogists, and this iron is called *telluric* in opposition to *meteoric* iron.—ED.)

at Vienna, which contains the richest existing collection of meteoric iron and meteoric stones. Quite recently, on the 14th of July, 1847, two masses fell at Braunau in Silesia, weighing 42 lbs. 3 oz. and 30 lbs. 8 oz., and the iron of these is especially remarkable—capable of being split into very perfect cubes, thus existing in a peculiarly complete condition of crystallization. A fall of iron is on record from the year 1559, as having occurred at Miskolcz in Hungary, where five lumps of iron as large as a man's head fell. Among other celebrated masses of meteoric iron, is that found in 1749 by a Cossack, near Krasnojarsk in Siberia, and conveyed at the instance of Pallas, in 1775, to St. Petersburgh, where it is well known by the name of Pallas's meteoric iron, and at the present time still weighs 1270 Russian pounds; the "Cursed Burgrave," as it is called, at Ellenbogen in Bohemia, weighing 191 lbs.; a mass in Tucuman in South America, weighing 15 tons; one in the little river Bendego in Brazil, estimated at 8½ tons, and many others. How highly such meteoric iron is valued, as a meteorological rarity, may be concluded from the fact that the mass from Agram, and the "Cursed Burgrave," in the Museum at Vienna, are each estimated at 1000*l.*

The crystalline structure of meteoric iron is rarely evident, but it becomes visible through acting upon a polished surface by means of acids, which brings to light triangular and other regular figures (the Widmannstädt figures, as they are called). Meteoric iron is very good to work, and for conversion into steel; and the orientalist, Von Hammer, is of opinion that the first Damascus blades were made from meteoric iron, as is related, indeed, of the swords of the Caliphs, which were forged from such heaven-descended iron, and were celebrated by the Arabian poets. Such a sword is thus described: "Glancing like a lightning-flash, cutting through marrow and bone, he who wields it has all before him, steel and precious stones vanish like water before its brilliancy." The Emperor Alexander of Russia obtained from Sowerby a meteoric sword of this kind, made from a mass of iron found in the south of Africa; and another mass, which has been met with in West Greenland, has been worked by the Esquimaux into knives and other instruments. Pure iron occurs, in small quantity, as stated already, in almost all meteoric stones, which seem to be, as it were, its peculiar rock.* Examined closely, these remarkable stones are found to consist of a fine mixture of various minerals, mostly of siliceous compounds, resembling chrysolite, augite, and leucite, to which are added, magnetic iron-ore, sulphuret of iron, and the like; and the elements of which the meteoric stones are composed, do not differ from those which are known upon our globe, and, so far as they have been investigated at present, the number amounts to about one-third of these. The stones are roundish, or formless masses, with rounded edges and corners; when split they exhibit a greyish white colour and a finely granular fracture, and they are coated by a thin, black, and fused external layer. Accounts of the fall of these stones are on record from 500 B.C.; the Greek Bæthylia, however, are also supposed to have been meteoric stones, and therefore these were mentioned even in their mythology. Magic powers were ascribed to them, and in the East they were often objects of divine worship, as Herodian narrates of one such stone in the Temple of Emisa, and Appian of another which was adored in Galatia, in the sanctuary of Cybele. Stones of this kind were also worshipped in the Temple of the Graces, at Orchomenos, these stones having been said to have fallen from heaven in the time of Eteocles, before the Trojan war (consequently more than a thousand years before Christ). About 465 B.C., a large stone fell near Ægospotamos in Thrace, which Pliny states to have been twice the size of a millstone, and to have weighed as heavy as an ordinary waggon-load. We have more accurate accounts of more recent meteoric stones, and one of the oldest is from Ensisheim in Alsace, from the date 1492. The stone was hung up in the church, with an inscription in verse attached, stating that it fell on a bright day in winter, with a clap of thunder, and weighed two hundred-weight and a half.

At that time, it was believed that a stone of such kind was a defence against lightning, and some Latin verses on the Ensisheim stone refer to this: "*Qui caste gerit hunc, à fulmine non ferietur. Nec domus, nec villæ, quibus adfuerit lapis ille.*" On the 26th of July, 1581, a stone of 39 lbs. fell in Thuringia. In 1672, two stones of 200 lbs. to 300 lbs.

* See *ante*, p. 356.

fell near Verona. Near Aigle (Normandy), nearly 3000 stones of various sizes, some amounting to 17 lbs., fell on the 26th of April, 1803; and this case, investigated and confirmed by the *Institut de France*, set aside all doubts which up to that time had been urged against the possibility of such aërolites, or were accepted as explanations of them. On the 13th of May, 1807, a stone of 160 lbs. fell at Juchnow, in the government of Smolensk; in 1768, a stone of 38 lbs. fell near Mauerkirchen, in the district of the Inn. Smaller ones fell in the Eichstadt district, in 1785; in Moravia, in 1808, &c.; and the most recent fall, of a stone of 14½ lbs., took place in the valley of the Mindel, December 25th, 1846. M. Landbeck, the steward of the Von Schertel property, an eye and ear witness, described the phenomenon in the following terms, in a letter: "On the 25th of December, 1846," he says, "it had snowed strongly in the morning, the sky was obscured and overcast, and the thermometer indicated the freezing-point. About two o'clock in the afternoon, I and my family were surprised by four explosions, like cannon-shots, slowly succeeding each other. I was just about to express my astonishment at the unusual time and place in which this cannonade appeared to occur, when it began again, and the explosions followed each other so quickly, that one was involuntarily reminded of the rattling firing of a review. After some twenty or thirty reports, the cannonade ceased, and a drumming commenced, very similar in tone to the tone of an F kettle-drum, but producing a noise like twenty drummers beating the *générale*. We observed that the noise came from the air, passing over my house, &c. The end of the whole, which might have lasted some three minutes, consisted of a long-drawn-out rushing sound. At the same time the clouds exhibited a fissure in the direction of the path of the meteor, in consequence of the violent convulsion. The stone was seen to fall in a garden, and it had driven in the fast-frozen loamy soil to a depth of two feet, the earth being scattered about in all directions. A smell of sulphur was observed in the vicinity of the stone, and from the heat of the stone even after it had been dug up, it must have been tolerably warm at the time it fell." The phenomena have been described in exactly the same way in other cases, and it is usually a ball of fire which bursts in the air and scatters the stones on the earth with a thundering crash. Instances are even known of men being killed by them; as, for example, a Franciscan in Milan, in 1650, another monk in Crema, in 1511, and two Swedish sailors on board a vessel, in 1674; and the stones have sometimes reached the earth so hot as to set on fire wood and similar substances. This isolated hail of stones has been observed, it is true, but comparatively seldom, yet there is no doubt that thousands fall of which we know nothing, for how many may lie in the depths of the ocean! Many physicists are inclined to regard shooting-stars as falls of meteoric stones; and, since these occur in considerable abundance every year, on St. Lawrence's day, and in the beginning of November, so much so, that in 1833 somewhere about 24,000 were observed, in North America, to fall in about nine hours, it would appear that at least some parts of the globe would be exposed to great danger from such hail. But this phenomenon is probably of a different kind, otherwise many more of these stones must be found; and they always have so characteristic an aspect that they cannot be confounded with other stones. Among the hypotheses as to the origin of these stones most divers opinions have been advocated: for a long period they were regarded as products thrown out from terrestrial volcanoes; this untenable view was then improved by explaining their origin by a derivation from the moon, not much more, however, being really known about the volcanoes of the moon, than that crater-like forms are observable on the surface of that satellite; then they were held to be formed by the evaporation of terrestrial elements; and at the present time almost all are agreed in returning to an opinion which was in existence two thousand years ago, namely, that these stones are cosmical bodies, revolving fragments of planets. "The Greek natural philosophers," says Alex. von Humboldt, "the majority of whom were little inclined to observation, but were persevering and indefatigable in multiplying the significations of the half known, left-behind views on the shooting-stars and meteoric stones, which in some cases agree most remarkably with that now almost universally received, of the cosmical process of the phenomena. Shooting-stars, says Plutarch in his 'Life of Lysander,' are regarded by some physicists, not as streams shooting out from the æthereal fire, which are extinguished in the air immediately after being inflamed, nor even as an inflammation and flashing-up of the air; they are rather a condition of planetary bodies, wherein, through a certain relaxation of the circulating force and the bias of an irregular motion, they become flung down, not merely on to the inhabited earth, but also outside it into the vast ocean, so that they are not found. Diogenes of Apollonia expresses himself still more distinctly. In his opinion there existed *invisible stars*, moving with the visible, the former of course having no name. These often fall down to the earth and are extinguished, as in the fiery fallen *stony star* near Ægos Potamus." The little planets Ceres, Pallas, Juno, and Vesta, have been assumed to be fragments of one larger planet, formerly circulating around the sun, and afterwards broken to pieces; and some incline to regard meteoric stones as fragments derived from that disruption, scattered through space, flying through their orbits until they come within the sphere of the earth's attraction, and in consequence of this, fall to its surface. As they rush through the atmosphere they become heated by the friction, and by the time they reach the surface are at a glowing heat, hence by night they look like balls of fire, and are enclosed in a fused shell. How long many a meteoric stone may have been flying, as a little offshot from a planet, through its circulating paths, through the midst of the infinite masses of the great rulers of the heavens! through what revolutions may it have been torn forth into the wide and strange starry space, separated from its mother Ceres, or Pallas, or whatever she may be called! What has it passed through in these dizzy heights, to the conception of which man can scarcely rise, even at certain moments, moments of the most exalted feeling, which at the same time humble him into reverence before Him who has thus created and ordered according to His will? Such thoughts crowd upon us as we gaze upon these black mysterious stones which now lie cold and motionless in our cabinets; perhaps in the bright nights when they see the distant stars glimmering without, they may yearn after the days of their lost freedom and for the wings on which they were then fearlessly borne.

Meteoric stones contain, besides iron and nickel, traces of other metals, namely, manganese, copper, cobalt, and tin.

It is remarkable that the noble metals are entirely wanting, and gold and silver do not appear to be dwellers in the enigmatical countries of the skies. So much the more does iron deserve our recognition; and this gives the *iron* crown of Lombardy its peculiar advantage over its golden sisters. Iron belonging originally to our earth is not found pure, but chiefly combined with oxygen and sulphur, and these compounds are very often associated with other constituents. The most important ores of iron used for producing the metal are, magnetic iron-ore, red and brown iron-ore, brown spar or carbonate of iron, and aluminous ironstone. *Magnetic iron-ore* occurs in octohedral crystals and in compact granular masses, is of an iron-black colour, is black when powdered, and is attracted by the magnet. It is composed of iron and oxygen, and 100 parts contain 72.4 of iron and 27.6 of oxygen (or 69 of peroxide of iron and 31 of protoxide of iron). This important iron-ore is chiefly met with in primitive rocks, and is widely diffused in the northern parts of the globe—in Norway, Sweden, Lapland, Siberia, and North America. Among the most important mines are those of Axendal in Norway, and of Dannemora and Taberg in Sweden. Colossal ironstone-hills are met with in Lapland, near Tornea, Gellivara, &c.; in the Ural, near Nischne Tagilsk, Blagodat, &c.; and this ore occurs also in the Zillerthal, in Tyrol, in Styria, in Piedmont, Brazil, &c. The magnetic iron-ore was the means of the original discovery of magnetism, and the ancients were acquainted with the fact that certain stones attract iron; the Greek and Roman naturalists speak of it, and Pliny observes that the magnet was discovered on Mount Ida, by a shepherd named Magnes, through the iron point of his staff and the nails of his shoes being suddenly held fast to the ground. He distinguished several kinds of magnet, especially male and female, according to the degree of force; and it sounds strange when he mentions that the worst kind, from Magnesia, did not attract iron, and resembled a pumice-stone. This reminds one of Lichtenberg's sword, which had neither blade nor hilt, for the power of attracting iron was the especial distinguishing character of the magnet among the ancients. Our knowledge, it is true, informs us that this power of attracting is only possessed by particular varieties, but all are capable of being attracted by a magnet. There is this distinction, that those varieties which attract iron are polar; that is, they attract a magnetic needle by one part and repel it by another, and if freely suspended turn their poles in the north-south direction like the magnetic needle. Those varieties which do not attract iron filings, or similar bodies, do act upon the magnetic needle, not, however, attracting and repelling it, but simply attracting it. What the natural cause is that renders some magnetic iron polar, and why the greater part of it is not so, is totally unknown. The ancients also observed that two freely suspended magnets, brought near together, attract each other in some parts and repel in others; but the discovery that a magnetic needle turns its poles *north* and *south* certainly belongs to the twelfth century of our era. According to Whewell, the oldest notice of it occurs in a poem by Guyot, of Provence. In this the magnetic needle is described as being laid upon a straw swimming on the surface of the water, and then turning toward the poles:

Puis se torne la pointe toute
Contre l'estoilę sans doute.

The property of attracting iron possessed by polar magnetic iron, has in all times filled observers with natural astonishment, and many have ascribed to the mountains in which this ore is found, such force of attraction as to draw, for instance, all the nails, bolts, and similar iron objects, out of ships sailing past them, so as to render it dangerous to sail near such a mountain. We may observe here, in passing, that another metal besides iron, *nickel*, possesses the power of receiving a permanent magnetization. The value of the magnetic needle in navigation, in the surveying of mines, &c., is sufficiently known, as is also the manner in which magnetism is imparted to non-magnetic iron by means of a magnet. Hæmatite, specular, or *red iron-ore*, and *brown hæmatite*, or brown *iron-ore*, contain iron as peroxide, the former without water, the latter with a proportion of 14.4 per cent. of water. Red iron-ore contains 70 per cent. of iron (and 30 of oxygen); brown iron-ore 60 per cent. of iron. Red iron-ore has an iron-black metallic aspect, but the colour of the powder is red, cherry-red, or brownish-red, and certain fibrous and earthy varieties (red ochres)* have these colours. It sometimes occurs in crystals (rhombohedra and six-sided plates), and the island of Elba is renowned for the crystallization of this ore, which is remarkable for the beautifully variegated colours which play upon its surface like iridescent steel. The specific gravity is 5. Brown iron-ore has not a metallic aspect, and in compact pieces it is of brown or brownish-black colour; the powder, however, is ochre-yellow, and earthy varieties (yellow ochres) also have this colour. It does not present itself in crystals, but mostly in fibrous masses of all kinds of shapes, in bunches, in conical pieces, &c.; also solid and mixed with clay, as the yellow *clay-ironstone*, or in roundish granules, as *bean-earth*. With the exception of some of the varieties of red hæmatite, the iron-ores do not act upon the magnetic needle, but the effect becomes evident after they have been sufficiently heated on charcoal before the blowpipe. Hæmatite, or specular iron-ore, occurs chiefly in primitive rocks, in enormous quantities, and often forms whole chains of hills, as in Gellivara in Lapland; very thick beds and vein-like masses, as in Elba, at Framont in Lothringia, in Sweden, Norway, Britain, Brazil, &c. It also occurs in the sublimates of volcanoes. Brown hæmatite is equally diffused in older and newer formations, in the Erz-gebirge, Thuringia, the Hartz, the Upper Palatinate, Styria, Cornwall, &c. A rare species, resembling brown iron-ore in composition, but containing ten per cent. of water, has been called *Goethite*, after Goethe, and it often forms most beautiful hyacinth-red laminæ. It occurs sparingly in Eiserfeld and Hollerterzug in the Westerwald, in the district of Zweibrücken; also at Lostwithiel in Cornwall, and at Clifton, Bristol.

This ore was known to the ancients also, and even the mines of the island of Elba (Ilva) were mentioned by Pliny. The fibrous red iron-ore, which they called *hæmatites*, was held in especial esteem, and used in medicine. These varieties were afterwards called *blood-stone*, and applied against hæmorrhages, and the faith in them still exists. This bloodstone is also used for polishing, and as a colour in painting, both in the ordinary way and on porcelain.

* Ruddle, or raddle, is an ochre of this kind mingled with clay.

Sparry iron, or *brown spar*, is a peculiar ore, consisting of 38 per cent. of carbonic acid and 62 per cent. of protoxide of iron, and contains, therefore, 48 per cent. of iron. This iron-ore bears great similarity to calcareous spar in crystallization, cleavage, &c., but it is readily distinguishable from this by becoming black when strongly heated, and then becoming strongly attracted by the magnet. It is met with in different formations, sometimes in considerable masses, as at Eisenerz in Styria, Hüttenberg in Carinthia, in Siegen, the Hartz, the Pyrenees, England, &c.

Aluminous, or *clay ironstone*, is an impure variety of sparry iron; it is found occasionally in transition rocks, but most abundantly in the coal formations of Great Britain, Belgium, and Silesia. Most British iron is manufactured from this impure ore, the carbonaceous matters in the black-band varieties assisting the reduction.

In the preparation of metallic iron from these ores there are two principal objects to be sought, namely, the separation of the oxygen from the iron, and the conversion of the stony matters intermingled with the ores into an easily fusible slag. To effect these, the ores are broken up into small fragments, and placed in a furnace in layers alternating with coal, charcoal, or coke, with the addition of lime, clay, and similar substances adapted to the production of slag, and the whole is melted by the aid of a powerful blast of air. The oxygen unites with the carbon into gases, which pass off, and the iron is restored to a metallic condition, at the same time, however, taking up a certain amount of carbon. This carburet of iron is comparatively easily fusible, and forms what is called *cast iron*, which is led into moulds in its melted state, or is subjected to another peculiar process of smelting, in which the carbon is burnt off (by what is called puddling) and converted into malleable bar-iron. This bar or malleable iron is converted into *steel* (cemented steel) by heating it in closed cases while embedded in powdered charcoal; this causes the iron to take up only about one to one and a half per cent. of carbon, whereby it acquires the property of becoming very hard and brittle when made red hot and rapidly cooled, for instance, by being dipped in water. Steel may also be made directly from cast iron by removing or burning off the requisite amount of carbon, and steel prepared in this way is termed cast steel.

There are often very considerable difficulties in the way of producing good iron, and these depend principally on the rock with which the ore is intermingled, and on the impurities of the ores themselves. The smallest quantities of sulphur and phosphorus, and arsenic also, are, above all, hostile to the preparation of useful iron; and to the progress of chemical analysis alone are owing the means which have been gradually acquired of overcoming the difficulties arising from these impurities. Although iron was known to some of the ancient races even before the Deluge, this was not the case with all, because the separation is not so easy as it is in many other metals. The ancient Israelites possessed iron chisels and axes; the giant, Og, King of Basan, had an iron bed; and iron weapons are mentioned in several places, in the accounts of the giant Goliath; the iron of his spear, for example, is said to have contained 600 shekels of this metal. The smiths of Crete, named Dactyloi, worked in iron from Mount Ida; the Romans were acquainted with the hardness of steel, and the waters of many localities had especial reputation in reference to its manufacture, and use was also made of oil. They made their swords of iron from Noricum, a part of Bavaria and Austria, and the quality of this iron was renowned; Horace speaks of a Noric sword as a strong and excellent blade. At the same time, in Cæsar's day (60 B.C.), iron was at first so dear in England, that it was valued at its weight in gold. In the time of Lycurgus, the money of the Spartans was of iron. The alchemists gave iron the sign of Mars, and did not fail to relate many wonders in regard to the sympathies existing between the two, its friendship with copper, and its disinclination towards gold, silver, and mercury. Pliny gives the following account of the uses of iron: "It is," he says, "the most useful and the most pernicious of all metals; it is useful, for it helps to draw furrows in the earth, to give the vine its proper form, to lop trees, to hew stones, to build houses; it is injurious, because it helps war and is the instrument of slaughter; man guides it in close conflict, he casts it forwards from his hand, he throws it from machines, he gives wings to it; the rage of mankind has dicovered nothing more rapid or more furious." A chemist of the last century gave the following opinion as to the preference of iron over gold and silver: "What a wretched people should we be, and what a most miserable life should we lead, if we had no iron—even if we had gold and silver piled up around us, metals which we could everywhere do without; as the old Germans said, 'Gold to amuse, iron to use.'" And, in fact, the greater hardness and elasticity which iron possesses, especially in the form of steel, gives this metal a considerable advantage over the more noble gold; for it would be but sorry fighting with a gold sword, and it would be vain to try to bring from golden harp-strings the sweet sounds which are drawn from iron ones. The honour in which iron is held in our times, has indeed been sung by many a poet, and the well-known German song, "Der Gott der Eisen wachsen liess, der wollte keine Knechte" (God, who made iron grow, wishes no slaves), says much in a few words. In the old stormy times of Germany it was chosen as the material for ornaments and for honorary decorations.

In addition to the iron-ores already mentioned, iron very frequently occurs in combination with sulphur, and this in two proportions, namely, 60 per cent. of iron with 40 per cent. of sulphur, and 46.5 of iron with 53.5 of sulphur. The first compound, rarely exhibiting distinct crystals, and mostly compact, is of a bronze-yellow colour, running into pinchbeck brown, and affects the magnetic needle; it is called *magnetic pyrites*, and occurs in Cornwall, at Bodenmais in Bavaria, in the Hartz, in Sweden, &c., but only in small quantities; the second very widely diffused compound is *iron pyrites;* occurring in cubes and in crystals bounded by twelve pentangular faces, also compact, it is of a brassy-yellow colour, and only affects the magnetic needle after being melted. When this pyrites is heated in close vessels, half of the sulphur is driven off, and this process is made available for obtaining sulphur, as was previously stated when speaking of that substance. Many kinds of pyrites become gradually weathered in a moist atmosphere, taking up oxygen and water, and becoming decomposed into *green vitriol* or *copperas*, a salt which crystallizes in oblique rhombic prisms of greenish colour, is readily soluble in water, and is composed of sulphuric acid, protoxide of iron and water. This green vitriol is used in dyeing, for making ink (by combining it with an infusion of gall-nuts), in the preparation of sulphuric acid, &c.

Among the ancients, iron pyrites was known under the name of Amphitane, so at least is it described by Pliny, with the statement that it attracts gold and silver. The latter might, perhaps, refer to the fact that much pyrites contains a small quantity of gold. Among the alchemists it was called Marchasita, also pyrites. It occurs still in a few mineralogical works under the name of Markasit, and so is often used in "name-rings" to indicate the letter M. It is also made use of for ornaments, by cutting it with facets in the same manner as steel. Among the other compounds of iron, of which there are very many kinds, there is one of especial interest, namely *chromate of iron, or chromite*, composed of protoxide of iron, protoxide of chrome (60 per cent.), and alumina. It is of an iron-black colour, and when pulverized becomes yellowish-brown; fused with borax before the blowpipe, it forms an emerald-green glass. It is mostly found in compact masses, and occurs in Scotland, in the department of the Var in France, at Kraubat in Styria, in Norway, Siberia, North America, &c. From it is obtained the oxide of chrome, which is used for producing green colours in glass and porcelain-painting, and the preparations of chromium, from which, by combination with salts of lead, the beautiful yellow and red pigments, the chrome yellows and reds, are made. After Vauquelin had discovered chromium, a metallic element, in a red ore of lead from Siberia, he found it in the present ore of iron, in 1797; and the latter discovery was very important, since that lead-ore is very rare, while chromate of iron occurs in sufficient quantity to allow of the beautiful colouring element it contains being made available in the arts. The name chrome is derived from a Greek word signifying *colour*.

Next in the series, we will take a metal which is a true companion of iron and its compounds, although it occurs in comparatively small quantity. This is *manganese*. There is scarcely a rock upon the globe which does not afford traces of iron and manganese, both ordinarily in combination with oxygen. Manganese does not occur in a metallic condition in nature, but almost exclusively in combination with oxygen, and the most important kind of ore is called *pyrolusite*, which name is of Greek construction, derived from words signifying *fire* and *washing*, because the mineral has the property of bleaching glasses which are coloured by iron, when fused with them, and thus, as it were, washing them white (the French term it *savon de verriers*, glass-blower's soap). Metallic manganese is only to be prepared with great difficulty, and at present is a chemical rarity; it bears a resemblance to iron. Pyrolusite is of an iron-black colour, is soft, infusible, and, fused with borax, gives an amethyst-coloured glass, which is a characteristic mark of all compounds of manganese. The existence of a peculiar metal in this mineral was first demonstrated by the Austrian chemist, Kaim, in 1740. The name manganese is of uncertain derivation, and is connected with the names of magnesia and magnet (which, according to some, originated from the Greek word μαγγανειν, manganein, which means to enchant), the manganese ore having been formerly termed *pseudo-magnes*, on account of some resemblance to magnetic iron-ore. Among the German miners, manganese ore is called *brown-stone*, because some of it gives a brown powder, but as it is always grey or black when in masses, the older mineralogists distinguished the kinds by the singular names of *grey* and *black* brown-stone. Pyrolusite is still often called grey brown-stone ore. This mineral has many scientific and technical uses. It is employed in preparing oxygen, of which it gives off one part when raised to a white heat; it is also used with common salt and sulphuric acid for preparing chlorine gas, which has important applications in bleaching; in destroying the colour of glass, in glass-painting and enamelling, in glazing brown earthenware. Pyrolusite and similar ores of manganese are found in Cornwall, at Ilmenau in Thuringia, Triebau in Moravia, Saxony, Hungary, &c.

In order to keep together in some degree the metals which are allied to each other, we will next select *nickel*, a metal which, as we have observed already, resembles iron in the capability of being made into a permanent magnet, and in its train we will speak also of *cobalt*, since these two metals are such inseparable companions that chemists have great trouble in parting them completely. There exists an ore which looks like copper, from which, however, no copper has ever been smelted. This ore was called by the old Saxon miners *kupfer-nickel*, a nickname, in which they adjoined the opprobrious German term *nickel* to that of the seeming copper (*kupfer*). About the year 1754, the Swedish chemist, Cronstedt, discovered a peculiar metal in this ore, and to this the name of nickel was then applied. The metal nickel does not occur pure in nature, and the operations of extracting it from its ores are rather complicated. It is almost as white as silver, is very ductile, and malleable, fusible, of the specific gravity 8.6, and is attracted by the magnet, like iron. The most important ore of this metal is the copper nickel already mentioned, which, in recent mineralogical works is called *red nickel pyrites*, *nickeline*, or *arsenical nickel*. It is composed of 56 per cent. of arsenic and 44 per cent. of nickel, and occurs in compact masses of a light coppery red colour, is not malleable, and readily betrays the arsenic it contains before the blowpipe, since, when it is heated, it emits a vapour of garlic-like odour. This ore is found, with a few other compounds of nickel, which however are rarities, principally in the Erz-gebirge of Saxony, and at Riechelsdorf in Hesse, at Wittich and Wolfach in Baden, in the Hartz, &c. By fusing nickel, copper, and zinc together, a metallic alloy is formed, which is much in use under the name of *German silver*, or *Argentane*. This was first made in quantity in Europe only in 1823, but has been long known to the Chinese, and is their Pack-fong (properly Pack-Tong, *i.e.*, white copper).

The ores of *cobalt* are almost always found associated with those of nickel. The name cobalt, or kobolt, occurs as early as about the close of the fourteenth century; it originates from the demon of the mines, the Kobold, whose name the miners formerly applied to such ores as afforded no metal, and evolved the vapour of arsenic when smelted. Like nickel, metallic cobalt does not occur native in a pure form; when prepared artificially, it exhibits a metallic reddish-white colour, is hard and brittle, of 8.5 specific gravity, and very difficult to fuse. It was first prepared by the Swedish chemist Brandt, about 1733. The ordinary ores of cobalt are *smaltine* or *speiss-cobalt*, and *cobaltine* or *glance-cobalt*. Speiss-cobalt occurs in small cubical crystals, but chiefly compact; it is of a tin-white colour in a clean fracture, brittle, and, when fused with borax, yields a glass of a very beautiful sapphire-blue, at the same time emitting vapours of arsenic. This blue colour of the borax glass is a characteristic property of all compounds of cobalt. Speiss-cobalt is a combination of 72 per cent. of arsenic with 28 per cent of cobalt; it occurs in veins in the primitive rocks, especially in the Saxon Erz-gebirge, in Hesse, Siegen, &c.; but also in Cornwall, France, Sweden, and Connecticut, United States. Glance-cobalt almost always occurs in crystals, combinations of cubes, octohedra, and pentagonal dodacahedra, is of reddish silver-white colour, and has much the same properties as speiss-cobalt, from which it is only distinguished in composition by containing sulphur, since it consists of 19.5 per cent. of sulphur, 45 per cent. of arsenic, and 35.5 of cobalt. This kind is rarer than the former, and occurs at Tunaberg in Sweden, and at Skutterud in Norway, also at St. Just in Cornwall, and Querbach in Silesia. The ores of cobalt have *one* principal application in the arts, through which, however, they have acquired a high value; they are used, namely, for making blue glass and smalt. This staining of glass by means of cobalt ores was first discovered about the middle of the sixteenth century by a glass-maker named Christopher Schürer, of Platten, in Bohemia. The blue glass was first used in pottery as a glaze, but the Dutch soon penetrated the mystery of the manufacture, and by grinding and washing the glass they produced the pigment on a large scale, using the roasted cobalt ores of Saxony in the preparation of the glass. The cobalt-blue works are therefore, properly speaking, glass-works. There are four in the Erz-gebirge, the oldest of which was established in the beginning of the seventeenth century, at Johanngeorgenstadt, Dutch workmen having been at first employed. All ores of cobalt are delivered under contract to these colour-works, and a heavy fine is incurred by carrying cobalt out of the country. A hundred-weight of cobalt-blue is sold for about 20*l*., and in 1844 the amount delivered from the four manufactories was of the value of about 50,000*l*. The annual production of smalt, or cobalt-blue, in the different countries of Europe is stated to amount to 1700 tons.

We next come to the ores of a metal which is no less beautiful than useful—copper. It is distinguished by its peculiar red colour, which is seen to the best advantage in copper-plate prepared by galvanic precipitation; and this colour is only shared by one other metallic element, *titanium*, which, however, is at present only known as a rarity. Copper derives its name from the island of Cyprus, which was formerly very rich in copper; among the ancients it is ordinarily mentioned under the name of bronze. It was known in the earliest times, and arms and instruments, afterwards made of iron, were originally of bronze or copper. Thus the heroes of the Trojan war had brazen weapons; the Cherusci were also acquainted with copper earlier than with iron, and drew out the boundaries of a city they were about to found with a ploughshare of copper; the Sabines used it for cutting the hair, which operation was performed by the priests; copper knives and copper money were universal. The axe-heads and hammers of the ancient Siberians were of cast copper, as also were the weapons of the Peruvians before the discovery of America by the Europeans. Since the art of extracting the metals from their ores advanced but very slowly, especially in some countries, and as at the same time mining was not pursued at all by particular nations, such as the ancient Germans, it is readily understood both how metals which nature presents in a pure state would be made use of first of all, and why in those times metals were so deficient, and of so much higher value. Even in the tenth century metals were so rare as means of exchange, that a measure of wheat weighing 60 lbs. would be given for 7 copper pfennigs. About 120 of these pfennigs made up a pound of copper, which now costs about one shilling. From the account-books of the cathedral of Strasburg, it appears that the masons received about 1½ to 2 pfennigs *per diem* in wages.

Copper occurs *pure* in nature and in manifold combinations, of which *yellow copper pyrites*, *copper glance*, *variegated* or *purple copper*, *malachite*, *azurite* or *blue carbonate of copper*, and *Fahl-ore* or *grey copper*, are the most important. Pure copper rarely occurs in distinct crystals (cubes, octohedra, &c.), but usually in compact masses, laminated incrustations, wire-like threads, &c. It is of moderate hardness, very malleable, has a specific gravity of 8.5-9, is not very difficult of fusion, and is easily dissolved by nitric acid into a blue solution. It occurs in the rocks of all formations, with the various ores of copper, and the principal localities are Cornwall, Chessy near Lyons, Moldawa in the Banat, the North American States, also Brazil, Chili, and Japan, the copper of the latter being known as the purest. Sometimes masses of considerable size are met with, and a block weighing 22 cwt. has been found on Lake Superior in North America, one of 26 cwt. in Bahia, and at the festal inauguration of the Mining Company at Adelaide, in 1845, a block from the rich mines of South Australia was exhibited, weighing 24 cwt., valued at 100*l.* sterling. Most copper, however, is obtained from *copper pyrites*, which is a compound of 35 per cent. of sulphur, 30.5 of iron, and 34.5 per cent. of copper. It is of a brass-yellow colour, and frequently tinged with beautifully variegated colours. It but rarely occurs in crystals, but mostly compact, and is easily distinguished from iron pyrites, which it resembles, by boiling it with nitric acid, which decomposes it, adding an excess of solution of ammonia, and pouring off the solution from the precipitate. The solution is of a beautiful lapis-lazuli blue colour, depending on the presence of dissolved oxide of copper, while the solution obtained from iron pyrites is colourless. The presence of copper in the solution may be demonstrated by rendering it slightly acid with sulphuric acid, and placing a clean knife-blade in it. This immediately becomes coated with brilliant metallic copper, the iron of the blade being dissolved and taking the place of the copper in the solution. Copper pyrites can also be distinguished in another way from similar ores which contain no copper, by melting it before the blowpipe, moistening the tested particle with hydrochloric acid, and again bringing before the blowpipe, when it imparts, for a short time, a beautiful blue colour to the flame. This process is applicable to the detection of all the other compounds of copper. Copper pyrites is met with in large masses embedded in micaceous schist at Fahlun in Sweden, at Roraas in Norway, and Herrengrund in Hungary, in hornblende schist at Kupferberg in Silesia, in clay-slate at Schmöllnitz in Hungary, and in granite and clay-slate in Cornwall. In Siegen, in the Hartz, in the Mannsfeld district, and in Lower Silesia, it occurs in various later rocks, in grauwacke, zechstein, variegated sandstone, muschelkalk, &c. Copper pyrites is accompanied in inferior quantities by the *variegated* or *purple copper ore*, which is formed of the same constituents, but in different proportions, and contains 63 per cent. of copper. Its colour is yellow, passing into copper-colour, and has the property of acquiring variegated tints when exposed to the air, whence its name. *Copper-glance*, occurring under similar circumstances, is a compound of 20 parts sulphur, with 80 parts of copper, and is distinguished both by a dark steel-grey colour, and by being soft and easily cut with a knife. *Fahl-ore* also, a brittle, steel-grey ore, is also a frequent companion of copper pyrites. It is of very complicated composition, and contains sulphur, copper, iron, arsenic, and antimony, and also often silver, so that it is worked for the sake of the latter. Argentiferous Fahl-ore, sometimes containing as much as 30 per cent. of silver, occurs at Freiberg in Saxony, in the district of Furstenburg in Hungary, &c.

Among the copper ores which are often met with, but not in such considerable masses as copper pyrites, and which, moreover, furnish very good copper, are the red copper ore, malachite, and azurite, or blue copper ore.

Red copper ore is a compound of 89 per cent. of copper with 11 per cent. of oxygen, and it occurs sometimes compact and sometimes in octohedral crystals of a cochineal-red colour, brilliant as a diamond, and occasionally, though rarely, almost transparent. This ore accompanies the preceding in various localities, as also do *malachite* and *azurite*, which are compounds of carbonic acid, oxide of copper and water, and contain on an average 70 per cent. of oxide of copper, or 56 per cent. of copper. Malachite has already been spoken of among the precious stones, since the compact varieties are capable of being polished, and are used as a material for articles of ornament and luxury. It is always of a green colour; many varieties are delicately fibrous, and occur in bundles; such bundles, looking like emerald green silk, are very pretty objects. The name of malachite is derived from the Greek word *μαλαχη*, *malache*, which signifies the *mallow*, probably on account of its colour. It is mentioned by Pliny as a highly-esteemed signet stone, and in the time of the alchemists it was regarded as a talisman which would protect children against all kinds of evil.

Azurite is blue, and often of a very beautiful smalt tint;

it occurs partly in crystals, oblique rhombic prisms, partly in radiating fibrous or compact forms, often associated with malachite. Some localities are renowned for beautiful groups of crystals of this ore, as, for example, Chessy near Lyons, Szaska and Moldawa in the Banat, Schlangenberg in Siberia, &c.

The extraction of copper from the ores last mentioned, which contain no sulphur, is tolerably simple; they are smelted with charcoal or coal and fluxes, in a wind-furnace, and the copper obtained (black copper) is purified by a second fusion in a reverberatory furnace, in which the blast of air causes the metals still remaining mingled with the copper, such as iron, lead, &c., which combine readily with oxygen, to pass into the state of oxides and go off in the slag. The pure copper found at the bottom of the slag is then run into pots, and the outer layers are lifted off in discs just as they are hardening, forming what are called *rosettes*, or rose-copper. But when the ores contain sulphur, like, for example, pyrites, copper-glance, &c., the extraction of pure copper is much more difficult, for the sulphur does not leave the copper so readily as oxygen, which, when carbon is present, combines with it if exposed to great heat. All ores which contain sulphur (or arsenic) require a preliminary operation, which is called *roasting*. This consists in raising the pulverized ore to a red heat with the access of air, by which means part of the sulphur is removed as such, and part is burnt away, that is to say, combines with the oxygen of the atmosphere into what is called sulphurous acid, and passes off in this form as a gas. The heaps of roasting ore are frequently so arranged that at least a part of the sulphur vapourized shall be collected in a separate form. Such piles of roasting ore often consist of 250 tons, and burn for more than six months. The roasting has usually to be repeated a few times after the smelting of the ore, until the black copper, and finally pure copper, is obtained.

Copper is also met with in another important compound, as an oxide combined with sulphuric acid and water, termed *blue vitriol*. Blue vitriol crystallizes in oblique prismatic crystals of beautiful blue colour, and is readily soluble in water. In nature it is usually found in this dissolved condition in what are called mine-waters, which collect in copper mines and take up the blue vitriol formed by the decomposition of the copper pyrites. Vitriolic streams of this kind occur in the island of Anglesea; at Schmöllnitz in Upper Hungary, at Fahlun in Sweden, at Rammelsberg near Goslar, &c. The copper is extracted by placing old iron in the water; the sulphuric acid leaves the copper to combine with the iron which thus passes into the solution, while the copper is deposited in crystalline crusts. Copper of this kind is called *cemented copper*. It is calculated that about twenty-five tons of cast or wrought iron are necessary in order to obtain five tons of precipitated rough copper, which requires to be further purified. This blue vitriol has acquired increased importance in our own times for electrotyping, and since this art is founded upon peculiar characters of the metal, it may prove interesting to the reader if we say a few words about it here.

When a strip of silver plate is placed in a glass with a solution of blue vitriol, no change is observed either in the fluid or in the silver; but when such a strip of silver is connected with a strip of zinc at the upper end, and the two opposite free ends of the strips are dipped into the solution of blue vitriol, the silver becomes coated with metallic copper in the course of a few seconds. Thus the contact of the silver and zinc has developed a force which is capable of decomposing the solution of vitriol and precipitating its copper upon the silver. The discovery that a peculiar force is excited in various kinds of metal by such contact, was made by Galvani, a physician and natural philosopher of Bologna, in 1791, and the immediate cause was the contraction of a dissection of a frog's thigh, which had been hung upon an iron bar by means of copper hooks. It was soon detected that the process was of an electrical character, and the phenomenon was at first called animal electricity, then *Voltaic*, after Professor Volta, of Pavia, who first correctly interpreted it, and at the same time came into use the name *Galvanism*, now generally adopted. Galvanism is, therefore, a kind of electricity produced by the contact of unlike metals; for example, of zinc and silver, zinc and copper, iron and copper, or silver, &c., and which possesses in a high degree the power of separating metallic and other solutions into their constituents, so that one kind is attracted to one metal, while the others are drawn toward the second metal and precipitated there. By means of a very simple galvanic apparatus we can accomplish the separation of metallic copper from blue vitriol so perfectly, that this copper forms a connected mass, a plate of any desired thickness; and when Jacobi discovered (1840) that such plates perfectly copy the surface of the metal upon which they are deposited, and can be removed from them, the discovery of the *electrotype* or *galvanoplasty* was essentially complete. In this way objects and plates of copper, silver, gold, brass, &c., with raised or engraved work, copper-plates of engraving, as well as wax, stearine, or plaster models, coated with black lead (graphite), can be coated with this galvanic copper and be copied in this metal; nay, even drawings with a pen or with the colour-pencil made in a suitable manner on a metal plate, are coated in this way, so that the copper plate formed may be removed when thick enough, and used for printing from (*galvanography, glyphography*).

The study of the metals and their properties has led to miracles—to results which would formerly have been regarded as impossibilities. We, as it were, command this brilliant element to depart from its solution, we assign to it the place where it shall be deposited, it is compelled to bend itself into prescribed forms, and to copy appointed models, in a manner which the greatest skill and most sustained industry would never enable a human artist to accomplish. Most has been done with copper as yet, but very advantageous applications of gold and silver are largely in use. The greater part of the blue vitriol of commerce is obtained artificially in the extraction of silver, as was stated under the head of that precious metal.

The copper product of Europe is very considerable, and amounts annually to about 14,450 tons; for Russia, 5000; for Sweden, 3500; Austria, 3000; Prussia, 1000; Hesse Darmstadt, 250; France, 150 tons, &c.

Not only is the use of metallic copper most extensive, but it is applied in very many ways in alloys. The best known is that with zinc, forming *brass* (72 parts copper and 28 zinc), which with a larger proportion of copper form *tombac* or *pinchbeck*. This metallic mixture was known to the ancients under the name of *Orichalcum*, and while some authors have distinctly described its preparation, it appears from what Pliny states as if a natural mixture of this kind was found, which, however, was described as very expensive. The alloys of copper with tin were likewise known long ago, and they furnish the various kinds of bronze, bell-metal, gun-metal, &c. The salts of copper are used in the manufacture of many colours, which are all poisonous. Copper was supposed to have a sympathy with the planet Venus, and in alchemy bore her sign (♀).

Zinc, which has just been mentioned as used in alloys with copper, does not occur pure in nature, and its ores have so little of a metallic aspect, that one would not readily conjecture that they contained one. Hence it remained unknown to the ancients, for in their fabrication of brass they did not melt metallic zinc with copper, but the so-called *cadmia*, which, from the descriptions, must have been our *calamine*. The name *zinc*, from the German *Zincken* (teeth), because it is deposited in jagged or tooth-like masses in the zinc-furnaces, occurs first in the fifteenth century. The accurate knowledge of the modes of preparing it dates only from the middle of the eighteenth century. The most important ores of zinc are compounds of oxide of zinc with silica and carbonic acid, with which also a little water is combined; they are called *siliceous oxide of zinc*, or *galmei* and *calamine*, and there is another compound, of zinc and sulphur, which is named *zinc-blende*. Siliceous oxide of zinc and calamine rarely occur in distinct crystals, but only in crystalline rods and granules, and in earthy masses of white, yellowish, or greenish colour. They are infusible, and when violently heated before the blowpipe upon charcoal, they afford a yellowish precipitate, which, moistened with solution of cobalt and again heated, assumes a beautiful green colour—a character by which they may be distinguished from all similar stones. Siliceous oxide of zinc gives a jelly with acids, but calamine is dissolved with effervescence, and does not produce a gelatinous solution. These ores occur chiefly in sedimentary rocks, in stratified masses and "nests," frequently with lead-glance and brown iron-ore, at Bleiberg and Raibel in Carinthia, Aix and Iserlohn, Tarnowitz in Silesia, Rauschenberg in Bavaria, Poland, Scotland, the Ural, &c.

Zinc-blende is a beautiful mineral with numerous laminated cracks, and of brilliant diamond-like lustre, whence probably the name *blende* (from *blenden*, to dazzle). It usually occurs in crystalline, but only rarely in distinct forms, of various colours, brown, green, yellow, black, red, and sometimes transparent. Its powder is coloured green by heating to redness, with the addition of solution of cobalt. It contains 33 per cent. of sulphur and 67 per cent. of zinc, and is very much diffused in the older rocks, presenting itself in especial beauty in Derbyshire and Cumberland, at Schemnitz and Felsobanya in Hungary, Freiberg in Saxony, in the Hartz, &c.

To extract zinc from its ores, the latter are first roasted in small fragments, then mingled with charcoal or coke and heated and reduced in closed distillatory apparatus, crucibles or tubes of clay or cast iron. As zinc is volatile at a white heat, the vapours formed are led through tubes into a condensing chamber, where the zinc drops into the receivers. It is then melted over again in iron pots, and run into moulds. Zinc is of bluish-white colour, has a laminated crystalline structure, and is rather hard and brittle, but may be hammered and rolled at temperatures between 212° and 300° Fahrenheit. It is rather a light metal, lighter than tin, lead, iron, and its specific gravity is 6.86. It is distinguished beyond many metals by its chemical peculiarities, and separates most of them from their solutions, taking their place. Many of our readers have probably seen the *lead-tree*, as it is called, which is made by placing a rod of zinc in a solution of a salt of lead, the result being a gradual precipitation of the lead in beautiful laminæ through the agency of the zinc. This peculiarity shows itself in another way. When strips of copper, iron, tin, and silver are placed in a glass of diluted nitric acid, in such a manner that they do not touch one another, the metals are gradually dissolved in the acid, but when each of them is soldered to a piece of zinc before placing it in the acid, they are not dissolved, and the zinc alone is attacked. The chemist Runge rightly said that "there is something magical in this action of zinc! The childish delusion of antiquity that there existed supernatural means of rendering a man invulnerable is here realised in the action of zinc upon its associate metals; it protects them from the destruction with which the acid threatens them." It is true this protection is afforded at the cost of the zinc itself. In like manner zinc protects copper from the attack of salt water, and use has been made of this in the application to the sheathing of ships, but given up again in consequence of accompanying disadvantages. On the other hand, zinc is frequently used for precipitating metals from solutions. The peculiarly important part it plays in galvanic electricity, its use in the manufacture of brass, of German silver, &c., have already been mentioned. It is also used alone in many ways, as for covering roofs, sheathing, works of art, &c.; it is not fit for drinking or cooking vessels, because its salts are poisonous. One peculiar use of the metal is in the hydrogen lamp. When placed in contact with a mixture of sulphuric acid and water it is dissolved, abstracting oxygen from the water, and setting free hydrogen,* a combustible gas, which is inflamed by means of an electric spark or spongy platinum. In commerce, zinc is known by the name of *spelter*, the origin of which is not certainly known. Belgium produces 7000 tons of zinc annually, Poland about 3000 tons, England about 600 tons, &c.

Lead is one of the most important metals, and to it the old chemical philosophers assigned the planetary sign of Saturn, since they imagined that great sympathy existed between Saturn and this metal, for, as it was said, even as Saturn is earnest, mournful, gloomy, and sluggish, so also lead is the least perfect metal, ashy-coloured, gloomy, and heavy in all chemical operations; and as Saturn devoured all his sons, so lead destroys and corrodes all metals, excepting only gold and silver, because these, as devoted to the sun and moon, are of female nature, and Saturn preserved his female children! Lead is, in truth, a less active-seeming metal, always of dull hue and having no ring; it might be even called a tiresome metal; and the chemist Runge called it "dulness turned into a metal," on account of its chemical phlegm. The same author remarks, truly, that the great value lead has in the arts, depends on this very immobility, its want of sympathy. "What," he says, "would our chemistry on the large scale be without lead? It is always the

* Water is a compound of two elements, oxygen and hydrogen, both of which are gases when in a free condition. One hundred parts, by weight, of water, contain 88.9 of oxygen, and 11.1 of hydrogen.

first resource when *vessels* are wanted to resist the action of other substances. Porcelain is too dear, stone-ware breaks, wood becomes leaky, rots, and stains, iron, tin, or copper are attacked by sulphuric acid, &c. None of these things, or but to a very slight degree, are true of lead; hence its extensive application in chemical manufactories." Its softness and malleability also contribute to its especial utility, and it may readily be obtained in sheets applicable to the most varied purposes. It is also very easily fusible, and adapted for casting. The ancient Romans already manufactured pipes of it, for the conveyance of water; indeed, it was generally known in antiquity, and is mentioned in the Bible. A more suitable material could scarcely be wished for the formation of bullets and shot, and the consumption for this purpose is enormous. Many of its alloys and chemical combinations are likewise applied on a very large scale; in type-founding, glass-making, glazing earthenware, as pigments, in medicine, &c.

The lead annually produced in Europe amounts to about 50,000 tons, of which England furnishes the greatest part, next the Rhine provinces, Austria, the Hartz, Spain, France, &c. The product of the United States of North America amounted to more than 15,000 tons in 1840.

This metal very seldom occurs *pure* in nature, and only in a few mines in England and Spain, as also in Madeira, where it has been found in very small portions in this condition. The most important ore of lead is a compound of this metal with sulphur, called *galena*, or *lead-glance*, since it has the colour and lustre of lead, only it is not malleable. Galena occurs frequently in crystals of cubic form, which split in cubes very readily, but the ordinary form in which it is found is that of granular masses. Metallic lead may readily be obtained from it by fusing it with soda, upon charcoal, before the blowpipe, as is the case with almost all the compounds of lead; the charcoal becomes coated with a greenish-yellow precipitate. Galena contains 13.5 of sulphur and 86.5 of lead in 100 parts.

Lead is obtained from this ore by roasting and fusing it with coal or charcoal, or it is melted with granulated cast iron and dross, in which case the sulphur passes over to the iron and the lead is separated. Galena often contains silver, and this metal is then found in the lead obtained from the galena. The extraction of the silver is of great importance. In this operation the lead is converted into what is called *litharge*, which is used in glazing pottery.

Galena is found in beds and veins, in transition and sedimentary rocks, and in the primitive rocks also; England and Scotland, Frieberg in Saxony, the Hartz, Bleiberg and Windischkappel in Carinthia, are rich localities for this ore. Lead is also found combined with oxygen and acids, and among these compounds are *lead-spar*, or *white lead-ore*, *green* and *brown lead-ore*, *yellow lead-ore*, and *red lead-ore*, named according to their colours. The green lead-ore, in particular, containing phosphoric acid, and the red lead-ore, containing chromic acid, are beautiful minerals, and while the former often encrusts the rock like a fresh green moss, the latter might be esteemed as a precious stone, like the ruby, if its want of hardness did not prevent its taking its place among the gems. This *red lead-ore*, which occurs rarely, and in handsome groups of crystals, in Siberia alone, is of an orange colour when pulverized, and is used as a pigment, but this is mostly prepared artificially, as mentioned under the head of chromate of iron.

White lead-ore is a carbonate of the oxide of lead, and occurs universally where lead-ores present themselves. It is also prepared artificially on a great scale, and is the essential part of the paint called *white-lead*. The pigment called *red-lead* is an oxide of lead occurring but sparingly in nature, but is manufactured in large quantities, especially in England. It is a property of most metallic oxides and their compounds to act as poisons when they enter the body in solution. Lead glazes dissolved off earthen vessels by vinegar, and the lead shot left in bottles which are often cleaned with them, thus remaining a long time in contact with wine, have often caused poisoning of this kind.

There is a metal which possesses almost all the good qualities of lead without sharing in its evil ones, namely, *tin*, an element very much resembling silver in colour and lustre, and which is obtained from *tin-ore*, its compound with oxygen (78.6 of tin and 21.4 of oxygen). This tin-ore, like most of the metallic oxides, has not at all the aspect of an ore, and its great specific gravity alone, amounting to 7, gives indication that it is a stone of metallic nature. It resembles many brown garnets, and occurs in crystals which are quadratic pyramids and prisms, and which ordinarily present themselves in what are called *hemitropes*. The name hemitrope signifies a thing turned half round, because the crystal which is so called looks as if it had been cut in half, and one portion turned half round upon the other. Tin is readily obtained in a metallic form from tin-ore by fusing it with cyanide of potassium on charcoal before the blowpipe.

Tin-ore presents itself in primitive rocks, and occurs also in sedimentary deposits; Cornwall, the Erz-gebirge, Malacca, and Banca in India, China, &c., are rich localities. Tin is obtained from it by fusion with carbonaceous matters and slags. The English tin mines are the richest, and annually yield about 5000 tons, Saxony furnishes 145 tons, Bohemia 500 tons. Malacca tin is the purest. Tin is very soft and malleable, and emits a crackling noise when bent; it is more fusible than lead, but the oxide, tin-ore itself, is infusible. Tin is one of the most useful metals, and has a thousand applications. It is very little attacked by articles of food and drink, and does not form any poisonous compounds like lead and copper; hence it is especially useful for plates, cans, cups, &c., and it also serves to coat copper and iron vessels, for "tinning" as it is called, which operation was known by the Romans. They called this metal *stannum*, whence the German word *stanniol* applied to tin-foil, tin beaten into very thin sheets, used for a variety of purposes, in excluding air and moisture in the preservation of food, wine, seeds, &c. What is called *tin-plate* or *white iron*, is thin sheet-iron coated with tin, and beautiful crystalline markings may be produced on this by acting upon it with weak nitric acid, forming what is called *metal moirée*. Tin also furnishes very useful alloys, among which that with copper, already mentioned, is the most familiar. As it renders most malleable metals brittle or less malleable, the older chemists called it the *devil* of the metals, and since it is used amalgamated with quicksilver for coating our mirrors, we have much commerce with the devil, which has subsisted since the fourteenth century, for that was the period in which the modern method of coating mirrors was discovered. Combined with lead, tin gives the easily fusible alloy called *soft-solder*. The oxide of tin is used in the manufacture of enamels, and chloride of tin is of very important application in dyeing, as a mordant. Gold purple, or purple of Cassius, has already been mentioned under gold.

The tin-ore referred to is the only ore from which tin is extracted; it occurs but rarely, otherwise, as a constituent of metallic compounds, and is not found pure, or if the accounts are correct, only in excessivley rare instances, in small granules in the Siberian gold-washings. English tin was known at a very early period; the Phœnicians exported it in the fourth century before the Christian era, from Cadiz, and dealt in it with the Romans, without making known the native locality. But the latter secretly followed their ships and then conquered the English tin-islands, which they called the Cassiterides.

The ready fusibility and the similar colour allies tin to *bismuth*, which metal is mostly found pure in nature, and but rarely in combination with sulphur or other elements. The fresh fracture has a reddish-silvery white colour, it is soft and brittle, and may be easily pulverized. It melts very readily, and crystallizes from the molten fluid, so that it is often obtained in beautiful dice-like crystals, which may be split parallel to their faces. Distinct crystals are rarely met with in nature; it mostly occurs in granular, foliaceous masses, which form reticulated or feathery figures in the rock in which they are embedded. On the whole, it is rare, being chiefly found in primitive rocks, in gneiss, clay-slate, &c., as in the Saxon Erz-gebirge, which annually produces about 20 tons; also in small quantities in Styria, Sweden, Norway, &c. The extraction is tolerably simple, the crushed ore being heated in inclined cast-iron tubes; the bismuth then flowing down from the rock is received in iron vessels filled with powdered charcoal.

This metal, which was first mentioned in the fifteenth century, has no important applications, but some of its alloys with lead have been found of use, and are remarkable for their fusibility, which is so great that the melting takes place at the boiling point of water, or even below. Such alloys (Rose's fusible alloy) are used for taking casts from wooden moulds, or taking impressions by the stamping process called cliché casting; also in safety-valves for steam-boilers, which at a certain temperature melt and allow the exit of the steam, &c. It is also used for fluxes in glass and porcelain painting, and in amalgams for mirrors, while some of its salts with nitric acid and chlorine, give a delicate white powder, which is used as a cosmetic. This was formerly an article of considerable trade, under the name of Spanish white (*blanc d'Espagne*).

Among the metals which have most occupied the chemists of ancient and modern times, and which have made good a character for varied value and interest on account of use in medicine, as also in alloys, is *antimony*. It was known to the ancients in its combination with sulphur, and was called by the Romans *Stibium*, which is derived from a Greek word signifying a cosmetie paint, for sulphuret of antimony was used by the Greek and Asiatic women to colour the hair and eyebrows black, a custom which survives in Upper Egypt. The name of antimony occurs first in the eighth century, and is said to have been derived from the Arabic. A tale is also related that this name comes from *antimoine*, or *anti-monachum*, signifying "against the monk," because a monk named Basilius Valentinus, who worked much at the metals, found, from experiment, that it had the effect of fattening swine; and "since he naturally wished to give the brothers of his monastery the benefit of this last property, he advised them to use his antimonials. Unluckily, however, many of the monks died of these medicines," whence the metal is said to have obtained the said name as a monk's poison. The German name is *spiess-glance*, or *spiess-glas*, referring to the brilliant needle- and spear- (spiess) shaped crystals, which are the peculiar form of the ordinary antimonial ore.

The medicinal effects of the preparations of antimony were the chief inducements which led the olden chemists to the study of this metal, and the Basilius Valentinus above mentioned, held them so high, that in a little tract called "The Triumphal Car of Antimony," he says of it: "It is the first of medicines, is equal to mercury, has equal effect with gold, has all the colours of the world, has the virtues of all the metals, gives wealth and health, has every taste, sweet, sour, bitter, saline, is a poison," &c., &c. But antimony was an important agent in gold-making, in the preparation of the philosopher's stone, &c., and some alchemists on this accou' called it *omnia in omnibus*, all in all.

This remarkable metal very rarely occurs *pure* and unmixed in nature. When it does, it forms foliaceous granular masses of a tin-white colour and brilliant metallic lustre, is brittle, rather hard, and melts readily (even in the flame of a candle), at the same time being gradually volatilized into a white vapour (the oxide). It is found in small portions at Allemont in France, in the Hartz, and at Prizbram in Bohemia. The common ore, used in the arts, is the *sulphuret of antimony*, composed of 27 parts sulphur and 73 parts antimony. Among mineralogists it is known by the name of *antimony-glance*. It usually forms needle-shaped or spike-like crystals of a bluish-grey colour, sometimes tinged with variegated hues upon the surface. It is also found in granular and radiated masses. It may readily be distinguished from similar ores, both by its easy fusibility and by its volatilizing in a white smoke, which settles on the charcoal before the blowpipe, and further, by the grey powder immediately assuming a yellow-ochre colour when heated with caustic potash. Hungary contains localities for this ore, and it occurs in great beauty at Schemnitz, Kremnitz, and Felsobanya, also at Prizbram in Bohemia, Wolfach in Baden, Allemont, Goldkronach in Bayreuth, &c.

The ore is separated from the rock with which it is associated, by melting it out in earthen pots or tubes, like bismuth. This fused sulphuret of antimony occurs in trade under the name of *crude antimony*.

To obtain the pure metal, the crude antimony is roasted to drive off the sulphur, and then reduced in crucibles with charcoal and potash, or it is fused in contact with iron, under which circumstances the sulphur passes over to the iron, and leaves the antimony free. Antimony forms alloys with lead and tin used in the manufacture of printing type, the antimony giving the requisite hardness. Some of its compounds with sulphur and oxygen have emetic properties, and, as already said, are greatly used in medicine. Among these are the preparations called kermes mineral, golden sulphuret, or oxysulphuret of antimony (a mixture of oxide and sulphuret of antimony), and tartar emetic (potassio-tartrate of antimony). These celebrated medicines cost the lives of many human beings before they were obtained in the same purity, and their effects as thoroughly understood, as at present. A certain Gui Patin wrote a book on them, containing a list of the medicinal martyrs who had fallen a sacrifice to *antimony-glance*, and in 1566 the use of antimonials was forbidden to all physicians by the parliament of Paris, a law which was not repealed till a hundred years later. Without taking into account other circumstances, many cases treated with antimonials turned out unfortunate, even from the circumstance that formerly no means were known of properly separating from crude antimony the arsenic which frequently occurs in it; hence the antimonial preparations contained more or less of that metal. Sulphuret of antimony has also come into great use in recent times, in the manufacture of percussion-caps for fire-arms, the detonating powder consisting of this substance mixed with chlorate of potash.

Iron and steel objects, arms, and similar articles, are imitated by applying finely powdered antimony upon pasteboard.

Other compounds of antimony, besides the sulphuret mentioned, occur only in very small quantity in nature; among these, what is called *white antimony* (oxide of antimony), and *red antimony* or *antimony blende* (sulphuret of antimony with oxide of antimony); and antimony is also a constituent in many lead, copper, and silver ores.

Closely related to antimony in chemical characters is the metal *arsenic*, a name dreaded as widely as it is known. The name is derived from the Greek, and indicates *strong*, *powerful*, probably on account of its violent effects upon animal organization. The Greeks, it is true, seem only to have been acquainted with the yellow and red sulphurets of arsenic, which are mentioned by Pliny under the names of *Auripigmentum* and *Sandaraca*. Certain knowledge of what is called white arsenic cannot be detected before Geber, in the eighth century, and the method of preparing metallic arsenic artificially was taught first in 1694, by the German chemist Schröder.

Arsenic occurs in nature both pure and combined with sulphur, but also forms a constituent of many other ores, so that it is pretty widely diffused.* Metallic arsenic is of a tin-white on a fresh fracture, but soon becomes tinged grey or blackish. It is rather hard and brittle, and is volatilized

* It is worthy of notice that traces of arsenic have been discovered in many mineral waters, among others in those of Kissingen, Wiesbaden, Ems, Pyrmont, &c. But the quantity is extremely small, so that no injurious effect is to be feared from it.

before the blowpipe, without melting, in the form of a white vapour, which has a strong scent of garlic, a characteristic mark, which exists also in its compounds. When it is heated in a glass tube closed at the bottom, the vapour formed is condensed in the cold end of the tube as a grey metallic mirror, that is to say, a metallic *sublimate* is obtained.* Pure arsenic does not occur often in nature, and it mostly forms kidney-shaped laminated compound masses, which are compact and finely granular in the fracture. It occurs in veins in the primitive rocks, with silver, lead, and bismuth ores, &c., principally in the Erz-gebirge, the Hartz, Alsace, Styria, Hungary, &c. Metallic arsenic is mostly obtained from arsenical ores. These are roasted, which causes the arsenic to combine with the oxygen of the atmosphere, and to be volatilized as a vapour, which is conducted into condensing chambers, called by the workmen the "poison-traps," where it is deposited as a white powder, *white arsenic* as it is called, from which metallic arsenic is obtained by sublimation, by heating it with charcoal in cast-iron vessels. Among the most important of the ores is *arsenical pyrites*, a compound of arsenic, sulphur, and iron, which is very widely distributed. Arsenical pyrites has a tin-white colour on the fresh fracture, and occurs principally in rod-shaped masses, but also in little rhombic prisms. A mine has been worked for such pyrites, for the sake of the arsenic, for four hundred years, at Altenberg, in Silesia. Fifteen tons of arsenic are obtained in five or six weeks, when the "poison-traps" are cleared out, and in this operation the workmen cover the face with a leather mask furnished with glass eye-holes, wearing at the same time closely-fastened leather clothing.

This oxide of arsenic, which sometimes occurs also in nature with other arsenical ores, is that fearful poison which has been the instrument of so many crimes, and caused so many melancholy accidents. When heated in a glass tube it sublimes in beautiful, brilliant octohedral crystals. They cover the walls of the tube like so many little diamonds, and when we contemplate a little heap of these sparkling, innocent-looking crystals, it seems scarcely credible that death dwells in them—death in its most gloomy form and with all its terrors. The compounds which arsenic forms

* *Sublimate* is the product of evaporation obtained in a solid form; when the duct is a fluid it is called a *distillate*.

with sulphur, called *orpiment* and *realgar*, are also poisonous, but not in so high a degree as the oxide. These sulphurets exhibit remarkable colours: orpiment, a citron-yellow with a high lustre; realgar, a red, like that of dawn; and they remind us of the similarly poisonous beauties of the vegetable kingdom, the toadstools, with their bright purple; the monk's-hood, with its elegant yellow or blue blossom; the mezereon, with its rosy flowers, &c.

Orpiment ordinarily forms a confused heap of tough plates, with a mother-of-pearl-like lustre; realgar, often short prismatic crystals, which are frequently transparent or translucent, and the red colour of which changes into yellow when they are broken or powdered. Both are easily fusible and volatile, with a fœtid vapour. Orpiment is composed of 40 parts sulphur and 60 parts arsenic; realgar, of 30 parts sulphur and 70 parts arsenic. Both are met with in great beauty in veins at Kapnik, Felsobanya, and Tajowa in Hungary; also at Joachim's-thal in Bohemia, Markirch in Alsace, &c. They are used as pigments, and prepared artificially, by melting and subliming arsenical pyrites, or white arsenic, with sulphur. They are also used to colour flame in pyrotechny.

The most important use made of metallic arsenic is in the manufacture of leaden shot, an addition of arsenic (2 per cent.) rendering the lead harder and more inclined to take a globular form. Combined with other metals, arsenic destroys their good qualities more than it increases them; thus it makes gold brittle, platinum fusible, and liable to fracture, iron "red-rotten"—that is, when present even in very small quantity it renders it incapable of being worked at a red heat, as it falls to pieces under the hammer. With copper it forms a white alloy, which has been used for optical mirrors. In commerce, metallic arsenic is also known as "fly-stone" and "pot-cobalt." White arsenic acts as an acid, and is therefore called arsenious acid, and with oxide of copper it forms a compound of a bright green colour, which is known under the name of *Scheele's green* and other titles, is used in painting and colour-printing, and is very poisonous. White arsenic is also used as a fly and rat-poison, and for protecting skins from the attacks of insects.

The chemistry of recent times has been much busied with this poison, and the investigations on this account have turned almost entirely upon its detection and its antidotes. Runge says: "The chemists have followed up arsenious acid just as the police track a noted malefactor, a particular description of it (*signalement*) stands in every chemical book, and it may be fairly said that it has been printed a million times already, and cannot be too often repeated." But the chemists have not laboured for nothing; and it is, above all, owing to the celebrated trial of Madame Laffarge, and the investigations connected therewith, that we are now in a position to detect the slightest traces of arsenic. It is sad to have to relate that a distinguished chemist, Gehlen, in the year 1815, met a lamentable death from a few unlucky inhalations, while experimenting on the very substances which now serve for the detection of arsenic. His researches upon arsenic, namely, and those of other chemists, led to the discovery of arseniuretted hydrogen, an invisible but most deadly poisonous gas, which is inflammable, and when a cold porcelain saucer is held in the flame, deposits metallic arsenic in a greyish-black patch. The English chemist, Marsh, applied this experiment as a test for arsenic (Marsh's test), as this arseniuretted hydrogen may easily be formed in any substance containing arsenic, and thus the presence of the latter is readily detected. Chemists have also discovered a powerful antidote to poisoning with white arsenic; this is freshly prepared hydrated oxide of iron (*i.e.*, oxide of iron containing water).

This metal, with its compounds, seems like a destroying demon—a foe to every living thing—and only when life is extinct does it present itself as a preserver of the dead, protecting the dead body from decay. Its mischievous effect is not confined to animal life, it is poisonous also to vegetables.

We close the list of the metals coming under our consideration with a short notice of one which is distinguished by especially remarkable properties—namely, *quicksilver or mercury*. While all the other metals occurring in nature are *solid*, and their point of fusion descends only to the boiling point of water in a few alloys, while some are infusible in the strongest heat of our furnaces, quicksilver, as is well known, is *fluid* at common temperatures, and only becomes solidified at a cold of 40° below zero, Fahrenheit, at which point it may be hammered and cut like lead. The name seems to refer to the ordinary fluid condition, having probably originated from the old word *quick*, living or lively, and *silver*.

The fluid condition renders quicksilver of the greatest value in many physical applications, as for example, in the barometer and thermometer, two well-known instruments, in the former of which the height of the column of quicksilver enables us to ascertain the varying pressure of the atmosphere, while in the latter the expansion and contraction of the enclosed metal indicates the rise or fall of temperature. Other fluids besides quicksilver may be used for thermometers, since all expand by heat and contract by cold, but this takes place most uniformly with quicksilver; for the barometer we have no fluid which can replace quicksilver, because none is so heavy as this metal, which is 13½ times heavier than water, and thus even a column of very small height (28 inches) is capable of balancing the pressure of the column of air of the atmosphere. If the column of quicksilver were replaced by water, for example, we should require a tube more than 32 feet high, and not to speak of the fact that such a barometer would be immovable, the evaporation of the water and other inconveniences would render the instrument very inefficient.*

Quicksilver is only found in notable quantity in nature, either pure, or mixed with sulphur as what is called *cinnabar*. Pure quicksilver forms drops of various size clinging among the rocks, or it occurs enclosed in cavities, and it is met with almost always in company with cinnabar, in clay-slate and carboniferous sandstones. Associated with it sometimes occurs what is termed *amalgam*, a compound of quicksilver (65 per cent.) with silver (35 per cent.), which looks like silver but is not malleable, and in which the quicksilver is easily detected by heating a fragment in a glass tube before the blowpipe. The quicksilver is volatilized, and condenses in the colder parts of the tube in metallic drops, the silver remaining behind.

The most important ore of quicksilver, from which most of the metal is obtained, is *cinnabar*. Its name is said to be

* The barometer was invented in 1643 by Toricelli, in Florence, and the fact that it must stand lower at the summit of a high mountain, in consequence of the smaller pressure of the atmosphere, than at the foot, was first practically demonstrated by Pascal, who caused a barometer to be taken to the peak of a mountain 5000 feet high, Puy de Dome, in Auvergne, where it was observed that it stood three inches lower than at the foot of the mountain.

of Indian extraction, and to signify dragon's blood, on account of the red colour. Cinnabar rarely occurs in distinct crystals, but chiefly in compact crystalline masses, in patches, or encrusting the rock. Its colour is cochineal-red, the powder is scarlet, the lustre adamantine. In many crystals, but these are rare, it is transparent. It resembles red lead-ore and realgar, which, however, are at once distinguished by the orange-yellow colour of their powders. Cinnabar is volatile before the blowpipe, and when it is mixed, in powder, with soda, and heated in a glass tube, the quicksilver contained may readily be detected, since it is deposited in the tube in little drops, like a metallic dew, and by scraping this together with a feather the globules of quicksilver become distinctly visible.

Quicksilver is obtained from cinnabar on a large scale, by separating the sulphur by means of lime or iron hammerings (the particles beaten off in forging), for which purpose a distillation is effected in cast-iron vessels, the quicksilver being collected in clay or iron receivers; or the cinnabar is heated in an open fire, with the access of air, by which means the sulphur is burnt off, and the quicksilver vapour is condensed in suitable chambers or receivers.

The most renowned quicksilver mines are those of Almaden, in Spain, and of Idria, in Carinthia. The former yield an annual product of 1150 tons: Idria produces only about 100 tons. Both mines are very old; that of Idria is said to have been discovered in the year 1497. Quicksilver mines exist also in Deux Ponts; these were formerly very rich, but at present yield very little; there are others, also, in Hungary and Transylvania. The soil of Lisbon is said to contain a good deal of quicksilver, but the collection to be so difficult, that the attempts made have been given up.

Those who work in quicksilver mines are very liable to be poisoned, and those especially suffer who have to clear out the quicksilver from the condensing chambers. As they breathe the floating particles of quicksilver, and absorb it through the skin, they soon become salivated, and are attacked by affections of the nervous system, in particular by what is called the mercurial palsy. The vapours of quicksilver are particularly poisonous in their effects; and a fire in the mines of Idria, on the 11th of May, 1803, poisoned the whole body of 1300 workmen by the mercurial vapours it produced, the greater portion being seized with a permanent palsy; all, however, being affected with sickness and debility, from which they never recovered. A similar case happened off Cadiz, in 1810, on board a ship laden with quicksilver. A portion of the metal escaped from the rotten bags, and the vapours from this produced symptoms of mercurial poisoning in the entire crew. Still more poisonous are the effects of the compounds of this metal with oxygen and chlorine, and some of them are exceedingly active; one compound of chlorine and quicksilver, however, *calomel* (quicksilver 85 parts, chlorine 15 parts), which, under certain circumstances, is not injurious, has numerous applications in medicine. This compound is met also in nature, but is a rarity.

The history of quicksilver affords abundance of facts of the highest interest, both for science and for the arts; hence a few words upon it may not be superfluous. Although the metal was mentioned by Theophrastus 300 B.C., and its preparation from cinnabar described, while it appears to have been little known previously, the alchemists were the first to make an accurate acquaintance with its properties, and they esteemed it as much as an essential and useful material in gold-making as they extolled its medicinal effects, and occupied themselves with the preparation of innumerable mercurial drugs. Among other things, they were able to convert this metal, by continued heating in the air, into a red powder, without knowing the cause of the phenomenon. This red powder (oxide of mercury, which, by a stronger heat, is decomposed into quicksilver and oxygen) gave rise at a later period to a total reform of chemistry, for from this powder oxygen was first prepared in a gaseous form, that element which is diffused more widely than any other in the air, water, and earth, which changes the metals with which it combines, so as to render them unrecognisable, which plays so important a part in its chemical processes, ruling over the combustion of bodies, and which has been demonstrated to be an indispensable element of life.

Priestley first discovered oxygen gas in 1774, and Lavoisier next showed that when metals are burnt, they are attacked by this oxygen; that it is this constituent of atmospheric air alone which supports combustion; that respiration is a kind of combustion, &c. The discovery of oxygen, and the recognition of its compounds, solved a thousand enigmas in chemistry; and the rapid progress since this discovery sufficiently proves its high value. Lavoisier has immortal merit in this. Robespierre's government rewarded him for it on the scaffold, in 1794.

The study of quicksilver has, moreover, led to the discovery of a salt, prepared with quicksilver, nitric acid and alcohol, which on account of its violent detonation is called *fulminating mercury*. This preparation (discovered by Howard in 1799) was formerly used for the priming of the caps of percussion fire-arms. The preparation and use of it are exceedingly dangerous, and the first maker of percussion-caps, Leroy, paid for this invention with his life. Nevertheless, experiments on its preparation were continued, and in 1836 the manufacturers of Paris, Prague, and Schönebeck, turned out daily more than a million of caps. Another detonating substance has been recently introduced, that named under antimony.

The applications of quicksilver in amalgamation and in the extraction of gold and silver, as also in gilding and silvering, have already been mentioned under these metals, and the amalgam for coating mirrors, under tin. The cinnabar used as a pigment under the name of *vermilion*, is ordinarily prepared artificially by subliming quicksilver and sulphur, or by a peculiar treatment of a similar mixture with caustic potash.

Other metals besides those we have mentioned occur in nature, mostly in combinations, but they are more or less rare; such are Cadmium, Cerium, Iridium, Lantanium, Molybdenum, Osmium, Palladium, Rhodium, Tantalium, Tellurium, Uranium, Vanadium, and Wolfram. Among them, Iridium is worthy of notice as the *heaviest* of known substances, being almost 24 times as heavy as water. It is silver-white, very hard, and still more infusible than platinum, with which it occurs in isolated grains in the sands of the Ural.

And thus may we close these sketches; and if the reader have only learnt to recognise the value of science, and how it has ever proved the basis and upholder of all practical art, the purpose is attained which constituted the principal aim in their preparation.

INDEX.

THE END.

A Select Catalogue of

NEW BOOKS AT REDUCED PRICES,

PUBLISHED OR SOLD BY

HENRY G. BOHN,

YORK STREET, COVENT GARDEN, LONDON.

THE COMPLETE CATALOGUE OF NEW BOOKS AND REMAINDERS, IN 100 PAGES, MAY BE HAD GRATIS.

*** *All the Books advertised in the present Catalogue are neatly boarded in cloth, or bound.*

FINE ARTS, ARCHITECTURE, SCULPTURE, PAINTING, HERALDRY, ANTIQUITIES, TOPOGRAPHY, SPORTING, PICTORIAL AND HIGHLY ILLUSTRATED WORKS, ETC. ETC.

ANGLER'S SOUVENIR. Fcap. 8vo, embellished with upwards of 60 beautiful Engravings on Steel by Beckwith and Topham, and hundreds of engraved Borders, every page being surrounded (pub. at 18s.), cloth, gilt, 9s. *Tilt*, 1835

ARTIST'S BOOK OF FABLES, comprising a Series of Original Fables, illustrated by 280 exquisitely beautiful Engravings on Wood, by Harvey and other eminent Artists, after Designs by the late James Northcote, R.A. Post 8vo, Portrait (pub. at 1*l.* 1s.), cloth, gilt, 9s. 1845

BARBER'S ISLE OF WIGHT. 42 fine Steel Plates, and Dr. Mantell's Geological Map. 8vo, gilt, cloth, 10s. 6d. 1845

BEWICK'S SELECT FABLES, with a Memoir, 8vo, with several Portraits of Bewick, and upwards of 350 Engravings on Wood, original impressions (pub. at 1*l.* 1s.), bds. 10s. *Newcastle*, 1820

BILLINGTON'S ARCHITECTURAL DIRECTOR, being an approved Guide to Architects, Draughtsmen, Students, Builders, and Workmen, to which is added a History of the Art, &c. and a Glossary of Architecture. New Edition, enlarged, 8vo, 100 Plates, cloth lettered (pub. at 1*l.* 8s.) 10s. 6d. 1848

BOOK OF COSTUME, from the earliest period to the present time. Upwards of 200 beautiful Engravings on Wood, by Linton. 8vo (pub. at 1*l.* 1s.), gilt cloth, gilt edges, 10s. 6d. 1847

BOOK OF GEMS, OR THE POETS AND ARTISTS OF GREAT BRITAIN. 3 vols. 8vo. 150 exquisite Line Engravings after Turner, Bonington, Landseer, Roberts, Mulready, etc. etc.; also numerous Autographs (pub. at 4*l.* 14s. 6d.) Cloth elegantly gilt, 2*l.* 5s., or in morocco, 3*l.* 3s.

BOOK OF GEMS, OR THE MODERN POETS AND ARTISTS OF GREAT BRITAIN. 8vo. 50 exquisitely beautiful Line Engravings after Turner, Bonington, etc. etc. (pub. at 1*l.* 11s. 6d.), cloth elegantly gilt, 15s., or morocco, 1*l.* 1s. 1844

BOOK OF RAPHAEL'S CARTOONS, BY CATTERMOLE. 8vo, with an exquisite Portrait of Raphael, a View of Hampton Court, and seven very highly finished Steel Engravings of the celebrated Cartoons at Hampton Court (pub. at 15s.), cloth, gilt, 7s. 6d. 1845

BOOK OF SHAKSPEARE GEMS. A Series of Landscape Illustrations of the most interesting localities of Shakspeare's Dramas; with Historical and Descriptive Accounts, by Washington Irving, Jesse, W. Howitt, Wordsworth, Inglis, and others. 8vo, with 45 highly-finished Steel Engravings (pub. at 1*l.* 11s. 6d.) gilt cloth, 14s. 1845

BOOK OF WAVERLY GEMS. A Series of 64 highly-finished Line Engravings of the most interesting Incidents and Scenery in Walter Scott's Novels, by Heath, Finden, Rolls and others, after Pictures by Leslie, Stothard, Cooper, Howard, &c., with illustrative letterpress, 8vo. (pub. at 1*l.* 11s. 6d.), cloth, elegantly gilt, 15s. 1846

BROCKEDON'S PASSES OF THE ALPS. 2 vols. medium 4to. Containing 109 beautiful Engravings (pub. at 10*l.* 10*s.* in boards), half-bound morocco, gilt edges, 3*l.* 13*s.* 6*d.* 1829

BRITTON'S CATHEDRAL CHURCH OF LINCOLN, 4to, 16 fine Plates, by Le Keux, (pub. at 3*l.* 3*s.*), cloth, 1*l.* 5*s.* Royal 4to, Large Paper, cloth 1*l.* 11*s*, 6*d.* 1837
This volume was published to complete Mr. Britton's Cathedrals, and is wanting in most of the sets.

BRYAN'S DICTIONARY OF PAINTERS AND ENGRAVERS. New Edition, corrected, greatly enlarged, and continued to the present time, by George Stanley, Esq., complete in one large volume, impl. 8vo, numerous plates of monograms, 2*l.* 2*s.*

BULWER'S PILGRIMS OF THE RHINE. 8vo. Embellished with 27 exquisite Line Engravings after David Roberts, Maclise, and Parris (pub. at 1*l.* 11*s.* 6*d.*), cloth gilt, 14*s.*

BURNETT'S ILLUSTRATED EDITION OF SIR JOSHUA REYNOLDS ON PAINTING, 4to, 12 fine Plates, cloth (pub. at 2*l.* 2*s.*), 1*l.* 1*s.* 1842
——— the same, large paper, royal 4to, proof impressions of Plates, cloth (pub. at 4*l.* 4*s.*), 2*l.* 2*s.*

CANOVA'S WORKS, engraved in outline by Moses, with Descriptions and a Biographical Memoir by Cicognara. 3 vols. imp. 8vo, 155 plates, and fine Portrait by Worthington, half-bound morocco (pub. at 6*l.* 12*s.*) 2*l.* 5*s.*
——— the same, 3 vols. 4to, large paper, half-bound, uncut (pub. at 9*l.* 18*s.*), 4*l* 4*s.*
——— the same, 3 vols. 4to, large paper, India Proofs, in parts, (pub. at 15*l.* 15*s.*) 7*l.* 10*s.*

CARTER'S ANCIENT ARCHITECTURE OF ENGLAND. Illustrated by 103 Copper-plate Engravings, comprising upwards of Two Thousand specimens. Edited by John Britton, Esq. Royal folio (pub. at 12*l.* 12*s.*), half-bound morocco, 4*l.* 4*s.* 1837

CARTER'S ANCIENT SCULPTURE AND PAINTING NOW REMAINING IN ENGLAND, from the Earliest Period to the Reign of Henry VIII. With Historical and Critical Illustrations, by Douce, Gough, Meyrick, Dawson Turner, and Britton. Royal folio, with 120 large Engravings, many of which are beautifully coloured, and several illuminated with gold (pub. at 15*l.* 15*s.*), half-bound morocco, 8*l.* 8*s.* 1838

CARTER'S GOTHIC ARCHITECTURE, and Ancient Buildings in England, with 120 Views, etched by himself. 4 vols. square 12mo (pub. at 2*l.* 2*s.*), half morocco, 18*s.* 1824

CATLIN'S NORTH AMERICAN INDIANS. 2 vols. impl. 8vo. 360 Engravings (pub. at 2*l.* 12*s.* 6*d.*), cloth, emblematically gilt, 1*l.* 10*s.* 1848

CATTERMOLE'S EVENINGS AT HADDON HALL. 24 exquisite Engravings on Steel, from Designs by himself. Post 8vo (originally pub. at 1*l.* 11*s.* 6*d.*), gilt cloth, gilt edges, 7*s.* 6*d.*

CHAMBERLAINE'S IMITATIONS OF DRAWINGS from the Great Masters, in the Royal Collection, engraved by Bartolozzi and others, impl. fol. 70 Plates (pub. at 12*l.* 12*s.*), half-bound morocco, gilt edges, 5*l.* 5*s.*

CLAUDE'S LIBER VERITATIS. A Collection of 300 Engravings in imitation of the original Drawings of Claude, by Earlom. 3 vols. folio (pub. at 31*l.* 10*s.*), half-bound morocco, gilt edges, 10*l.* 10*s.*

CLAUDE, BEAUTIES OF, 24 FINE ENGRAVINGS, containing some of his choicest Landscapes, beautifully Engraved on Steel, folio, with descriptive letter-press, and Portrait, in a portfolio (pub. at 3*l.* 12*s.*), 1*l.* 5*s.*

COESVELT'S PICTURE GALLERY. With an Introduction by Mrs. Jameson. Royal 4to 90 Plates beautifully engraved in outline. India Proofs (pub. at 5*l.* 5*s.*), half-bound morocco extra, 3*l.* 3*s.* 1836

COOKE'S SHIPPING AND CRAFT. A Series of 65 brilliant Etchings, comprising Picturesque, but at the same time extremely accurate Representations. Royal 4to (pub. at 3*l.* 13*s.* 6*d.*), gilt cloth, 1*l.* 11*s.* 6*d.*

COOKE'S PICTURESQUE SCENERY OF LONDON AND ITS VICINITY. 50 beautiful Etchings, after Drawings by Calcott, Stanfield, Prout, Roberts, Harding, Stark, and Cotman. Royal 4to. Proofs (pub. at 5*l.*), gilt cloth, 2*l.* 2*s.*

CONEY'S FOREIGN CATHEDRALS, HOTELS DE VILLE, TOWN HALLS, AND OTHER REMARKABLE BUILDINGS IN FRANCE, HOLLAND, GERMANY, AND ITALY. 32 fine large Plates. Imperial folio (pub. at 10*l.* 10*s.*), half morocco, gilt edges, 3*l.* 13*s.* 6*d.* 1842

CORNWALL, AN ILLUSTRATED ITINERARY OF; including Historical and Descriptive Accounts. Imperial 8vo, illustrated by 118 beautiful Engravings on Steel and Wood, by Landells, Hinchcliffe, Jackson, Williams, Sly, etc. after drawings by Creswick. (Pub. at 16*s.*), half morocco, 8*s.* 1842
Cornwall is undoubtedly the most interesting county in England.

CORONATION OF GEORGE THE FOURTH, by Sir George Nayler, in a Series of above 40 magnificent Paintings of the Procession, Ceremonial, and Banquet, comprehending faithful portraits of many of the distinguished Individuals who were present; with historical and descriptive letter-press, atlas folio (pub. at 52*l.* 10*s.*), half bound morocco, gilt edges, 12*l.* 12*s.*

COTMAN'S SEPULCHRAL BRASSES IN NORFOLK AND SUFFOLK, tending to illustrate the Ecclesiastical, Military, and Civil Costume of former ages, with Letter-press Descriptions, etc. by Dawson Turner, Sir S. Meyrick, etc. 173 Plates. The enamelled Brasses are splendidly illuminated, 2 vols. impl. 4to half-bound morocco, gilt edges, 6*l.* 6*s.* 1838
——— the same, large paper, imperial folio, half morocco, gilt edges, 8*l.* 8*s.*

COTMAN'S ETCHINGS OF ARCHITECTURAL REMAINS in various counties in England, with Letter-press Descriptions by RICKMAN. 2 vols. imperial folio, containing 240 highly spirited Etchings (pub. at 24*l.*), half morocco, 8*l.* 8*s.* 1838

DANIELL'S ORIENTAL SCENERY AND ANTIQUITIES. The original magnificent edition, 150 splendid coloured Views, on the largest scale, of the Architecture, Antiquities, and Landscape Scenery of Hindoostan, 6 vols. in 3, elephant folio (pub. at 210*l.*), elegantly half-bound morocco, 52*l.* 10*s.*

DANIELL'S ORIENTAL SCENERY, 6 vols. in 3, small folio, 150 Plates (pub. at 18*l.* 18*s.* half-bound morocco, 6*l.* 6*s.*

This is reduced from the preceding large work, and is uncoloured.

DANIELL'S ANIMATED NATURE, being Picturesque Delineations of the most interesting Subjects from all Branches of Natural History, 125 Engravings, with Letter-press Descriptions 2 vols. small folio (pub. at 15*l.* 15*s.*), half morocco (uniform with the Oriental Scenery), 3*l.* 3*s.*

DON QUIXOTE, PICTORIAL EDITION. Translated by JARVIS, carefully revised. With a copious original Memoir of Cervantes. Illustrated by upwards of 820 beautiful Wood Engravings, after the celebrated Designs of TONY JOHANNOT, including 16 new and beautiful large Cuts, by ARMSTRONG, now first added. 2 vols. royal 8vo (pub. at 2*l.* 10*s.*), cloth gilt, 1*l.* 8*s.* 1843

DULWICH GALLERY, a Series of 50 Beautifully Coloured Plates from the most Celebrated Pictures in this Remarkable Collection; executed by R. COCKBURN (Custodian). All mounted on Tinted Card-board in the manner of Drawings, imperial folio, including 4 very large additional Plates, published separately at from 3 to 4 guineas each, and not before included in the Series. In a handsome portfolio, with morocco back (pub. at 40*l.*), 16*l.* 16*s.*

"This is one of the most splendid and interesting of the British Picture Galleries, and has for some years been quite unattainable, even at the full price."

EGYPT AND THE PYRAMIDS.—COL. VYSE'S GREAT WORK ON THE PYRAMIDS OF GIZEH. With an Appendix, by J. S. PERRING, Esq., on the Pyramids at Abou Roash, the Fayoum, &c. &c. 3 vols. imperial 8vo, with 60 Plates, lithographed by HAGHE (pub. at 2*l.* 12*s.* 6*d.*), 1*l.* 1*s.* 1840

EGYPT—PERRING'S FIFTY-EIGHT LARGE VIEWS AND ILLUSTRATIONS OF THE PYRAMIDS OF GIZEH, ABOU ROASH, &c. Drawn from actual Survey and Admeasurement. With Notes and References to Col. Vyse's great Work, also to Denon, the great French Work on Egypt, Rosellini, Belzoni, Burckhardt, Sir Gardner Wilkinson, Lane, and others. 3 Parts, elephant folio, the size of the great French "Egypte" (pub. at 15*l.* 15*s.*) in printed wrappers, 3*l.* 3*s.*; half-bound morocco, 4*l.* 14*s.* 6*d.* 1842

ENGLEFIELD'S ISLE OF WIGHT. 4to. 50 large Plates, Engraved by COOKE, and a Geological Map (pub. 7*l.* 7*s.*), cloth, 2*l.* 5*s.* 1816

FLAXMAN'S HOMER. Seventy-five beautiful Compositions to the ILIAD and ODYSSEY, engraved under FLAXMAN'S inspection, by PIROLI, MOSES, and BLAKE. 2 vols. oblong folio (pub. at 5*l.* 5*s.*), boards 2*l.* 2*s.* 1805

FLAXMAN'S ÆSCHYLUS, Thirty-six beautiful Compositions from. Oblong folio (pub. at 2*l.* 12*s.* 6*d.*), boards 1*l.* 1*s.* 1831

FLAXMAN'S HESIOD, Thirty-seven beautiful Compositions from. Oblong folio (pub. at 2*l.* 12*s.* 6*d.*), boards 1*l.* 5*s.* 1817

"Flaxman's unequalled Compositions from Homer, Æschylus, and Hesiod, have long been the admiration of Europe; of their simplicity and beauty the pen is quite incapable of conveying an adequate impression."—*Sir Thomas Lawrence.*

FLAXMAN'S ACTS OF MERCY. A Series of Eight Compositions, in the manner of Ancient Sculpture, engraved in imitation of the original Drawings, by F. C. LEWIS. Oblong folio (pub. at 2*l.* 2*s.*), half-bound morocco, 16*s.* 1831

FROISSART, ILLUMINATED ILLUSTRATIONS OF. Seventy-four Plates, printed in Gold and Colours. 2 vols. super-royal 8vo, half-bound, uncut (pub. at 4*l.* 10*s.*), 3*l.* 10*s.*

——— the same, large paper, 2 vols. royal 4to, half-bound, uncut (pub. at 10*l.* 10*s.*), 6*l.* 6*s.*

GELL AND GANDY'S POMPEIANA; or, the Topography, Edifices, and Ornaments of Pompeii. Original Series, containing the Result of the Excavations previous to 1819 2 vols royal 8vo, best edition, with upwards of 100 beautiful Line Engravings by GOODALL, COOKE HEATH, PYE, etc. (pub. at 7*l.* 4*s.*), boards, 3*l.* 3*s.* 1824

GEMS OF ART, 36 FINE ENGRAVINGS, after REMBRANDT, CUYP, REYNOLDS, POUSSIN, MURILLO, TENIERS, CORREGIO, VANDERVELDE, folio, proof impressions, in portfolio (pub. at 8*l.* 8*s.*), 1*l.* 11*s.* 6*d.*

GILLRAY'S CARICATURES, printed from the Original Plates, all engraved by himself between 1779 and 1810, comprising the best Political and Humorous Satires of the Reign of George the Third, in upwards of 600 highly spirited Engravings. In 1 large vol. atlas folio (exactly uniform with the original Hogarth, as sold by the advertiser), half-bound red morocco extra, gilt edges, 8*l.* 8*s.*

GILPIN'S PRACTICAL HINTS UPON LANDSCAPE GARDENING, with some Remarks on Domestic Architecture. Royal 8vo, Plates, cloth (pub. at 1*l.*), 7*s.*

GOETHE'S FAUST, ILLUSTRATED BY RETZSCH in 26 beautiful Outlines. Royal 4to (pub. at 1*l.* 1*s.*), gilt cloth, 10*s.* 6*d.*

This edition contains a translation of the original poem, with historical and descriptive notes.

GOODWIN'S DOMESTIC ARCHITECTURE. A Series of New Designs for Mansions, Villas, Rectory-Houses, Parsonage-Houses; Bailiff's, Gardener's, Gamekeeper's, and Park-Gate Lodges: Cottages and other Residences, in the Grecian, Italian, and Old English Style of Architecture: with Estimates. 2 vols. royal 4to, 96 Plates (pub. at 5*l.* 5*s.*), cloth, 2*l.* 12*s.* 6*d.*

GRINDLAY'S (CAPT.) VIEWS IN INDIA, SCENERY, COSTUME, AND ARCHITECTURE: chiefly on the Western Side of India. Atlas 4to. Consisting of 36 most beautifully coloured Plates, highly finished, in imitation of Drawings; with Descriptive Letter-press. (Pub. at 12*l.* 12*s.*), half-bound morocco, gilt edges, 8*l.* 8*s.* 1830

This is perhaps the most exquisitely-coloured volume of landscapes ever produced.

HANSARD'S ILLUSTRATED BOOK OF ARCHERY. Being the complete History and Practice of the Art: interspersed with numerous Anecdotes; forming a complete Manual for the Bowman. 8vo. Illustrated by 39 beautiful Line Engravings, exquisitely finished, by Englehart, Portbury, etc., after Designs by Stephanoff (pub. at 1*l.* 11*s.* 6*d.*), gilt cloth, 10*s.* 6*d.*

HARRIS'S GAME AND WILD ANIMALS OF SOUTHERN AFRICA. Large impl. folio. 30 beautifully coloured Engravings, with 30 Vignettes of Heads, Skins, &c. (pub. at 10*l.* 10*s.*), hf. morocco, 6*l.* 6*s.* 1844

HARRIS'S WILD SPORTS OF SOUTHERN AFRICA. Impl. 8vo. 26 beautifully coloured Engravings, and a Map (pub. at 2*l.* 2*s.*), gilt cloth, gilt edges, 1*l.* 1*s.* 1844

HEATH'S CARICATURE SCRAP BOOK, on 60 Sheets, containing upwards of 1000 Comic Subjects after Seymour, Cruikshank, Phiz, and other eminent Caricaturists, oblong folio (pub. at 2*l.* 2*s.*), cloth, gilt, 15*s.*

This clever and entertaining volume is now enlarged by ten additional sheets, each containing numerous subjects. It includes the whole of Heath's Omnium Gatherum, both Series; Illustrations of Demonology and Witchcraft; Old Ways and New Ways; Nautical Dictionary; Scenes in London; Sayings and Doings, etc.; a series of humorous illustrations of Proverbs, etc. As a large and almost infinite storehouse of humour it stands alone. To the young artist it would be found a most valuable collection of studies; and to the family circle a constant source of unexceptionable amusement.

HOGARTH'S WORKS ENGRAVED BY HIMSELF. 153 fine Plates (including the two well-known "suppressed Plates"), with elaborate Letter-press Descriptions, by J. Nichols. Atlas folio (pub. at 50*l.*), half-bound morocco, gilt back and edges, with a secret pocket for suppressed plates, 7*l.* 7*s.* 1822

HOLBEIN'S COURT OF HENRY THE EIGHTH. A Series of 80 exquisitely beautiful Portraits, engraved by Bartolozzi, Cooper, and others, in imitation of the original Drawings preserved in the Royal Collection at Windsor; with Historical and Biographical Letter-press by Edmund Lodge, Esq. Published by John Chamberlaine. Imperial 4to (pub. at 15*l.* 15*s.*), half-bound morocco, full gilt back and edges, 5*l.* 15*s.* 6*d.* 1812

HOFLAND'S BRITISH ANGLER'S MANUAL; Edited by Edward Jesse, Esq.; or, the Art of Angling in England, Scotland, Wales, and Ireland; including a Piscatorial Account of the principal Rivers, Lakes, and Trout Streams; with Instructions in Fly Fishing, Trolling, and Angling of every Description. With upwards of 60 exquisite Plates, many of which are highly-finished Landscapes engraved on Steel, the remainder beautifully engraved on Wood. 8vo, elegant in gilt cloth, 12*s.* 1848

HOPE'S COSTUME OF THE ANCIENTS. Illustrated in upwards of 320 beautifully-engraved Plates, containing Representations of Egyptian, Greek, and Roman Habits and Dresses. 2 vols. royal 8vo, New Edition, with nearly 20 additional Plates, boards, reduced to 2*l.* 5*s.* 1841

HOWARD (FRANK) ON COLOUR, as a Means of Art, being an adaptation of the Experience of Professors to the practice of Amateurs, illustrated by 18 coloured Plates, post 8vo, cloth gilt, 8*s.*

In this able volume are shown the ground colours in which the most celebrated painters worked. It is very valuable to the connoisseur, as well as the student, in painting and water-colour drawing.

HOWARD'S (HENRY, R. A.) LECTURES ON PAINTING. Delivered at the Royal Academy, with a Memoir, by his son, Frank Howard, large post 8vo, cloth, 7*s.* 6*d.* 1848

HOWARD'S (FRANK) SPIRIT OF SHAKSPEARE. 483 fine outline Plates, illustrative of all the principal Incidents in the Dramas of our national Bard, 5 vols. 8vo (pub. at 14*l.* 8*s.*), cloth, 2*l.* 2*s.* 1827—33

*** The 483 Plates may be had without the letter-press, for illustrating all 8vo editions of Shakspeare, for 1*l.* 11*s.* 6*d.*

HUMPHREY'S (H. NOEL) ART OF ILLUMINATION AND MISSAL PAINTING, illustrated with 12 splendid Examples from the Great Masters of the Art, selected from Missals, all beautifully illuminated. Square 12mo, decorated binding, 1*l.* 1*s.*

HUMPHREY'S COINS OF ENGLAND, a Sketch of the progress of the English Coinage, from the earliest period to the present time, with 228 beautiful fac-similes of the most interesting specimens, illuminated in gold, silver, and copper, square 8vo, neatly decorated binding, 18*s.*

HUNT'S EXAMPLES OF TUDOR ARCHITECTURE ADAPTED TO MODERN HABITATIONS. Royal 4to, 37 Plates (pub. at 2*l.* 2*s.*), half morocco 1*l.* 4*s.*

HUNT'S DESIGNS FOR PARSONAGE-HOUSES, ALMS-HOUSES, ETC. Royal 4to, 21 Plates (pub. at 1*l.* 1*s.*), half morocco, 14*s.* 1841

HUNT'S DESIGNS FOR GATE LODGES, GAMEKEEPERS' COTTAGES, ETC. Royal 4to, 13 Plates (pub. at 1*l.* 1*s.*), half morocco, 14*s.* 1841

HUNT'S ARCHITETTURA CAMPESTRE; OR, DESIGNS FOR LODGES, GARDENERS' HOUSES, ETC. IN THE ITALIAN STYLE. 12 Plates, royal 4to (pub. at 1*l.* 1*s.*), half morocco, 14*s.* 1827

ILLUMINATED BOOK OF CHRISTMAS CAROLS, square 8vo. 24 Borders illuminated in Gold and Colours, and 4 beautiful Miniatures, richly Ornamented Binding (pub. at 1*l.* 5*s.*), 15*s.* 1846

ILLUMINATED BOOK OF NEEDLEWORK, By MRS. OWEN, with a History of Needlework, by the COUNTESS of WILTON, Coloured Plates, post 8vo (pub. at 18*s.*), gilt cloth, 9*s.* 1847

ILLUMINATED CALENDAR FOR 1850. Copied from a celebrated Missal known as the "Hours" of the Duke of Anjou, imperial 8vo, 36 exquisite Miniatures and Borders, in gold and colours, Ornamented Binding (pub. at 2*l.* 2*s.*), 15*s.*

ILLUSTRATED FLY-FISHER'S TEXT BOOK. A Complete Guide to the Science of Trout and Salmon Fishing. By THEOPHILUS SOUTH, GENT. (ED. CHITTY, BARRISTER). With 23 beautiful Engravings on Steel, after Paintings by COOPER, NEWTON, FIELDING, LEE, and others. 8vo (pub. at 1*l.* 11*s.* 6*d.*), cloth, gilt, 10*s.* 6*d.* 1845

ITALIAN SCHOOL OF DESIGN. Consisting of 100 Plates, chiefly engraved by BARTOLOZZI, after the original Pictures and Drawings of GUERCINO, MICHAEL ANGELO, DOMENICHINO, ANNIBALE, LUDOVICO, and AGOSTINO CARACCI, PIETRO DA CORTONA, CARLO MARATTI, and others, in the Collection of Her Majesty. Imperial 4to (pub. at 10*l.* 10*s.*), half morocco, gilt edges, 3*l.* 3*s.* 1842

JAMES' (G. P. R.) BOOK OF THE PASSIONS, royal 8vo, illustrated with 16 splendid Line Engravings, after drawings by EDWARD CORBOULD STEPHANOFF CHALON, KENNY MEADOWS, and JENKINS; engraved under the superintendence of CHARLES HEATH. New and improved edition (just published), elegant in gilt cloth, gilt edges (pub. at 1*l.* 11*s.* 6*d.*), 12*s.*

JAMESON'S BEAUTIES OF THE COURT OF CHARLES THE SECOND. 2 vols. impl. 8vo, 21 beautiful Portraits (pub. at 2*l.* 5*s.*), cloth, 1*l.* 1*s.* 1838

JOHNSON'S SPORTSMAN'S CYCLOPEDIA of the Science and Practice of the Field, the Turf, and the Sod, or operations of the Chase, the Course, and the Stream, in one very thick vol. 8vo, illustrated with upwards of 50 Steel Engravings, after COOPER, WARD, HANCOCK, and others (pub. at 1*l.* 11*s.* 6*d.*), cloth, 15*s.*

KNIGHT'S (HENRY GALLY), ECCLESIASTICAL ARCHITECTURE OF ITALY, FROM THE TIME OF CONSTANTINE TO THE FIFTEENTH CENTURY. With an Introduction and Text. Imperial folio. First Series, containing 40 beautiful and highly interesting Views of Ecclesiastical Buildings in Italy, several of which are expensively illuminated in gold and colours, half-bound morocco, 5*l.* 5*s.* 1843

Second and Concluding Series, containing 41 beautiful and highly-interesting Views of Ecclesiastical Buildings in Italy, arranged in Chronological Order; with Descriptive Letter-press. Imperial folio, half-bound morocco, 5*l.* 5*s.* 1844

KNIGHT'S (HENRY GALLY) SARACENIC AND NORMAN REMAINS. To illustrate the Normans in Sicily. Imperial folio. 30 large Engravings, consisting of Picturesque Views, Architectural Remains, Interiors and Exteriors of Buildings, with Descriptive Letterpress. Coloured like Drawings, half-bound morocco, 8*l.* 8*s.* 1846

But very few copies are now first executed in this expensive manner.

KNIGHT'S PICTORIAL LONDON. 6 vols. bound in 3 thick handsome vols. imperial 8vo, illustrated by 650 Wood Engravings (pub. at 3*l.* 3*s.*), cloth, gilt, 1*l.* 18*s.* 1841-44

LONDON.—WILKINSON'S LONDINA ILLUSTRATA; OR, GRAPHIC AND HISTORICAL ILLUSTRATIONS of the most Interesting and Curious Architectural Monuments of the City and Suburbs of London and Westminster, *e.g.*, Monasteries, Churches, Charitable Foundations, Palaces, Halls, Courts, Processions, Places of early Amusements, Theatres, and Old Houses. 2 vols. imperial 4to, containing 207 Copper-plate Engravings, with Historical and Descriptive Letter-press (pub. at 26*l.* 5*s.*), half-bound morocco, 5*l.* 5*s.* 1819-25

LOUDON'S EDITION OF REPTON ON LANDSCAPE GARDENING AND LANDSCAPE ARCHITECTURE. New Edition, 250 Wood Cuts, Portrait, thick 8vo, cloth lettered (pub. at 1*l.* 10*s.*), 15*s.*

LYSON'S ENVIRONS OF LONDON; being an Historical Account of the Towns, Villages and Hamlets in the Counties of Surrey, Kent, Essex, Herts, and Middlesex, 5 vols. 4to, Plates (pub. at 10*l.* 10*s.*), cloth, 2*l.* 10*s.*

The same, large paper, 5 vols. royal 4to (pub. at 15*l.* 15*s.*), cloth, 3*l.* 3*s.*

MACGREGOR'S PROGRESS OF AMERICA FROM THE DISCOVERY BY COLUMBUS, to the year 1846, comprising its History and Statistics, 2 remarkably thick volumes, imperial 8vo. cloth lettered (pub. at 4*l.* 14*s.* 6*d.*), 1*l.* 11*s.* 6*d.* 1847

MARTIN'S CIVIL COSTUME OF ENGLAND, from the Conquest to the Present Period, from Tapestry, MSS. &c. Royal 4to 61 Plates, beautifully Illuminated in Gold and Colours, cloth, gilt, 2*l.* 12*s.* 6*d.* 1842

MEYRICK'S PAINTED ILLUSTRATIONS OF ANCIENT ARMS AND ARMOUR, a Critical Inquiry into Ancient Armour as it existed in Europe, but particularly in England, from the Norman Conquest to the Reign of Charles II, with a Glossary, etc. by SIR SAMUEL RUSH MEYRICK, LL.D., F.S.A., etc., new and greatly improved Edition, corrected and enlarged throughout by the Author himself, with the assistance of Literary and Antiquarian Friends (ALBERT WAY, etc.), 3 vols. imperial 4to, illustrated by more than 100 Plates, splendidly illuminated, mostly in gold and silver, exhibiting some of the finest Specimens existing in England; also a new Plate of the Tournament of Locks and Keys (pub. at 21*l.*), half-bound morocco, gilt edges, 10*l.* 10*s.* 1844

SIR WALTER SCOTT justly describes this collection as "THE INCOMPARABLE ARMOURY." —*Edinburgh Review.*

MEYRICK'S DESCRIPTION OF ANCIENT ARMS AND ARMOUR, in the Collection of Goodrich Court, 150 Engravings by JOS. SKELTON, 2 vols. folio (pub. at 11*l.* 11*s.*), half morocco, top edges gilt, 4*l.* 14*s.* 6*d.*

MILLINGEN'S ANCIENT UNEDITED MONUMENTS; comprising Painted Greek Vases, Statues, Busts, Bas-Reliefs, and other Remains of Grecian Art, 62 large and beautiful Engravings, mostly coloured, with Letter-press Descriptions, imperial 4to (pub. at 9*l.* 9*s.*), half morocco, 4*l.* 14*s.* 6*d.* 1822

MOSES' ANTIQUE VASES, CANDELABRA, LAMPS, TRIPODS, PATERÆ, Tazzas, Tombs, Mausoleums, Sepulchral Chambers, Cinerary Urns, Sarcophagi, Cippi; and other Ornaments, 170 Plates, several of which are coloured, with Letter-press, by HOPE, small 8vo (pub. at 3*l.* 3*s.*), cloth, 1*l.* 5*s.* 1814

MURPHY'S ARABIAN ANTIQUITIES OF SPAIN; representing, in 100 very highly finished line Engravings, by LE KEUX, FINDEN, LANDSEER, G. COOKE, &c., the most remarkable Remains of the Architecture, Sculpture, Paintings, and Mosaics of the Spanish Arabs now existing in the Peninsula, including the magnificent Palace of Alhambra; the celebrated Mosque and Bridge at Cordova; the Royal Villa of Generaliffe; and the Casa de Carbon: accompanied by Letter-press Descriptions, in 1 vol. atlas folio, original and brilliant impressions of the Plates (pub. at 42*l.*), half morocco, 12*l.* 12*s.* 1813

MURPHY'S ANCIENT CHURCH OF BATALHA, IN PORTUGAL, Plans, Elevations, Sections, and Views of the; with its History and Description, and an Introductory Discourse on GOTHIC ARCHITECTURE, imperial folio, 27 fine Copper Plates, engraved by LOWRY (pub. at 6*l.* 6*s.*), half morocco, 2*l.* 8*s.* 1795

NAPOLEON GALLERY; Or Illustrations of the Life and Times of the Emperor, with 99 Etchings on Steel by REVEIL, and other eminent Artists, in one thick volume post 8vo. (pub. at 1*l.* 1*s.*), gilt cloth, gilt edges, 10*s.* 6*d.* 1846

NICOLAS'S (SIR HARRIS) HISTORY OF THE ORDERS OF KNIGHTHOOD OF THE BRITISH EMPIRE; with an Account of the Medals, Crosses, and Clasps which have been conferred for Naval and Military Services; together with a History of the Order of the Guelphs of Hanover. 4 vols. imperial 4to, splendidly printed and illustrated by numerous fine Woodcuts of Badges, Crosses, Collars, Stars, Medals, Ribbands, Clasps, etc. and many large Plates, illuminated in gold and colours, including full-length Portraits of Queen Victoria, Prince Albert, the King of Hanover, and the Dukes of Cambridge and Sussex. (Pub. at 14*l.* 14*s.*), cloth, with morocco backs, 5*l.* 15*s.* 6*d.* *** *Complete to 1847*

———— the same, with the Plates richly coloured but not illuminated, and without the extra portraits, 4 vols. royal 4to. cloth, 3*l.* 10*s.* 6*d.*

"Sir Harris Nicolas has produced the first comprehensive History of the British Orders of Knighthood; and it is *one of the most elaborately prepared and splendidly printed works that ever issued from the press.* The Author appears to us to have neglected no sources of information, and to have exhausted them, as far as regards the general scope and purpose of the inquiry. The Graphical Illustrations are such as become a work of this character upon such a subject; at, of course, a lavish cost. The resources of the recently revived art of wood-engraving have been combined with the new art of printing in colours, so as to produce a rich effect, almost rivalling that of the monastic illuminations. *Such a book is sure of a place in every great library.* It contains matter calculated to interest extensive classes of readers, and we hope by our specimen to excite their curiosity."—*Quarterly Review.*

NICHOLSON'S ARCHITECTURE; ITS PRINCIPLES AND PRACTICE. 218 Plates by LOWRY, new edition, revised by JOS. GWILT, ESQ., one volume, royal 8vo, 1*l.* 11*s.* 6*d.* 1848

For classical Architecture, the text book of the Profession, the most useful Guide to the Student, and the best Compendium for the Amateur. An eminent Architect has declared it to be "not only the most useful book of the kind ever published, but absolutely indispensable to the Student."

PICTORIAL HISTORY OF GERMANY DURING THE REIGN OF FREDERICK THE GREAT, including a complete History of the Seven Years' War. By FRANCIS KUGLER. Illustrated by ADOLPH MENZEL. Royal 8vo, with above 500 Woodcuts (pub. at 1*l.* 8*s.*), cloth gilt, 12*s.* 1845

PICTORIAL GALLERY OF RACE-HORSES. Containing Portraits of all the Winning Horses of the Derby, Oaks, and St. Leger Stakes during the last Thirteen Years, and a History of the principal Operations of the Turf. By WILDRAKE (Geo. Tattersall, Esq.). Royal 8vo, containing 95 beautiful Engravings of Horses, after Pictures by COOPER, HERRING, HANCOCK, ALKEN, &c. Also full-length characteristic Portraits of celebrated living Sportsmen ("Cracks of the Day"), by SEYMOUR (pub. at 2*l.* 2*s.*), scarlet cloth, gilt, 1*l.* 1*s.*

PICTURESQUE TOUR OF THE RIVER THAMES, in its Western Course, including particular Descriptions of Richmond, Windsor, and Hampton Court. By John Fisher Murray. Illustrated by upwards of 100 very highly-finished Wood Engravings by Orrin Smith, Branston, Landells, Linton, and other eminent artists; to which are added several beautiful Copper and Steel Plate Engravings by Cooke and others. One large handsome volume, royal 8vo (pub. at 1*l.* 5*s.*), gilt cloth, 10*s.* 6*d.* 1845

The most beautiful volume of Topographical Lignographs ever produced.

PINELLI'S ETCHINGS OF ITALIAN MANNERS AND COSTUME, including his Carnival, Banditti, &c., 27 Plates, imperial 4to, half-bound morocco, 15*s.* *Rome,* 1849

PRICE (SIR UVEDALE) ON THE PICTURESQUE in Scenery and Landscape Gardening, with an Essay on the Origin of Taste, and much additional matter. By Sir Thomas Dick Lauder, Bart. 8vo, with 60 beautiful Wood Engravings by Montagu Stanley (pub. at 1*l.* 1*s.*), gilt cloth, 12*s.* 1842

PUGIN'S GLOSSARY OF ECCLESIASTICAL ORNAMENT AND COSTUME; setting forth the Origin, History, and Signification of the various Emblems, Devices, and Symbolical Colours, peculiar to Christian Designs of the Middle Ages. Illustrated by nearly 80 Plates, splendidly printed in gold and colours. Royal 4to, half morocco extra, top edges gilt, 7*l.* 7*s.*

PUGIN'S ORNAMENTAL TIMBER GABLES, selected from Ancient Examples in England and Normandy. Royal 4to, 30 Plates, cloth, 18*s.* 1839

PUGIN'S EXAMPLES OF GOTHIC ARCHITECTURE, selected from Ancient Edifices in England; consisting of Plans, Elevations, Sections, and Parts at large, with Historical and Descriptive letter-press, illustrated by 225 Engravings by Le Keux. 3 vols. 4to (pub. at 12*l.* 12*s.*), cloth, 7*l.* 17*s.* 6*d.* 1839

PUGIN'S GOTHIC ORNAMENTS. 90 fine Plates, drawn on Stone by J. D. Harding and others. Royal 4to, half morocco, 3*l.* 3*s.* 1844

PUGIN'S NEW WORK ON FLORIATED ORNAMENT, with 30 plates, splendidly printed in Gold and Colours, royal 4to, elegantly bound in cloth, with rich gold ornaments, 3*l.* 3*s.*

RADCLIFFE'S NOBLE SCIENCE OF FOX-HUNTING, for the use of Sportsmen, royal 8vo., nearly 40 beautiful Wood Cuts of Hunting, Hounds, &c. (pub. at 1*l.* 8*s.*), cloth gilt, 10*s.* 6*d.* 1839

RETZSCH'S OUTLINES TO SCHILLER'S "FIGHT WITH THE DRAGON," Royal 4to., containing 16 Plates, Engraved by Moses, stiff covers, 7*s.* 6*d.*

RETZSCH'S ILLUSTRATIONS TO SCHILLER'S "FRIDOLIN," Royal 4to., containing 8 Plates, Engraved by Moses, stiff covers, 4*s.* 6*d.*

REYNOLDS' (SIR JOSHUA) GRAPHIC WORKS. 300 beautiful Engravings (comprising nearly 400 subjects) after this delightful painter, engraved on Steel by S. W. Reynolds. 3 vols. folio (pub. at 36*l.*), half bound morocco, gilt edges, 12*l.* 12*s.*

REYNOLDS' (SIR JOSHUA) LITERARY WORKS. Comprising his Discourses, delivered at the Royal Academy, on the Theory and Practice of Painting; his Journey to Flanders and Holland, with Criticisms on Pictures; Du Fresnoy's Art of Painting, with Notes, to which is prefixed, a Memoir of the Author, with Remarks illustrative of his Principles and Practice, by Beechey. New Edition. 2 vols. fcap. 8vo, with Portrait (pub. at 18*s.*), gilt cloth, 10*s.* 1846

"His admirable Discourses contain such a body of just criticism, clothed in such perspicuous, elegant, and nervous language, that it is no exaggerated panegyric to assert, that they will last as long as the English tongue, and contribute, not less than the productions of his pencil, to render his name immortal."—*Northcote.*

ROBINSON'S RURAL ARCHITECTURE; being a Series of Designs for Ornamental Cottages, in 96 Plates, with Estimates. Fourth, greatly improved, Edition. Royal 4to (pub. at 4*l.* 4*s.*), half morocco, 2*l.* 5*s.*

ROBINSON'S NEW SERIES OF ORNAMENTAL COTTAGES AND VILLAS. 56 Plates by Harding and Allom. Royal 4to, half morocco, 2*l.* 2*s.*

ROBINSON'S ORNAMENTAL VILLAS, 96 Plates (pub. at 4*l.* 4*s.*), half morocco, 2*l.* 5*s.*

ROBINSON'S FARM BUILDINGS. 56 Plates (pub. at 2*l.* 2*s.*), half morocco, 1*l.* 11*s.* 6*d.*

ROBINSON'S LODGES AND PARK ENTRANCES. 48 Plates (pub. at 2*l.* 2*s.*), half morocco, 1*l.* 11*s.* 6*d.*

ROBINSON'S VILLAGE ARCHITECTURE. Fourth Edition, with additional Plate. 41 Plates (pub at 1*l.* 16*s.*), half bound uniform, 1*l.* 4*s.*

ROBINSON'S NEW VITRUVIUS BRITANNICUS; Or, Views, Plans, and Elevations of English Mansions, viz., Woburn Abbey, Hatfield House, and Hardwicke Hall; also Cassiobury House, by John Britton, imperial folio, 50 fine engravings, by Le Keux (pub. at 16*l.* 16*s.*) half morocco, gilt edges, 3*l.* 13*s.* 6*d.* 1847

ROYAL VICTORIA GALLERY, comprising 33 beautiful Engravings, after pictures at BUCKINGHAM PALACE, particularly Rembrandt, the Ostades, Teniers, Gerard Dow, Both, Cuyp, Reynolds, Titian, and Rubens, engraved by Greatbach, S. W. Reynolds, Presbury, Burnet, &c.; with letter-press by Linnell, royal 4to (pub. at 4*l.* 4*s.*), half morocco, 1*l.* 11*s.* 6*d.*

RUDING'S ANNALS OF THE COINAGE OF GREAT BRITAIN AND ITS DEPENDENCIES. Three vols., 4to., 159 plates, (pub. at 6*l.* 6*s.*) cloth, 4*l.* 4*s.* 1840

SHAKSPEARE PORTFOLIO; a Series of 96 GRAPHIC ILLUSTRATIONS, after Designs by the most eminent British Artists, including Smirke, Stothard, Stephanoff, Cooper, Westall, Hilton, Leslie, Briggs, Corbould, Clint, &c., beautifully engraved by Heath, Greatbach, Robinson, Pye, Finden, Englehart, Armstrong, Rolls, and others (pub. at 8*l.* 8*s.*), in a case, with leather back, imperial 8vo, 1*l.* 1*s.*

SHAW AND BRIDGENS' DESIGNS FOR FURNITURE, with Candelabra and interior Decoration, 60 Plates, royal 4to, (pub. at 3*l.* 3*s.*), half-bound, uncut, 1*l.* 11*s.* 6*d.* 1838

The same, large paper, impl. 4to, the Plates coloured (pub. at 6*l.* 6*s.*), hf.-bd., uncut, 3*l.* 3*s.*

SHAW'S LUTON CHAPEL, its Architecture and Ornaments, illustrated in a series of 26 highly finished Line Engravings, imperial folio (pub. at 3*l.* 3*s.*), half morocco, uncut, 1*l.* 16*s.* 1830

SILVESTRE'S UNIVERSAL PALEOGRAPHY, or Fac-similes of the writings of every age, taken from the most authentic Missals and other interesting Manuscripts existing in the Libraries of France, Italy, Germany, and England. By M. Silvestre, containing upwards of 300 large and most beautifully executed fac-similes, on Copper and Stone, most richly illuminated in the finest style of art, 2 vols. atlas folio, half morocco extra, gilt edges, 31*l.* 10*s.*

——— The Historical and Descriptive Letter-press by Champollion, Figeac, and Champollion, jun. With additions and corrections by Sir Frederick Madden. 2 vols. royal 8vo, cloth, 1*l.* 16*s.* 1850

——— the same, 2 vols. royal 8vo, hf. mor. gilt edges (uniform with the folio work), 2*l.* 8*s.*

SMITH'S (C. J.) HISTORICAL AND LITERARY CURIOSITIES. Consisting of Fac-similes of interesting Autographs, Scenes of remarkable Historical Events and interesting Localities, Engravings of Old Houses, Illuminated and Missal Ornaments, Antiquities, &c. &c., containing 100 Plates, some illuminated, with occasional Letter-press. In 1 volume 4to, half morocco, uncut, reduced to 3*l.* 1840

SMITH'S ANCIENT COSTUME OF GREAT BRITAIN AND IRELAND. From the 7th to the 16th Century, with Historical Illustrations, folio, with 62 coloured plates illuminated with gold and silver, and highly finished (pub. at 10*l.* 10*s.*) half bound, morocco, extra, gilt edges, 3*l.* 13*s.* 6*d.*

SPORTSMAN'S REPOSITORY; comprising a Series of highly finished Line Engravings, representing the Horse and the Dog, in all their varieties, by the celebrated engraver JOHN SCOTT, from original paintings by Reinagle, Gilpin, Stubbs, Cooper, and Landseer, accompanied by a comprehensive Description by the Author of the "British Field Sports," 4to, with 37 large Copper Plates, and numerous Wood Cuts by Burnett and others (pub. at 2*l.* 12*s.* 6*d.*), cloth gilt, 1*l.* 1*s.*

STORER'S CATHEDRAL ANTIQUITIES OF ENGLAND AND WALES. 4 vols. 8vo., with 256 engravings (pub. at 7*l.* 10*s.*), half morocco, 2*l.* 13*s.* 6*d.*

STOTHARD'S MONUMENTAL EFFIGIES OF GREAT BRITAIN. 147 beautifully finished Etchings, all of which are more or less tinted, and some of them highly illuminated in gold and colours, with Historical Descriptions and Introduction, by KEMPE. Folio (pub. at 19*l.*), half morocco, 8*l.* 8*s.*

STRUTT'S SYLVA BRITANNICA ET SCOTICA; or, Portraits of Forest Trees, distinguished for their Antiquity, Magnitude, or Beauty, comprising 50 very large and highly-finished painters' Etchings, imperial folio (pub. at 9*l.* 9*s.*), half morocco extra, gilt edges, 4*l.* 10*s.* 1826

STRUTT'S DRESSES AND HABITS OF THE PEOPLE OF ENGLAND, from the Establishment of the Saxons in Britain to the present time; with an historical and Critical Inquiry into every branch of Costume. New and greatly improved Edition, with Critical and Explanatory Notes, by J. R. PLANCHÉ, ESQ., F.S.A. 2 vols. royal 4to, 153 Plates, cloth, 4*l.* 4*s.* The Plates, coloured, 7*l.* 7*s.* The Plates splendidly illuminated in gold, silver, and opaque colours, in the Missal style, 20*l.* 1842

STRUTT'S REGAL AND ECCLESIASTICAL ANTIQUITIES OF ENGLAND. Containing the most authentic Representations of all the English Monarchs from Edward the Confessor to Henry the Eighth; together with many of the Great Personages that were eminent under their several Reigns. New and greatly improved Edition, by J. R. PLANCHÉ, ESQ., F.S.A. Royal 4to, 72 Plates, cloth, 2*l.* 2*s.* The Plates coloured, 4*l.* 4*s.* Splendidly illuminated, uniform with the Dresses, 12*l.* 12*s.* 1842

STUBBS' ANATOMY OF THE HORSE. 24 fine large Copper-plate Engravings. Imperial folio (pub. at 4*l.* 4*s.*), boards, leather back, 1*l.* 11*s.* 6*d.*

The original edition of this fine old work, which is indispensable to artists. It has long been considered rare.

TATTERSALL'S SPORTING ARCHITECTURE, comprising the Stud Farm, the Stall, the Stable, the Kennel, Race Studs, &c. with 43 beautiful steel and wood illustrations, several after HANCOCK, cloth gilt (pub. at 1*l.* 11*s.* 6*d.*), 1*l.* 1*s.* 1850

TAYLOR'S HISTORY OF THE FINE ARTS IN GREAT BRITAIN. 2 vols. post 8vo. Woodcuts (pub. at 1*l.* 1*s.*), cloth, 7*s.* 6*d.* 1841

"The best view of the state of modern art."—*United States' Gazette.*

TOD'S ANNALS AND ANTIQUITIES OF RAJASTHAN: OR, THE CENTRAL AND WESTERN RAJPOOT STATES OF INDIA, COMMONLY CALLED RAJPOOTANA). By Lieut.-Colonel J. TOD, imperial 4to, embellished with above 28 extremely beautiful line Engravings by FINDEN, and capital large folding map (4*l.* 14*s.* 6*d.*), cloth, 25*s.* 1839

TURNER AND GIRTIN'S RIVER SCENERY; folio, 20 beautiful engravings on steel, after the drawings of J. M. W. TURNER, brilliant impressions, in a portfolio, with morocco back (pub. at 5*l.* 5*s.*), reduced to 1*l.* 11*s.* 6*d.*

——— the same, with thick glazed paper between the plates, half bound morocco, gilt edges (pub. at 6*l.* 6*s.*), reduced to 2*l.* 2*s.*

WALKER'S ANALYSIS OF BEAUTY IN WOMAN. Preceded by a critical View of the general Hypotheses respecting Beauty, by LEONARDO DA VINCI, MENGS, WINCKELMANN, HUME, HOGARTH, BURKE, KNIGHT, ALISON, and others. New Edition, royal 8vo, illustrated by 22 beautiful Plates, after drawings from life, by H. HOWARD, by GAUCI and LANE (pub. at 2*l.* 2*s.*), gilt cloth, 1*l.* 1*s.* 1846

WALPOLE'S (HORACE) ANECDOTES OF PAINTING IN ENGLAND, with some Account of the Principal Artists, and Catalogue of Engravers, who have been born or resided in England, with Notes by DALLAWAY; New Edition, Revised and Enlarged, by RALPH WORNUM, Esq., complete in 3 vols. 8vo, with numerous beautiful portraits and plates, 2*l.* 2*s.*

WATTS'S PSALMS AND HYMNS, ILLUSTRATED EDITION, complete, with indexes of "Subjects," "First Lines," and a Table of Scriptures, 8vo, printed in a very large and beautiful type, embellished with 24 beautiful Wood Cuts by Martin, Westall, and others (pub. at 1*l.* 1*s.*), gilt cloth, 7*s.* 6*d.*

WHISTON'S JOSEPHUS, ILLUSTRATED EDITION, complete; containing both the Antiquities and the Wars of the Jews. 2 vols. 8vo, handsomely printed, embellished with 52 beautiful Wood Engravings, by various Artists (pub. at 1*l.* 4*s.*), cloth bds., elegantly gilt, 14*s.* 1848

WHITTOCK'S DECORATIVE PAINTER'S AND GLAZIER'S GUIDE, containing the most approved methods of imitating every kind of fancy Wood and Marble, in Oil or Distemper Colour, Designs for Decorating Apartments, and the Art of Staining and Painting on Glass, &c., with Examples from Ancient Windows, with the Supplement, 4to, illustrated with 104 plates, of which 44 are coloured, (pub. at 2*l.* 14*s.*) cloth, 1*l.* 10*s.*

WHITTOCK'S MINIATURE PAINTER'S MANUAL. Foolscap 8vo., 7 coloured plates, and numerous woodcuts (pub. at 5*s.*) cloth, 3*s.*

WIGHTWICK'S PALACE OF ARCHITECTURE, a Romance of Art and History. Imperial 8vo, with 211 Illustrations, Steel Plates, and Woodcuts (pub. at 2*l.* 12*s.* 6*d.*), cloth, 1*l.* 1*s.* 1840

WILD'S ARCHITECTURAL GRANDEUR of Belgium, Germany, and France, 24 fine Plates by LE KEUX, &c. Imperial 4to (pub. at 1*l.* 18*s.*), half morocco, 1*l.* 4*s.* 1837

WILD'S FOREIGN CATHEDRALS, 12 Plates, coloured and mounted like Drawings, in a handsome portfolio (pub. at 12*l.* 12*s.*), imperial folio, 5*l.* 5*s.*

WILLIAMS' VIEWS IN GREECE, 64 beautiful Line Engravings by MILLER, HORSBURGH, and others. 2 vols. imperial 8vo (pub. at 6*l.* 6*s.*), half bound mor. extra, gilt edges, 2*l.* 12*s.* 6*d.* 1829

WINDSOR CASTLE AND ITS ENVIRONS, INCLUDING ETON, by LEITCH RITCHIE, new edition, edited by E. JESSE, Esq., illustrated with upwards of 50 beautiful Engravings on Steel and Wood, royal 8vo., gilt cloth, 15*s.*

WOOD'S ARCHITECTURAL ANTIQUITIES AND RUINS OF PALMYRA AND BALBEC. 2 vols. in 1, imperial folio, containing 110 fine Copper-plate Engravings, some very large and folding (pub. at 7*l.* 7*s.*), half morocco, uncut, 3*l.* 13*s.* 6*d.* 1827

Natural History, Agriculture, &c.

ANDREWS' FIGURES OF HEATHS, with Scientific Descriptions. 6 vols. royal 8vo, with 300 beautifully coloured Plates (pub. at 15*l.*), cloth, gilt, 7*l.* 10*s.* 1845

BARTON AND CASTLE'S BRITISH FLORA MEDICA; OR, HISTORY OF THE MEDICINAL PLANTS OF GREAT BRITAIN. 2 vols. 8vo, illustrated by upwards of 200 Coloured Figures of Plants (pub. at 3*l.* 3*s.*), cloth, 1*l.* 16*s.* 1845

BAUER AND HOOKER'S ILLUSTRATIONS OF THE GENERA OF FERNS, in which the characters of each Genus are displayed in the most elaborate manner, in a series of magnified Dissections and Figures, highly finished in Colours. Imp. 8vo, Plates, 6*l.* 1838-42

BEECHEY.—BOTANY OF CAPTAIN BEECHEY'S VOYAGE, comprising an Account of the Plants collected by Messrs. LAY and COLLIE, and other Officers of the Expedition, during the Voyage to the Pacific and Behring's Straits. By SIR WILLIAM JACKSON HOOKER, and G. A. W. ARNOTT, Esq., illustrated by 100 Plates, beautifully engraved, complete in 10 parts, 4to (pub. at 7*l.* 10*s.*), 5*l.* 1831-41

BEECHEY.—ZOOLOGY OF CAPTAIN BEECHEY'S VOYAGE, compiled from the Collections and Notes of Captain BEECHEY and the Scientific Gentlemen who accompanied the Expedition. The Mammalia, by Dr. RICHARDSON; Ornithology, by N. A. VIGORS, Esq., Fishes, by G. T. LAY, Esq., and E. T. BENNETT, Esq.; Crustacea, by RICHARD OWEN, Esq.; Reptiles, by JOHN EDWARD GRAY, Esq.; Shells, by W. SOWERBY, Esq.; and Geology, by the Rev. Dr. BUCKLAND. 4to, illustrated by 47 Plates, containing many hundred Figures, beautifully coloured by SOWERBY (pub. at 5*l.* 5*s.*), cloth, 3*l.* 13*s.* 6*d.* 1839

BOLTON'S NATURAL HISTORY OF BRITISH SONG BIRDS. Illustrated with Figures, the size of Life, of the Birds, both Male and Female, in their most Natural Attitudes; their Nests and Eggs, Food, Favourite Plants, Shrubs, Trees, &c. &c. New Edition, revised and very considerably augmented. 2 vols. in 1, medium 4to, containing 80 beautifully coloured plates (pub. at 8*l.* 8*s.*), half bound morocco, gilt backs, gilt edges, 3*l.* 3*s.* 1845

BRITISH FLORIST, OR LADY'S JOURNAL OF HORTICULTURE. 6 vols. 8vo, 81 coloured plates of flowers and groups (pub. at 4*l.* 10*s.*), cloth, 1*l.* 14*s.* 1846

BROWN'S ILLUSTRATIONS OF THE LAND AND FRESH WATER SHELLS OF GREAT BRITAIN AND IRELAND; with Figures, Descriptions, and Localities of all the Species. Royal 8vo, containing on 27 large Plates, 330 Figures of all the known British Species, in their full size, accurately drawn from Nature (pub. at 15*s.*), cloth, 10*s.* 6*d.* 1845

CURTIS'S FLORA LONDINENSIS; Revised and Improved by GEORGE GRAVES, extended and continued by Sir W. JACKSON HOOKER; comprising the History of Plants indigenous to Great Britain, with Indexes; the Drawings made by SYDENHAM, EDWARDS, and LINDLEY. 5 vols. royal folio (or 109 parts), containing 647 Plates, exhibiting the full natural size of each Plant, with magnified Dissections of the Parts of Fructification, &c., all beautifully coloured (pub. at 87*l.* 4*s.* in parts), half bound morocco, top edges gilt, 30*l.* 1835

DENNY—MONOGRAPHIA ANOPLURORUM BRITANNIÆ, OR BRITISH SPECIES OF PARASITE INSECTS (published under the patronage of the British Association), 8vo, numerous beautifully coloured plates of Lice, containing several hundred magnified figures, cloth, 1*l.* 11*s.* 6*d.* 1842

DON'S GENERAL SYSTEM OF GARDENING AND BOTANY. 4 volumes, royal 4to, numerous woodcuts (pub. at 14*l.* 8*s.*), cloth, 1*l.* 11*s.* 6*d.* 1831-1838

DON'S HORTUS CANTABRIGIENSIS; thirteenth Edition, 8vo (pub. at 1*l.* 4*s.*), cloth, 12*s.* 1845

DONOVAN'S NATURAL HISTORY OF THE INSECTS OF INDIA. Enlarged, by J. O. WESTWOOD, Esq., F.L.S., 4to, with 58 plates, containing upwards of 120 exquisitely coloured figures (pub. at 6*l.* 6*s.*), cloth, gilt, reduced to 2*l.* 2*s.* 1842

DONOVAN'S NATURAL HISTORY OF THE INSECTS OF CHINA. Enlarged, by J. O. WESTWOOD, Esq., F.L.S., 4to, with 50 plates, containing upwards of 120 exquisitely coloured figures (pub. at 6*l.* 6*s.*), cloth, gilt, 2*l.* 5*s.*

"Donovan's works on the Insects of India and China are splendidly illustrated and extremely useful."—*Naturalist.*

"The entomological plates of our countryman Donovan, are highly coloured, elegant, and useful, especially those contained in his quarto volumes (Insects of India and China), where a great number of species are delineated for the first time."—*Swainson.*

DONOVAN'S WORKS ON BRITISH NATURAL HISTORY. Viz.—Insects, 16 vols, —Birds, 10 vols.—Shells, 5 vols.—Fishes, 5 vols.—Quadrupeds, 3 vols.—together 39 vols. 8vo. containing 1198 beautifully coloured plates (pub. at 66*l.* 9*s.*), boards, 23*l.* 17*s.* The same set of 39 vols. bound in 21 (pub. at 73*l.* 10*s.*), half green morocco extra, gilt edges, gilt backs, 30*l.* Any of the classes may be had separately.

DOYLE'S CYCLOPEDIA OF PRACTICAL HUSBANDRY, and Rural Affairs in General, New Edition, Enlarged, thick 8vo., with 70 wood engravings (pub. at 12*s.*), cloth, 8*s.* 6*d.* 1843

DRURY'S ILLUSTRATIONS OF FOREIGN ENTOMOLOGY; wherein are exhibited upwards of 600 exotic Insects, of the East and West Indies, China, New Holland, North and South America, Germany, &c. By J. O. WESTWOOD, ESQ., F.L.S., Secretary of the Entomological Society, &c. 3 vols, 4to, 150 Plates, most beautifully coloured, containing above 600 figures of Insects (originally pub. at 15*l.* 15*s.*), half bound morocco, 6*l.* 16*s.* 6*d.* 1837

EVELYN'S SYLVA AND TERRA. A Discourse of Forest Trees, and the Propagation of Timber, a Philosophical Discourse of the Earth; with Life of the Author, and Notes by Dr. A. Hunter, 2 vols. royal 4to. Fifth improved Edition, with 46 Plates (pub. at 5*l.* 5*s.*), cloth, 2*l.* 1825

FITZROY AND DARWIN.—ZOOLOGY OF THE VOYAGE IN THE BEAGLE. 166 plates, mostly coloured, 3 vols. royal 4to. (pub. at 9*l.*), cloth, 5*l.* 5*s.* 1838-43

GREVILLE'S CRYPTOGAMIC FLORA, comprising the Principal Species found in Great Britain, inclusive of all the New Species recently discovered in Scotland. 6 vols. royal 8vo, 360 beautifully coloured Plates (pub. at 16*l.* 16*s.*), half morocco, 8*l.* 8*s.* 1823-8

This, though a complete Work in itself, forms an almost indispensable Supplement to the thirty-six volumes of Sowerby's English Botany, which does not comprehend Cryptogamous Plants. It is one of the most scientific and best executed works on Indigenous Botany ever produced in this country.

HARDWICKE AND GRAY'S INDIAN ZOOLOGY. Twenty parts, forming two vols., royal folio, 202 coloured plates (pub. at 21*l.*), sewed, 12*l.* 12*s.*, or half morocco, gilt edges, 14*l.* 14*s.*

HARRIS'S AURELIAN; OR ENGLISH MOTHS AND BUTTERFLIES, Their Natural History, together with the Plants on which they feed; New and greatly improved Edition, by J. O. WESTWOOD, ESQ., F.L.S., &c., in 1 vol. sm. folio, with 44 plates, containing above 400 figures of Moths, Butterflies, Caterpillars, &c., and the Plants on which they feed, exquisitely coloured after the original drawings, half-bound morocco, 4*l.* 4*s.* 1840

This extremely beautiful work is the only one which contains our English Moths and Butterflies of the full natural size, in all their changes of Caterpillar, Chrysalis, &c., with the plants on which they feed.

HOOKER AND GREVILLE, ICONES FILICUM; OR, FIGURES OF FERNS With DESCRIPTIONS, many of which have been altogether unnoticed by Botanists, or have not been correctly figured. 2 vols. folio, with 240 beautifully coloured Plates (pub. at 25*l.* 4*s.*), half morocco, gilt edges, 12*l.* 12*s.* 1829-31

The grandest and most valuable of the many scientific Works produced by Sir William Hooker.

HOOKER'S EXOTIC FLORA, containing Figures and Descriptions of Rare, or otherwise interesting Exotic Plants, especially of such as are deserving of being cultivated in our Gardens. 3 vols. imperial 8vo, containing 232 large and beautifully coloured Plates (pub. at 15*l.*), cloth, 6*l.* 6*s.* 1823-1827

This is the most superb and attractive of all Dr. Hooker's valuable works.

"The 'Exotic Flora,' by Dr. Hooker, is like that of all the Botanical publications of the indefatigable author, excellent; and it assumes an appearance of finish and perfection to which neither the Botanical Magazine nor Register can externally lay claim."—*Loudon.*

HOOKER'S JOURNAL OF BOTANY; containing Figures and Descriptions of such Plants as recommend themselves by their novelty, rarity, or history, or by the uses to which they are applied in the Arts, in Medicine, and in Domestic Economy; together with occasional Botanical Notices and Information, and occasional Portraits and Memoirs of eminent Botanists. 4 vols. 8vo, numerous plates, some coloured (pub. at 3*l.*), cloth, 1*l.* 1834-42

HOOKER'S BOTANICAL MISCELLANY; containing Figures and Descriptions of Plants which recommend themselves by their novelty, rarity, or history, or by the uses to which they are applied in the Arts, in Medicine, and in Domestic Economy, together with occasional Botanical Notices and Information, including many valuable Communications from distinguished Scientific Travellers. Complete in 3 thick vols. royal 8vo, with 153 plates, many finely coloured (pub. at 5*l.* 5*s.*), gilt cloth, 2*l.* 12*s.* 6*d.* 1830-33

HOOKER'S FLORA BOREALI-AMERICANA; OR, THE BOTANY OF BRITISH NORTH AMERICA. Illustrated by 240 plates, complete in Twelve Parts, royal 4to, (pub. at 12*l.* 12*s.*), 8*l.* The Twelve Parts complete, done up in 2 vols. royal 4to, extra cloth, 8*l.* 1829-40

HUISH ON BEES; THEIR NATURAL HISTORY AND GENERAL MANAGEMENT. New and greatly improved Edition, containing also the latest Discoveries and Improvements in every department of the Apiary, with a description of the most approved HIVES now in use, thick 12mo, Portrait and numerous Woodcuts (pub. at 10*s.* 6*d.*), cloth, gilt, 6*s.* 6*d.* 1844

JOHNSON'S GARDENER, complete in 12 vols. with numerous woodcuts, containing the Potato, one vol.—Cucumber, one vol.—Grape Vine, two vols.—Auricula and Asparagus, one vol.—Pine Apple, two vols.—Strawberry, one vol.—Dahlia, one vol.—Peach, one vol.—Apple, two vols.—together 12 vols. 12mo, woodcuts (pub. at 1*l.* 10*s.*), cloth, 12*s.* 1847

——— either of the volumes may be had separately (pub. at 2*s.* 6*d.*), at 1*s.*

JOHNSON'S DICTIONARY OF MODERN GARDENING, numerous Woodcuts, very thick 12mo, cloth lettered (pub. at 10*s.* 6*d.*), 4*s.* A comprehensive and elegant volume. 1846

LATHAM'S GENERAL HISTORY OF BIRDS. Being the Natural History and Description of all the Birds (above four thousand) hitherto known or described by Naturalists, with the Synonymes of preceding Writers; the second enlarged and improved Edition, comprehending all the discoveries in Ornithology subsequent to the former publication, and a General Index, 11 vols. in 10, 4to, with upwards of 200 coloured Plates, lettered (pub. at 26*l.* 8*s.*), cloth, 7*l.* 17*s.* 6*d.* *Winchester*, 1821-28. The same with the plates exquisitely coloured like drawings, 11 vols. in 10, elegantly half bound, green morocco, gilt edges, 12*l.* 12*s.*

LEWIN'S NATURAL HISTORY OF THE BIRDS OF NEW SOUTH WALES. Third Edition, with an Index of the Scientific Names and Synonymes by Mr. GOULD and Mr. EYTON, folio, 27 plates, coloured (pub. at 4*l.* 4*s.*), hf. bd. morocco, 2*l.* 2*s.* 1838

LINDLEY'S BRITISH FRUITS; OR, FIGURES AND DESCRIPTIONS OF THE MOST IMPORTANT VARIETIES OF FRUIT CULTIVATED IN GREAT BRITAIN. 3 vols. royal 8vo, containing 152 most beautifully coloured plates, chiefly by MRS. WITHERS, Artist to the Horticultural Society (pub. at 10*l.* 10*s.*), half bound, morocco extra, gilt edges, 5*l.* 5*s.* 1841

"This is an exquisitely beautiful work. Every plate is like a highly finished drawing, similar to those in the Horticultural Transactions."

LINDLEY'S DIGITALIUM MONOGRAPHIA. Folio, 28 plates of the Foxglove (pub. at 4*l.* 4*s.*), cloth, 1*l.* 11*s.* 6*d.*

——— the same, the plates beautifully coloured (pub. at 6*l.* 6*s.*), cloth, 2*l.* 12*s.* 6*d.*

LOUDON'S (MRS.) ENTERTAINING NATURALIST, being Popular Descriptions, Tales, and Anecdotes of more than Five Hundred Animals, comprehending all the Quadrupeds, Birds, Fishes, Reptiles, Insects, &c. of which a knowledge is indispensable in polite education. With Indexes of Scientific and Popular Names, an Explanation of Terms, and an Appendix of Fabulous Animals, illustrated by upwards of 500 beautiful woodcuts by BEWICK, HARVEY, WHIMPER, and others. New Edition, revised, enlarged, and corrected to the present state of Zoological Knowledge. In one thick vol. post 8vo. gilt cloth, 7*s.* 6*d.* 1850

LOUDON'S (J. C.) ARBORETUM ET FRUTICETUM BRITANNICUM, or the Trees and Shrubs of Britain, Native and Foreign, delineated and described; with their propagation, culture, management, and uses. Second improved Edition, 8 vols. 8vo, with above 400 plates of trees, and upwards of 2500 woodcuts of trees and shrubs (pub. at 10*l.*), 5*l.* 5*s.* 1844

MANTELL'S (DR.) NEW GEOLOGICAL WORK. THE MEDALS OF CREATION or First Lessons in Geology, and in the Study of Organic Remains; including Geological Excursions to the Isle of Sheppey, Brighton, Lewes, Tilgate Forest, Charnwood Forest, Farringdon, Swindon, Caine, Bath, Bristol, Clifton, Matlock, Crich Hill, &c. By GIDEON ALGERNON MANTELL, Esq., LL.D., F.R.S., &c. Two thick vols. foolscap 8vo, with coloured Plates, and several hundred beautiful Woodcuts of Fossil Remains, cloth gilt, 1*l.* 1*s.* 1844

MANTELL'S WONDERS OF GEOLOGY, or a Familiar Exposition of Geological Phenomena. Sixth greatly enlarged and improved Edition. 2 vols. post 8vo, coloured Plates, and upwards of 200 Woodcuts, gilt cloth, 18*s.* 1848

MANTELL'S GEOLOGICAL EXCURSION ROUND THE ISLE OF WIGHT, and along the adjacent Coast of Dorsetshire. In 1 vol. post 8vo, with numerous beautifully executed Woodcuts, and a Geological Map, cloth gilt, 12*s.* 1847

MUDIE'S NATURAL HISTORY OF BRITISH BIRDS; OR, THE FEATHERED TRIBES OF THE BRITISH ISLANDS. 2 vols. 8vo. New Edition, the Plates beautifully coloured (pub. at 1*l.* 8*s.*), cloth gilt, 16*s.* 1835

"This is, without any exception, the most truly charming work on Ornithology which has hitherto appeared, from the days of Willoughby downwards. Other authors describe, Mudie paints; other authors give the husk, Mudie the kernel. We most heartily concur with the opinion expressed of this work by Leigh Hunt (a kindred spirit) in the first few numbers of his right pleasant *London Journal*. The descriptions of Bewick, Pennant, Lewin, Montagu, and even Wilson, will not for an instant stand comparison with the spirit-stirring emanations of Mudie's 'living pen,' as it has been called. We are not acquainted with any author who so felicitously unites beauty of style with strength and nerve of expression; he does not specify, but paints."—*Wood's Ornithological Guide.*

RICHARDSON'S GEOLOGY FOR BEGINNERS, comprising a familiar Explanation of Geology and its associate Sciences, Mineralogy, Physical Geology, Fossil Conchology, Fossil Botany, and Palæontology, including Directions for forming Collections, &c. By G. F. RICHARDSON, F.G.S. (formerly with Dr. Mantell, now of the British Museum). Second Edition, considerably enlarged and improved. One thick vol. post 8vo, illustrated by upwards of 260 Woodcuts (pub. at 10*s.* 6*d.*), cloth, 7*s.* 6*d.* 1846

SELBY'S COMPLETE BRITISH ORNITHOLOGY. A most magnificent work of the Figures of British Birds, containing exact and faithful representations in their full natural size, of all the known species found in Great Britain, 383 Figures in 228 beautifully coloured Plates. 2 vols. elephant folio, elegantly half bound morocco (pub. at 105*l.*), gilt back and gilt edges, 31*l.* 10*s.* 1834

"The grandest work on Ornithology published in this country, the same for British Birds that Audubon's is for the birds of America. Every figure, excepting in a very few instances of extremely large birds, is of the full natural size, beautifully and accurately drawn, with all the spirit of life."—*Ornithologist's Text Book.*

"What a treasure, during a rainy forenoon in the country, is such a gloriously illuminated work as this of Mr. Selby! It is, without doubt, the most splendid of the kind ever published in Britain, and will stand a comparison, without any eclipse of its lustre, with the most magnificent ornithological illustrations of the French school. Mr. Selby has long and deservedly ranked high as a scientific naturalist."—*Blackwood's Magazine.*

SELBY'S ILLUSTRATIONS OF BRITISH ORNITHOLOGY. 2 vols. 8vo. Second Edition (pub. at 1*l.* 1*s.*), boards, 12*s.* 1833

SIBTHORP'S FLORA GRÆCA. The most costly and magnificent Botanical work ever published. 10 vols. folio, with 1000 beautifully coloured Plates, half bound morocco, publishing by subscription, and the number strictly limited to those subscribed for (pub. at 252*l.*), 63*l.*

Separate Prospectuses of this work are now ready for delivery. Only forty copies of the original stock exist. No greater number of subscribers' names can therefore be received.

SIBTHORP'S FLORÆ GRÆCÆ PRODROMUS. Sive Plantarum omnium Enumeratio, quas in Provinciis aut Insulis Graciæ invenit JOH. SIBTHORP: Characteres et Synonyma omnium cum Annotationibus JAC. EDW. SMITH. Four parts, in 2 thick vols, 8vo (pub. at 2*l.* 2*s.*), 14*s.* *Londini*, 1816

SOWERBY'S MANUAL OF CONCHOLOGY. Containing a complete Introduction to the Science, illustrated by upwards of 650 Figures of Shells, etched on copper-plates, in which the most characteristic examples are given of all the Genera established up to the present time, arranged in Lamarckian Order, accompanied by copious Explanations; Observations respecting the Geographical or Geological distribution of each; Tabular Views of the Systems of Lamarck and De Blainville; a Glossary of Technical Terms, &c. New Edition, considerably enlarged and improved, with numerous Woodcuts in the text, now first added, 8vo, cloth, 18*s.* The plates coloured, cloth, 1*l.* 16*s.* 1846

SOWERBY'S CONCHOLOGICAL ILLUSTRATIONS; OR, COLOURED FIGURES OF ALL THE HITHERTO UNFIGURED SHELLS, complete in 200 Shells, 8vo, comprising several thousand Figures, in parts, all beautifully coloured (pub. at 15*l.*), 7*l.* 10*s.* 1845

SPRY'S BRITISH COLEOPTERA DELINEATED; containing Figures and Descriptions of all the Genera of British Beetles, edited by SHUCKARD, 8vo, with 94 plates, comprising 638 figures of Beetles, beautifully and most accurately drawn (pub. at 2*l.* 2*s.*), cloth, 1*l.* 1*s.* 1840

"The most perfect work yet published in this department of British Entomology."

STEPHENS' BRITISH ENTOMOLOGY, 12 vols. 8vo, 100 coloured Plates (pub. at 21*l.*), half bound, 8*l.* 8*s.* 1828-46

——Or separately, LEPIDOPTERA, 4 vols. 4*l.* 4*s.* COLEOPTERA, 5 vols. 4*l.* 4*s.* DERMAPTERA, ORTHOP., NEUROP., &c., 1 vol 1*l.* 1*s.* HYMENOPTERA, 2 vols. 2*l.* 2*s.*

SWAINSON'S EXOTIC CONCHOLOGY; OR, FIGURES AND DESCRIPTIONS OF RARE, BEAUTIFUL, OR UNDESCRIBED SHELLS. Royal 4to, containing 94 large and beautifully coloured figures of Shells, half bound mor. gilt edges (pub. at 5*l.* 5*s*), 2*l.* 12*s.* 6*d.*

SWAINSON'S ZOOLOGICAL ILLUSTRATIONS; OR, ORIGINAL FIGURES AND DESCRIPTIONS OF NEW, RARE, OR INTERESTING ANIMALS, selected chiefly from the Classes of Ornithology, Entomology, and Conchology. 6 vols. royal 8vo, containing 318 finely coloured plates (pub. at 16*l.* 16*s.*), half bound morocco, gilt edges, 9*l.* 9*s.*

SWEET'S FLORA AUSTRALASICA; OR, A SELECTION OF HANDSOME OR CURIOUS PLANTS, Natives of New Holland and the South Sea Islands. 15 Nos. forming 1 vol. royal 8vo, complete, with 56 beautifully coloured plates (pub. at 3*l.* 15*s.*), cloth, 1*l.* 18*s.* 1827-28

SWEET'S CISTINEÆ; OR, NATURAL ORDER OF CISTUS, OR ROCK ROSE. 30 Nos. forming 1 vol. royal 8vo, complete, with 112 beautifully coloured plates (pub. at 5*l.* 5*s.*), cloth, 2*l.* 12*s.* 6*d.* 1828

"One of the most interesting, and hitherto the scarcest of Mr. Sweet's beautiful publications."

Miscellaneous English Literature,

INCLUDING

HISTORY, BIOGRAPHY, VOYAGES AND TRAVELS, POETRY AND THE DRAMA, MORALS, AND MISCELLANIES.

BACON'S WORKS, both English and Latin. With an Introductory Essay, and copious Indexes. Complete in 2 large vols. imperial 8vo, Portrait (pub. at 2*l.* 2*s.*), cloth, 1*l.* 16*s.* 1838

BACON'S ESSAYS AND ADVANCEMENT OF LEARNING, with Memoir and Notes by Dr. Taylor, square 12mo, with 34 Woodcuts (pub. at 4*s.*), ornamental wrapper, 2*s.* 6*d.* 1840

BANCROFT'S HISTORY OF THE UNITED STATES, from the Discovery of the American Continent. Twelfth Edition, 3 vols, 8vo (published at 2*l.* 10*s.*), cloth, 1*l.* 11*s.* 6*d.* 1847

BATTLES OF THE BRITISH NAVY, from A.D. 1000 to 1840. By JOSEPH ALLEN, of Greenwich Hospital. 2 thick elegantly printed vols. foolscap 8vo, illustrated by 24 Portraits of British Admirals, beautifully engraved on Steel, and numerous Woodcuts of Battles (pub. at 1*l.* 1*s.*), cloth gilt, 14*s.* 1842

"These volumes are invaluable; they contain the very pith and marrow of our best Naval Histories and Chronicles."—*Sun.*

"The best and most complete repository of the triumphs of the British Navy which has yet issued from the press."—*United Service Gazette.*

BORDERER'S, THE TABLE BOOK, or Gatherings of the Local History and Romance of the English and Scottish Borders, by M. A. RICHARDSON (of Newcastle), 8 vols. bound in 4, royal 8vo, Illustrated with nearly 1000 interesting Woodcuts, extra cloth (pub. at 3*l.* 10*s.*), 1*l.* 11*s.* *Newcastle*, 1846

*** One of the cheapest and most attractive sets of books imaginable.

BOSWELL'S LIFE OF DR. JOHNSON; BY THE RIGHT HON. J. C. CROKER, Incorporating his Tour to the Hebrides, and accompanied by the Commentaries of all preceding Editors: with numerous additional Notes and Illustrative Anecdotes; to which are added Two Supplementary Volumes of Anecdotes by HAWKINS, PIOZZI, MURPHY, TYERS, REYNOLDS, STEEVENS, and others. 10 vols. 12mo, illustrated by upwards of 50 Views, Portraits, and Sheets of Autographs, finely engraved on Steel, from Drawings by Stanfield, Harding, &c., cloth, reduced to 1*l.* 10*s.* 1848

This new, improved, and greatly enlarged edition, beautifully printed in the popular form of Sir Walter Scott, and Byron's Works, is just such an edition as Dr. Johnson himself loved and recommended. In one of the Ana recorded in the supplementary volumes of the present edition, he says: "Books that you may carry to the fire, and hold readily in your hand, are the most useful after all. Such books form the mass of general and easy reading."

BOURRIENNE'S MEMOIRS OF NAPOLEON, one stout, closely, but elegantly printed vol., foolscap 12mo, with fine equestrian Portrait of Napoleon and Frontispiece (pub. at 5*s.*), cloth, 3*s.* 6*d.* 1844

BRITISH ESSAYISTS, viz., Spectator, Tatler, Guardian, Rambler, Adventurer, Idler, and Connoisseur, 3 thick vols. 8vo, portraits (pub. at 2*l.* 5*s.*), cloth, 1*l.* 7*s.* Either volume may be had separate.

BRITISH POETS, CABINET EDITION, containing the complete works of the principal English poets, from Milton to Kirke White. 4 vols. post 8vo (size of Standard Library) printed in a very small but beautiful type, 22 Medallion Portraits (pub. at 2*l.* 2*s.*), cloth, 18*s.*

BROUGHAM'S (LORD) POLITICAL PHILOSOPHY, and Essay on the British Constitution, 3 vols. 8vo (pub. at 1*l.* 11*s.* 6*d.*), cloth, 1*l.* 1*s.* 1844-6

——— British Constitution (a portion of the preceding work), 8vo. cloth, 3*s.*

BROUGHAM'S (LORD) HISTORICAL SKETCHES OF STATESMEN, and other Public Characters of the time of George III. Vol. III. royal 8vo, with 10 fine portraits (pub. at 1*l.* 1*s.*), cloth, 10*s.* 6*d.* 1846

BROUGHAM'S (LORD) LIVES OF MEN OF LETTERS AND SCIENCE, Who flourished in the time of George III, royal 8vo, with 10 fine portraits (pub. at 1*l.* 1*s.*), cloth, 12*s.* 1845

——— the same, also with the portraits, demy 8vo (pub. at 1*l.* 1*s.*), cloth, 10*s.* 6*d.* 1846

BROWNE'S (SIR THOMAS) WORKS, COMPLETE. Including his Vulgar Errors, Religio Medici, Urn Burial, Christian Morals, Correspondence, Journals, and Tracts, many of them hitherto unpublished. The whole collected and edited by SIMON WILKIN, F.L.S. 4 vols. 8vo, fine Portrait (pub. at 2*l.* 8*s.*), cloth, 1*l.* 11*s.* 6*d.* *Pickering*, 1836

"Sir Thomas Browne, the contemporary of Jeremy Taylor, Hooke, Bacon, Selden, and Robert Burton, is undoubtedly one of the most eloquent and poetical of that great literary era. His thoughts are often truly sublime, and always conveyed in the most impressive language."—*Chambers.*

BUCKINGHAM'S AMERICA; HISTORICAL, STATISTICAL, AND DESCRIPTIVE, viz.: Northern States, 3 vols.; Eastern and Western States, 3 vols.; Southern or Slave States, 2 vols.; Canada, Nova Scotia, New Brunswick, and the other British Provinces in North America, 1 vol. Together 9 stout vols. 8vo, numerous fine Engravings (pub. at 6*l.* 10*s.* 6*d.*), cloth, 2*l.* 12*s.* 6*d.* 1841-43

"Mr. Buckingham goes deliberately through the States, treating of all, historically and statistically—of their rise and progress, their manufactures, trade, population, topography, fertility, resources, morals, manners, education, and so forth. *His volumes will be found a storehouse of knowledge.*"—*Athenæum.*

"A very entire and comprehensive view of the United States, diligently collected by a man of great acuteness and observation."—*Literary Gazette.*

BURKE'S (EDMUND) WORKS. With a Biographical and Critical Introduction by ROGERS. 2 vols. imperial 8vo, closely but handsomely printed (pub. at 2*l.* 2*s.*), cloth, 1*l.* 10*s.* 1841

BURKE'S ENCYCLOPÆDIA OF HERALDRY; OR, GENERAL ARMOURY OF ENGLAND, SCOTLAND, AND IRELAND. Comprising a Registry of all Armorial Bearings, Crests, and Mottoes, from the Earliest Period to the Present Time, including the late Grants by the College of Arms. With an Introduction to Heraldry, and a Dictionary of Terms. Third Edition, with a Supplement. One very large vol. imperial 8vo, beautifully printed in small type, in double columns, by WHITTINGHAM, embellished with an elaborate Frontispiece, richly illuminated in gold and colours; also Woodcuts (pub. at 2*l.* 2*s.*), cloth gilt, 1*l.* 5*s.* 1844

The most elaborate and useful Work of the kind ever published. It contains upwards of 30,000 armorial bearings, and incorporates all that have hitherto been given by Guillim, Edmondson, Collins, Nisbet, Berry, Robson, and others; besides many thousand names which have never appeared in any previous Work. This volume, in fact, in a small compass, but without abridgment, contains more than four ordinary quartos.

BURNS' WORKS, WITH LIFE BY ALLAN CUNNINGHAM, AND NOTES BY SIR WALTER SCOTT, CAMPBELL, WORDSWORTH, LOCKHART, &c. Royal 8vo, fine Portrait and Plates (pub. at 18*s.*), cloth, uniform with Byron, 10*s.* 6*d.* 1842

This is positively the only complete edition of Burns, in a single volume, 8vo. It contains not only every scrap which Burns ever wrote, whether prose or verse, but also a considerable number of Scotch national airs, collected and illustrated by him (not given elsewhere) and full and interesting accounts of the occasions and circumstances of his various writings. The very complete and interesting Life by Allan Cunningham alone occupies 164 pages, and the Indices and Glossary are very copious. The whole forms a thick elegantly printed volume, extending in all to 848 pages. The other editions, including one published in similar shape, with an abridgment of the Life by Allan Cunningham, comprised in only 47 pages, and the whole volume in only 504 pages, do not contain above two-thirds of the above.

CAMPBELL'S LIFE AND TIMES OF PETRARCH. With Notices of Boccaccio and his Illustrious Contemporaries. Second Edition. 2 vols. 8vo, fine Portraits and Plates (pub. at 1*l.* 11*s.* 6*d.*), cloth, 12*s.* 1843

CARY'S EARLY FRENCH POETS, a Series of Notices and Translations, with an Introductory Sketch of the History of French Poetry; Edited by his Son, the Rev. HENRY CARY. foolscap, 8vo, cloth, 5*s.* 1846

CARY'S LIVES OF ENGLISH POETS, supplementary to Dr. JOHNSON'S "Lives." Edited by his Son, foolscap 8vo, cloth, 7*s.* 1846

CHATHAM PAPERS, being the Correspondence of William Pitt, Earl of Chatham Edited by the Executors of his Son, John Earl of Chatham, and published from the Original Manuscripts in their possession. 4 vols. 8vo (pub. at 3*l.* 12*s.*), cloth, 1*l.* 5*s.* *Murray*, 1838-40

"A production of greater historical interest could hardly be imagined. It is a standard work, which will directly pass into every library."—*Literary Gazette.*

"There is hardly any man in modern times who fills so large a space in our history, and of whom we know so little, as Lord Chatham; he was the greatest Statesman and Orator that this country ever produced. We regard this Work, therefore, as one of the greatest value."—*Edinburgh Review.*

CHATTERTON'S WORKS, both Prose and Poetical, including his Letters; with Notices of his Life, History of the Rowley Controversy, and Notes Critical and Explanatory. 2 vol's post 8vo, elegantly printed, with Engraved Fac-similes of Chatterton's Handwriting and the Rowley MSS. (pub. at 15s.), cloth, 9s. Large Paper, 2 vols. crown 8vo (pub. at 1l. 1s.), cloth, 12s. 1842

"Warton, Malone, Croft, Dr. Knox, Dr. Sherwin, and others, in prose; and Scott, Wordsworth, Kirke White, Montgomery, Shelley, Coleridge, and Keats, in verse; have conferred lasting immortality upon the Poems of Chatterton."

"Chatterton's was a genius l'e that of Homer and Shakspeare, which appears not above once in many centuries."—*Vicesimus Knox.*

CLARKE'S (DR. E. D.) TRAVELS IN VARIOUS COUNTRIES OF EUROPE, ASIA, AND AFRICA, 11 vols. 8vo, maps and plates (pub. at 10l.), cloth, 3l. 3s. 1827-34

CLASSIC TALES, Cabinet Edition, comprising the Vicar of Wakefield, Elizabeth, Paul and Virginia, Gulliver's Travels, Sterne's Sentimental Journey, Sorrows of Werter, Theodosius and Constantia, Castle of Otranto, and Rasselas, complete in 1 vol. 12mo.; 7 medallion portraits (pub. at 10s. 6d.), cloth, 3s. 6d.

COLMAN'S (GEORGE) POETICAL WORKS, containing his Broad Grins, Vagaries, and Eccentricities, 24mo, woodcuts (pub. at 2s. 6d.), cloth, 1s. 6d. 1840

COOPER'S (J. F.) HISTORY OF THE NAVY OF THE UNITED STATES OF AMERICA, from the Earliest Period to the Peace of 1815, 2 vols, 8vo (pub. at 1l. 10s.), gilt cloth, 12s. 1839

COPLEY'S (FORMERLY MRS. HEWLETT) HISTORY OF SLAVERY AND ITS ABOLITION. Second Edition, with an Appendix, thick small 8vo, fine Portrait of Clarkson (pub. at 6s.), cloth, 4s. 6d. 1839

COSTELLO'S SPECIMENS OF THE EARLY FRENCH POETRY, from the time of the Troubadours to the Reign of Henry IV, post 8vo, with 4 Plates, splendidly illuminated in gold and colours, cloth gilt, 18s. 1835

COWPER'S COMPLETE WORKS, EDITED BY SOUTHEY; comprising his Poems, Correspondence, and Translations; with a Life of the Author. 15 vols. post 8vo, embellished with numerous exquisite Engravings, after the designs of HARVEY (pub. at 3l. 15s.), cloth, 2l. 5s. 1835-37

This is the only complete edition of Cowper's Works, prose and poetical, which has ever been given to the world. Many of them are still exclusively copyright, and consequently cannot appear in any other edition.

CRAWFURD'S (J.) EMBASSY TO SIAM AND COCHIN-CHINA. 2 vols. 8vo, Maps, and 25 Plates (pub. at 1l. 11s. 6d.), cloth, 12s. 1830

CRAWFURD'S EMBASSY TO AVA, with an Appendix on Fossil Remains by Professor BUCKLAND. 2 vols. 8vo, with 13 Maps, Plates, and Vignettes (pub. at 1l. 11s. 6d.), cloth, 12s. 1834

CRUIKSHANK'S THREE COURSES AND A DESSERT. A Series of Tales, in Three Sets, viz., Irish, Legal, and Miscellaneous. Crown 8vo, with 51 extremely clever and comic Illustrations (publishing in the Illustrated Library at 5s.)

"This is an extraordinary performance. Such an union of the painter, the poet, and the novelist, in one person, is unexampled. A tithe of the talent that goes to making the stories would set up a dozen of annual writers; and a tithe of the inventive genius that is displayed in the illustrations would furnish a gallery."—*Spectator.*

DAVIS'S SKETCHES OF CHINA, During an Inland Journey of Four Months; with an Account of the War. Two vols., post 8vo, with a new map of China (pub. at 16s.), cloth, 9s. 1841

DIBDIN'S BIBLIOMANIA: OR BOOK-MADNESS. A Bibliographical Romance. New Edition, with considerable Additions, including a Key to the assumed Characters in the Drama, and a Supplement. 2 vols. royal 8vo, handsomely printed, embellished by numerous Woodcuts, many of which are now first added (pub. at 3l. 3s.), cloth, 1l. 11s. 6d. Large Paper, imperial 8vo, of which only very few copies were printed (pub. at 5l. 5s.), cloth, 3l. 13s. 6d. 1842

This celebrated Work, which unites the entertainment of a romance with the most valuable information on all bibliographical subjects, has long been very scarce and sold for considerable sums—the small paper for 8l. 8s., and the large paper for upwards of 50 guineas!!!

DIBDIN'S (CHARLES) SONGS, Admiralty edition, complete, with a Memoir by T. DIBDIN, illustrated with 12 Characteristic Sketches, engraved on Steel by GEORGE CRUIKSHANK, 12mo, cloth lettered, 5s. 1848

DOMESTIC COOKERY, by a Lady (Mrs. RUNDELL) New Edition, with numerous additional Receipts, by Mrs. BIRCH, 12mo., with 9 plates (pub. at 6s.) cloth, 3s. 1846

DRAKE'S SHAKSPEARE AND HIS TIMES, including the Biography of the Poet, Criticisms on his Genius and Writings, a new Chronology of his Plays, and a History of the Manners, Customs, and Amusements, Superstitions, Poetry, and Literature of the Elizabethan Era. 2 vols. 4to (above 1400 pages), with fine Portrait and a Plate of Autographs (pub. at 5l. 5s.), cloth, 1l. 1s. 1817

"A masterly production, the publication of which will form an epoch in the Shaksperian history of this country. It comprises also a complete and critical analysis of all the Plays and Poems of Shakspeare; and a comprehensive and powerful sketch of the contemporary literature."—*Gentleman's Magazine.*

ENGLISH CAUSES CELEBRES, OR, REMARKABLE TRIALS. Square 16mo, (pub. at 6d.), ornamental wrapper, 2s. 1844

FENN'S PASTON LETTERS. Original Letters of the Paston Family, written during the Reigns of Henry VI, Edward IV, and Richard III, by various Persons of Rank and Consequence, chiefly on Historical Subjects. New Edition, with Notes and Corrections, complete, 2 vols. bound in 1, square 12mo (pub. at 10s.), cloth gilt, 5s. Quaintly bound in maroon morocco, carved boards, in the early style, gilt edges, 15s. 1849

The original edition of this very curious and interesting series of historical Letters is a rare book, and sells for upwards of ten guineas. The present is not an abridgment, as might be supposed from its form, but gives the whole matter by omitting the duplicate version of the letters written in an obsolete language, and adopting only the more modern, readable version published by Fenn.

"The Paston Letters are an important testimony to the progressive condition of society, and come in as a precious link in the chain of the moral history of England, which they alone in this period supply. They stand indeed singly in Europe."—*Hallam.*

FIELDING'S WORKS, EDITED BY ROSCOE, COMPLETE IN ONE VOLUME. (Tom Jones, Amelia, Jonathan Wild, Joseph Andrews. Plays, Essays, and Miscellanies.) Medium 8vo, with 20 capital Plates by CRUIKSHANK (pub. at 1*l.* 4*s.*), cloth gilt, 14*s.* 1848

"Of all the works of imagination to which English genius has given origin, the writings of Henry Fielding are perhaps most decidedly and exclusively her own."—*Sir Walter Scott.*

"The prose Homer of human nature."—*Lord Byron.*

FOSTER'S ESSAYS ON DECISION OF CHARACTER; on a Man's Writing Memoirs of Himself; on the epithet Romantic; on the Aversion of Men of Taste to Evangelical Religion, &c. Fcap. 8vo, Eighteenth Edition (pub. at 6*s.*), cloth, 5*s.* 1848

"I have read with the greatest admiration the Essays of Mr. Foster. He is one of the most profound and eloquent writers that England has produced."—*Sir James Mackintosh.*

FOSTER'S ESSAY ON THE EVILS OF POPULAR IGNORANCE. New Edition, elegantly printed, in fcap. 8vo, now first uniform with his Essays on Decision of Character, cloth, 5s. 1847

"Mr. Foster always considered this his best work, and the one by which he wished his literary claims to be estimated."

"A work which, popular and admired as it confessedly is, has never met with the thousandth part of the attention which it deserves."—*Dr. Pye Smith.*

FROISSART'S CHRONICLES OF ENGLAND, FRANCE, AND SPAIN, &c. New Edition, by Colonel Johnes, with 120 beautiful Woodcuts, 2 vols. super-royal 8vo, cloth lettered (pub. at 1*l.* 16*s.*), 1*l.* 8*s.* 1849

FROISSART, ILLUMINATED ILLUSTRATIONS OF, 74 plates, printed in gold and colours, 2 vols. super-royal 8vo, half bound, uncut (pub. at 4*l.* 10*s.*), 3*l.* 10*s.*

——— the same, large paper, 2 vols. royal 4to, half bound, uncut (pub. at 10*l.* 10*s.*), 6*l.* 6*s.*

FROISSART'S CHRONICLES, WITH THE 74 ILLUMINATED ILLUSTRATIONS INSERTED, 2 vols. super-royal 8vo, elegantly half bound red morocco, gilt edges, emblematically tooled (pub. at 6*l.* 6*s.*), 4*l.* 10*s.* 1849

GAZETTEER.—NEW EDINBURGH UNIVERSAL GAZETTEER, AND GEOGRAPHICAL DICTIONARY, more complete than any hitherto published. New Edition, revised and completed to the present time, by JOHN THOMSON (Editor of the *Universal Atlas*, &c.), very thick 8vo (1040 pages), Maps (pub. at 18*s.*), cloth, 12*s.*

This comprehensive volume is the latest, and by far the best Universal Gazetteer of its size. It includes a full account of Affghanistan, New Zealand, &c. &c.

GELL'S (SIR WILLIAM) TOPOGRAPHY OF ROME AND ITS VICINITY. An improved Edition, complete in 1 vol. 8vo, with several Plates, cloth, 12*s.* With a very large Map of Rome and its Environs (from a most careful trigonometrical survey), mounted on cloth, and folded in a case so as to form a volume. Together 2 vols. 8vo, cloth, 1*l.* 1*s.* 1846

"These volumes are so replete with what is valuable, that were we to employ our entire journal, we could, after all, afford but a meagre indication of their interest and worth. It is, indeed, a lasting memorial of eminent literary exertion, devoted to a subject of great importance, and one dear, not only to every scholar, but to every reader of intelligence to whom the truth of history is an object of consideration."

GILLIES' (DR.) HISTORICAL COLLECTIONS, Relating to Remarkable Periods of the Success of the Gospel, including the Appendix and Supplement, with Prefaces and Continuation by the Rev. H. BONAR, royal 8vo (pub. at 15*s.* 6*d.*), cloth, 7*s.* 6*d.* 1845

GLEIG'S MEMOIRS OF WARREN HASTINGS, first Governor-General of Bengal. 3 vols. 8vo, fine Portrait (pub. at 2*l.* 5*s.*), cloth, 1*l.* 1*s.* 1841

GOETHE'S FAUST, PART THE SECOND, as completed in 1831, translated into English Verse by JOHN MACDONALD BELL, Esq. Second Edition, fcap. 8vo (pub. at 6*s.*), cloth, 3*s.* 1842

GOLDSMITH'S WORKS, with a Life and Notes. 4 vols. fcap. 8vo, with engraved Titles and Plates by STOTHARD and CRUIKSHANK. New and elegant Edition (pub. at 1*l.*), extra cloth, 12*s.* 1848

"Can any author—can even Sir Walter Scott, be compared with Goldsmith for the variety, beauty, and power of his compositions? You may take him and 'cut him out in little stars,' so many lights does he present to the imagination."—*Athenæum.*

"The volumes of Goldsmith will ever constitute one of the most precious 'wells of English undefiled.'"—*Quarterly Review.*

GORDON'S HISTORY OF THE GREEK REVOLUTION, and of the Wars and Campaigns arising from the Struggles of the Greek Patriots in emancipating their country from the Turkish yoke. By the late THOMAS GORDON, General of a Division of the Greek Army. Second Edition, 2 vols. 8vo, Maps and Plans (pub. at 1*l.* 10*s.*), cloth, 10*s.* 6*d.* 1842

GORTON'S BIOGRAPHICAL DICTIONARY, 3 thick vols. 8vo, cloth lettered (pub. at 2*l.* 2*s.*), 1*l.* 11*s.* 6*d.*

GRANVILLE'S (DR.) SPAS OF ENGLAND and Principal Sea Bathing Places. 3 vols. post 8vo, with large Map, and upwards of 50 beautiful Woodcuts (pub. at 1*l.* 13*s.*), cloth, 15*s.* 1841

GRANVILLE'S (DR.) SPAS OF GERMANY, 8vo, with 39 Woodcuts and Maps (pub. at 18*s.*), cloth, 9*s.* 1843

HALL'S (CAPTAIN BASIL) PATCHWORK, consisting of Travels, and Adventures in Switzerland, Italy, France, Sicily, Malta, &c. 3 vols, 12mo, Second Edition, cloth, gilt (pub. at 15*s.*), 7*s* 6*d.*

HEEREN'S (PROFESSOR) HISTORICAL WORKS, translated from the German, viz.—Asia, New Edition, complete in 2 vols.—Africa, 1 vol.—Europe and its Colonies, 1 vol.—Ancient Greece, and Historical Treatises, 1 vol.—Manual of Ancient History, 1 vol.—together 6 vols. 8vo (formerly pub. at 7*l.*), cloth lettered, uniform, 3*l.* 3*s.*
*** *New and Complete Editions, with General Indexes.*

"Professor Heeren's Historical Researches stand in the very highest rank among those with which modern Germany has enriched the Literature of Europe."—*Quarterly Review.*

HEEREN'S HISTORICAL RESEARCHES INTO THE POLITICS, INTERCOURSE, AND TRADES OF THE ANCIENT NATIONS OF AFRICA; including the Carthaginians, Ethiopians, and Egyptians. New Edition, corrected throughout, with an Index, Life of the Author, new Appendixes, and other Additions. Complete in 1 vol. 8vo, cloth, 16*s.* 1850

HEEREN'S HISTORICAL RESEARCHES INTO THE POLITICS, INTERCOURSE, AND TRADES OF THE ANCIENT NATIONS OF ASIA; including the Persians, Phenicians, Babylonians, Scythians, and Indians. New and improved Edition, complete in 2 vols. 8vo, elegantly printed (pub. originally at 2*l.* 5*s.*), cloth, 1*l.* 4*s.* 1846

"One of the most valuable acquisitions made to our historical stories since the days of Gibbon."—*Athenæum.*

HEEREN'S MANUAL OF THE HISTORY OF THE POLITICAL SYSTEM OF EUROPE AND ITS COLONIES, from its formation at the close of the Fifteenth Century, to its re-establishment upon the Fall of Napoleon, translated from the Fifth German Edition New Edition, complete in 1 vol. 8vo, cloth, 14*s.* 1846

"The best History of Modern Europe that has yet appeared, and it is likely long to remain without a rival."—*Athenæum.*

"A work of sterling value, which will diffuse useful knowledge for generations, after all the shallow pretenders to that distinction are fortunately forgotten."—*Literary Gazette.*

HEEREN'S ANCIENT GREECE. translated by Bancroft; and **HISTORICAL TREATISES;** viz:—I. The Political Consequences of the Reformation. II. The Rise, Progress, and Practical Influence of Political Theories. III. The Rise and Growth of the Continental Interests of Great Britain. In 1 vol. 8vo, with Index, cloth, 15*s.* 1847

HEEREN'S MANUAL OF ANCIENT HISTORY, particularly with regard to the Constitutions, the Commerce, and the Colonies of the States of Antiquity. Third Edition, corrected and improved. 8vo (pub. at 15*s.*), cloth, 12*s.*
*** *New Edition, with Index.* 1847

"We never remember to have seen a Work in which so much useful knowledge was condensed into so small a compass. A careful examination convinces us that this book will be useful for our English higher schools or colleges, and will contribute to direct attention to the better and more instructive parts of history. The translation is executed with great fidelity."—*Quarterly Journal of Education.*

HEEREN'S MANUAL OF ANCIENT GEOGRAPHY. For the use of Schools and Private Tuition. Compiled from the Works of A. H. L. Heeren, 12mo (pub. at 2*s.* 6*d.*), cloth, 2*s.* *Oxford, Talboys,* 1830

"An excellent and most useful little volume, and admirably adapted for the use of schools and private instruction."—*Literary Gazette.*

"A valuable addition to our list of school books."—*Athenæum.*

JACOB'S HISTORICAL INQUIRY INTO THE PRODUCTION AND CONSUMPTION OF THE PRECIOUS METALS, 2 vols. 8vo (pub. at 1*l.* 4*s.*), cloth, 16*s.* 1831

JAMES'S WILLIAM THE THIRD, comprising the History of his Reign, illustrated in a series of unpublished letters, addressed to the Duke of Shrewsbury, by James Vernon, Secretary of State, with Introduction and Notes, by G. P. R. James, Esq. 3 vols. 8vo, Portraits (pub. at 2*l.* 2*s.*), cloth, 18*s.* 1841

JAENISCH'S CHESS PRECEPTOR; a new Analysis of the openings of Games; translated, with Notes, by Walker, 8vo, cloth lettered (pub. at 15*s.*), 6*s.* 6*d.* 1847

JOHNSON'S (DR.) ENGLISH DICTIONARY, printed verbatim from the Author's last Folio Edition. With all the Examples in full. To which are prefixed a History of the Language, and an English Grammar. 1 large vol. imperial 8vo (pub. at 2*l.* 2*s.*), cloth, 1*l.* 8*s.* 1846

JOHNSON'S (DR.) LIFE AND WORKS, by Murphy. New and improved Edition, complete in 2 thick vols. 8vo, Portrait, cloth lettered (pub. at 1*l.* 11*s.* 6*d.*), 15*s.* 1850

JOHNSONIANA; a Collection of Miscellaneous Anecdotes and Sayings, gathered from nearly a hundred different Publications, and not contained in Boswell's Life of Johnson. Edited by J. W. Croker, M.P. thick fcap. 8vo, portrait and frontispiece (pub. at 10*s.*), cloth, 4*s.* 6*d.* 1845

JOHNSTON'S TRAVELS IN SOUTHERN ABYSSINIA, through the Country of Adal, to the Kingdom of Shoa. 2 vols. 8vo, map and plates (pub. at 1*l.* 8*s.*), cloth, 10*s.* 6*d.* 1844

KIRBY'S WONDERFUL MUSEUM. 5 vols. 8vo, upwards of 100 curious portraits and plates (pub. at 4*l.* 4*s.*), cloth, 1*l.* 1*s.*

KNIGHT'S JOURNEY-BOOKS OF ENGLAND. BERKSHIRE, including a full Description of Windsor. With 23 Engravings on Wood, and a large Illuminated Map. Reduced to 1*s.* 6*d.*

HAMPSHIRE, including the Isle of Wight. With 32 Engravings on Wood, and a large Illuminated Map. Reduced to 2*s.*

DERBYSHIRE, including the Peak, &c. With 23 Engravings on Wood, and a large Illuminated Map. Reduced to 1*s.* 6*d.*

KENT. With 58 Engravings on Wood, and a large Illuminated Map. Reduced to 2*s.* 6*d.*

KNOWLES'S IMPROVED WALKER'S PRONOUNCING DICTIONARY, containing above 50,000 additional Words; to which is added an Accentuated Vocabulary of Classical and Scripture Proper Names, new Edition, in 1 thick handsome volume, large 8vo, with Portrait, cloth lettered (pub. at 1*l.* 4*s.*), 7*s.* 6*d.* 1849

LACONICS; OR, THE BEST WORDS OF THE BEST AUTHORS. Seventh Edition. 3 vols. 18mo, with elegant Frontispieces, containing 30 Portraits (pub. at 15*s.*), cloth gilt, 7*s.* 6*d.* Tilt, 1840

This pleasant collection of pithy and sententious readings, from the best English authors of all ages, has long enjoyed great and deserved popularity.

LANE'S KORAN, SELECTIONS FROM THE, with an interwoven Commentary, translated from the Arabic, methodically arranged, and illustrated by Notes, 8vo (pub. at 10*s.* 6*d.*), cloth, 5*s.* 1843

LEAKE'S (COL.) TRAVELS IN THE MOREA. 3 vols. 8vo. With a very large Map of the Morea, and upwards of 30 various Maps, Plans, Plates of ancient Greek Inscriptions, &c. (pub. at 2*l.* 5*s.*) cloth, 1*l.* 8*s.* 1830

LEWIS'S (MONK) LIFE AND CORRESPONDENCE, with many Pieces in Prose and Verse never before published. 2 vols. 8vo, portrait (pub. at 1*l.* 8*s.*), cloth, 12*s.* 1839

LISTER'S LIFE OF EDWARD FIRST EARL OF CLARENDON. With Original Correspondence and Authentic Papers, never before published. 3 vols. 8vo, Portrait (pub. at 2*l.* 8*s.*), cloth, 18*s.* 1838

"A Work of laborious research, written with masterly ability."—*Atlas.*

LOCKHART'S HISTORY OF THE CONQUEST OF MEXICO AND NEW SPAIN, AND MEMOIRS OF THE CONQUISTADOR, BERNAL DIAZ DEL CASTILLO. Written by himself, and now first completely translated from the original Spanish. 2 vols. 8vo, (pub. at 1*l.* 4*s.*), cloth, 12*s.* 1844

"Bernal Diaz's account bears all the marks of authenticity, and is accompanied with such pleasant naïveté, with such interesting details, and such amusing vanity, and yet so pardonable in an old soldier, who has been, as he boasts, in a hundred and nineteen battles, as renders his book one of the most singular that is to be found in any language."—*Dr. Robertson in his "History of America."*

LODGE'S (EDMUND) ILLUSTRATIONS OF BRITISH HISTORY, BIOGRAPHY, AND MANNERS, in the Reigns of Henry VIII., Edward VI., Mary, Elizabeth, and James I. Second Edition, with above 80 autographs of the principal characters of the period. Three vols. 8vo (pub. at 1*l.* 16*s.*), cloth, 1*l.* 1838

MACGREGOR'S PROGRESS OF AMERICA FROM THE DISCOVERY BY COLUMBUS, to the year 1846, comprising its History and Statistics, 2 remarkably thick volumes, imp. 8vo, cloth lettered (pub. at 4*l.* 14*s.* 6*d.*), 1*l.* 11*s.* 6*d.* 1847

MALCOLM'S MEMOIR OF CENTRAL INDIA. Two vols. 8vo, third edition, with large map (pub. at 1*l.* 8*s.*), cloth, 18*s.* 1832

MARTIN'S (MONTGOMERY) BRITISH COLONIAL LIBRARY; forming a popular and Authentic Description of all the Colonies of the British Empire, and embracing the History—Physical Geography—Geology—Climate—Animal, Vegetable, and Mineral Kingdoms—Government—Finance—Military Defence—Commerce—Shipping—Monetary System—Religion—Population, White and Coloured—Education and the Press—Emigration—Social State, &c., of each Settlement. Founded on Official and Public Documents, furnished by Government, the Hon. East India Company, &c. Illustrated by original Maps and Plates. 10 vols. foolscap 8vo (pub. at 3*l.*), cloth, 1*l.* 15*s.*

These 10 vols. contain the 5 vols. 8vo, verbatim, with a few additions. Each volume of the above series is complete in itself, and sold separately, as follows, at 3*s.* 6*d.*:—

Vol. I.—The Canadas, Upper and Lower.

Vol. II.—New South Wales, Van Diemen's Land, Swan River, and South Australia.

Vol. III.—The Cape of Good Hope, Mauritius, and Seychelles.

Vol. IV.—The West Indies. Vol. I.—Jamaica, Honduras, Trinidad, Tobago, Granada, the Bahamas, and the Virgin Isles.

Vol. V.—The West Indies. Vol. II.—British Guiana, Barbadoes, St. Lucia, St. Vincent, Demerara, Essequibo, Berbice, Anguilla, Tortola, St. Kitt's, Barbuda, Antigua, Montserrat, Dominica, and Nevis.

Vol. VI.—Nova Scotia, New Brunswick, Cape Breton, Prince Edward's Isle, The Bermudas, Newfoundland, and Hudson's Bay.

Vol. VII.—Gibraltar, Malta, The Ionian Islands, &c.

Vol. VIII.—The East Indies. Vol. I. containing Bengal, Madras, Bombay, Agra, &c.

Vol. IX.—The East Indies. Vol. II.

Vol. X.—British Possessions in the Indian and Atlantic Oceans, viz.—Ceylon, Penang, Malacca, Singapore, Sierra Leone, the Gambia, Cape Coast Castle, Accra, the Falkland Islands, St. Helena and Ascension.

MARTIN'S (MONTGOMERY) CHINA, Political, Commercial, and Social. Two vols. 8vo, 6 maps, statistical tables, &c. (pub. at 1l. 4s.), cloth, 14s. 1847

MAXWELL'S LIFE OF THE DUKE OF WELLINGTON. 3 handsome volumes, 8vo. Embellished with numerous highly-finished Line-Engravings by COOPER and other eminent Artists, consisting of Battle-Pieces, Portraits, Military Plans and Maps; besides a great number of fine Wood Engravings. (Pub. at 3l. 7s.), elegant in gilt cloth, 1l. 16s. Large paper, India proofs (pub. at 5l.), gilt cloth, 3l. 3s. 1839-41

"Mr. Maxwell's 'Life of the Duke of Wellington,' in our opinion, has no rival among similar publications of the day. . . . . We pronounce it free from flattery and bombast, succinct and masterly. . . . . The type and mechanical execution are admirable; the plans of battles and sieges numerous, ample, and useful; the portraits of the Duke and his warrior contemporaries many and faithful; the battle pictures animated and brilliant; and the vignettes of costumes and manners worthy of the military genius of Horace Vernet himself."—*Times.*

MILL'S ELEMENTS OF POLITICAL ECONOMY, new Edition, revised and corrected, 8vo (pub. at 8s.), cloth, 3s. 6d. 1844

MILTON'S WORKS, BOTH PROSE AND POETICAL, with an Introductory Review, by FLETCHER, complete in 1 thick vol. imperial 8vo (pub. at 1l. 5s.), cloth lettered, 1l. 1s. 1838

This is the only complete edition of Milton's Prose Works, at a moderate price.

MITFORD'S HISTORY OF GREECE, BY LORD REDESDALE, the Chronology corrected and compared with *Clinton's Fasti Hellenici*, by KING, (Cadell's last and much the best Edition, 1838) 8 vols. 8vo (pub. at 4l. 4s.), gilt cloth, 1l. 18s.

Tree-marbled calf extra, by CLARKE, 4l. 4s.

In respect to this new and improved edition, one of the most eminent scholars of the present day has expressed his opinion that "the increased advantages given to it have doubled the original value of the work."

It should be observed that the numerous additions and the amended Chronology, from that valuable performance, the *Fasti Hellenici*, are subjoined in the shape of Notes, so as not to interfere with the integrity of the text.

As there are many editions of Mitford's Greece before the public, it may be necessary to observe that the present octavo edition is the only one which contains Mr. King's last corrections and additions (which, as stated in his advertisement, are material); it is at the same time the only edition which should at the present day be chosen for the gentleman's library, being the handsomest, the most correct, and the most complete.

Lord Byron says of Mitford, "His is the best Modern History of Greece in any language, and he is perhaps the best of all modern historians whatsoever. His virtues are learning, labour, research, and earnestness."

"Considered with respect, not only to the whole series of ancient events which it comprises, but also to any very prominent portion of that series, Mr. Mitford's History is the best that has appeared since the days of Xenophon."—*Edinburgh Review.*

MONSTRELET'S CHRONICLES OF ENGLAND AND FRANCE, by Colonel JOHNES, with Notes, and upwards of 100 Woodcuts (uniform with Froissart), 2 vols. super-royal 8vo, cloth lettered (pub. at 1l. 10s.), 1l. 4s.

MOORE'S (THOMAS) EPICUREAN, A TALE; AND ALCIPHRON, A POEM. TURNER'S Illustrated Edition, fcap. 8vo, 4 beautiful Engravings (pub. at 10s. 6d.), cloth, 3s., or elegantly bound in morocco, 7s. 6d. 1839

MORE'S UTOPIA, OR, THE HAPPY REPUBLIC. a Philosophical Romance; to which is added, THE NEW ATLANTIS, by LORD BACON; with a Preliminary Discourse, and Notes, by J. A. ST. JOHN, fcap. 8vo (pub. at 6s.), cloth, 4s. 6d.—With the Life of Sir Thomas More, by SIR JAMES MACKINTOSH, 2 vols. fcap. 8vo, cloth, 8s. 1845

NELSON'S LETTERS AND DISPATCHES, by Sir HARRIS NICOLAS, 7 vols. 8vo (pub. at 5l. 10s.), cloth, 3l. 10s. 1845-46

NIEBUHR'S HISTORY OF ROME epitomized, with Chronological Tables and an Appendix, by TRAVERS TWISS, B.C.L. 2 vols. 8vo, cloth (pub. at 1l. 1s.), 10s. 6d.

———— the same, in calf, gilt (for school prizes), 15s.

OSSIAN'S POEMS, translated by MACPHERSON, with Dissertations concerning the Era and Poems of OSSIAN; and Dr. BLAIR'S Critical Dissertation, complete in 1 neatly printed vol. 18mo, Frontispiece (pub. at 4s.), cloth, 3s. 1844

OUSELEY'S (SIR WILLIAM) TRAVELS IN VARIOUS COUNTRIES OF THE EAST, MORE PARTICULARLY PERSIA; with Extracts from rare and valuable Oriental Manuscripts; and 80 Plates and Maps, 3 vols. 4to (pub. at 11l.), extra cloth boards, 3l. 3s.

OXFORD ENGLISH PRIZE ESSAYS, new Edition, brought down to 1836, 5 vols. crown 8vo, cloth lettered (pub. at 2l. 5s.), 1l. 5s.

PARDOE'S (MISS) CITY OF THE MAGYAR, Or Hungary and her Institutions in 1839-40, 3 vols. 8vo, with 9 Engravings (pub. at 1l. 11s. 6d.), gilt cloth, 10s. 6d. 1840

PARRY'S CAMBRIAN PLUTARCH, comprising Memoirs of some of the most eminent Welshmen, from the earliest times to the present, 8vo (pub. at 10s. 6d.), cloth, 5s. 1834

PERCY'S RELIQUES OF ANCIENT ENGLISH POETRY, consisting of Old Heroic Ballads, Songs, and other Pieces of our Earlier Poets, together with some few of later date, and a copious Glossary, complete in 1 vol. medium 8vo. New and elegant Edition, with beautifully engraved Title and Frontispiece, by STEPHANOFF (pub. at 15s.), cloth, gilt, 7s. 6d. 1844

"But above all, I then first became acquainted with Bishop Percy's 'Reliques of Ancient Poetry.' The first time, too, I could scrape a few shillings together, I bought unto myself a copy of these beloved volumes; nor do I believe I ever read a book half so frequently, or with half the enthusiasm."—*Sir Walter Scott.*

"Percy's Reliques are the most agreeable selection, perhaps, which exists in any language."—*Ellis*

POPULAR ERRORS EXPLAINED AND ILLUSTRATED. By JOHN TIMBS (Author of Laconics, and Editor of the "Illustrated London News,") thick fcap. 8vo, closely but elegantly printed, Frontispiece, cloth, reduced to 5s. 1841

PRIOR'S LIFE OF EDMUND BURKE, with unpublished Specimens of his Poetry and Letters. Third and much improved Edition, 8vo, Portrait and Autographs (pub. at 14s.), gilt cloth, 9s. 1839

"Excellent feeling, in perspicuous and forcible language."—*Quarterly Review.*

PRIOR'S LIFE OF OLIVER GOLDSMITH, from a variety of Original Sources, 2 vols. 8vo, handsomely printed (pub. at 1l. 10s.), gilt cloth, 12s. 1837

"The solid worth of this biography consists in the many striking anecdotes which Mr. Prior has gathered in the course of his anxious researches among Goldsmith's surviving acquaintances, and the immediate descendants of his personal friends in London, and relations in Ireland; above all, in the rich mass of the poet's own familiar letters, which he has been enabled to bring together for the first time. No poet's letters in the world, not even those of Cowper, appear to us more interesting."—*Quarterly Review.*

RAFFLES' HISTORY OF JAVA, AND LIFE, with an account of Bencoolen, and Details of the Commerce and Resources of the Indian Archipelago. Edited by LADY RAFFLES. Together 4 vols. 8vo, and a splendid quarto atlas, containing upwards of 100 Plates by DANIEL, many finely coloured (pub. at 4l. 14s.), cloth, 2l. 8s. 1830-35

RICH'S BABYLON AND PERSEPOLIS, viz. Narrative of a Journey to the Site of Babylon; Two Memoirs on the Ruins; Remarks on the Topography of Ancient Babylon, by Major RENNELL; Narrative of a Journey to Persepolis, with hitherto unpublished Cuneiform Inscriptions. 8vo, Maps and Plates (pub. at 1l. 1s.), cloth, 10s. 6d. *Duncan*, 1839

RITSON'S VARIOUS WORKS AND METRICAL ROMANCES, as Published by Pickering, the Set, viz:—Robin Hood, 2 vols.—Annals of the Caledonians, 2 vols.—Ancient Songs and Ballads, 2 vols.—Memoirs of the Celts, 1 vol.—Life of King Arthur, 1 vol.—Ancient Popular Poetry, 1 vol.—Fairy Tales, 1 vol.—Letters and Memoirs of Ritson, 2 vols: together 12 vols. post 8vo (pub. at 6l. 5s. 6d.), cloth gilt, 3l. 8s. 1827-33

Or separately as follows:

RITSON'S ROBIN HOOD, a Collection of Ancient Poems, Songs, and Ballads, relative to that celebrated Outlaw; with Historical Anecdotes of his Life. 2 vols. 16s.

RITSON'S ANNALS OF THE CALEDONIANS, PICTS, AND SCOTS. 2 vols. 16s.

RITSON'S MEMOIRS OF THE CELTS OR GAULS. 10s.

RITSON'S ANCIENT SONGS AND BALLADS. 2 vols. 18s.

RITSON'S PIECES OF ANCIENT POPULAR POETRY. Post 8vo, 7s.

RITSON'S FAIRY TALES, now first collected; to which are prefixed two Dissertations—1. On Pigmies. 2. On Fairies, 8s.

RITSON'S LIFE AND LETTERS OF JOSEPH RITSON, Esq. edited from Originals in the Possession of his Nephew, by SIR HARRIS NICOLAS, 2 vols. 16s.

"No library can be called complete in old English lore, which has not the whole of the productions of this laborious and successful antiquary."—*Athenæum.*

"Joseph Ritson was an antiquary of the first order."—*Quarterly Review.*

ROBINSON CRUSOE, Cabinet Pictorial Edition, including his Further Adventures, with Life of Defoe, &c. upwards of 60 fine Woodcuts, from Designs by HARVEY, fcap. 8vo, New and improved Edition, with additional cuts, cloth gilt, 5s. 1846

The only small edition which is quite complete.

"Perhaps there exists no work, either of instruction or entertainment, in the English language which has been more generally read, or more deservedly admired, than the Life and Adventures of Robinson Crusoe."—*Sir Walter Scott.*

RODNEY'S (LORD) LIFE, by Lieut.-Gen. MUNDY, New Edition, fcap. 8vo, Portrait, cloth (pub. at 6s.), 3s. 6d.

ROLLIN'S ANCIENT HISTORY, a New and complete Edition, with engraved Frontispieces and 7 Maps. 2 vols. bound in 1 stout handsome vol. royal 8vo (pub. at 1l. 4s.), cloth, 12s. 1844

The only complete edition in a compact form; it is uniform in size and appearance with Moxon's Series of Dramatists, &c. The previous editions of Rollin in a single volume are greatly abridged, and contain scarcely half the work.

ROSCOE'S LIFE AND PONTIFICATE OF LEO THE TENTH. New and much improved Edition, edited by his Son, THOMAS ROSCOE. Complete in 1 stout vol. 8vo, closely but very handsomely printed, illustrated by 3 fine Portraits, and numerous illustrative Engravings, as head and tail-pieces, cloth, 1l. 4s. 1845

ROSCOE'S LIFE OF LORENZO DE MEDICI, CALLED "THE MAGNIFICENT." New and much improved Edition, edited by his Son, THOMAS ROSCOE. Complete in 1 stout vol. 8vo, closely but very handsomely printed, illustrated by numerous Engravings, introduced as head and tail-pieces, cloth, 12s. 1845

"I have not terms sufficient to express my admiration of Mr. Roscoe's genius and erudition, or my gratitude for the amusement and information I have received. I recommend his labours to our country as works of unquestionable genius and uncommon merit. They add the name of Roscoe to the very first rank of English Classical Historians."—*Matthias, Pursuits of Literature.*

"Roscoe is, I think, by far the best of our Historians, both for beauty of style and for deep reflections; and his translations of poetry are equal to the originals."—*Walpole, Earl of Orford.*

ROSCOE'S ILLUSTRATIONS, HISTORICAL AND CRITICAL, of the Life of Lorenzo de Medici, with an Appendix of Original Documents. 8vo, Portrait of Lorenzo, and Plates (pub. at 14s.), boards, 7s., or in 4to, printed to match the original edition. Portrait and Plates (pub. at 1l. 11s. 6d.), boards, 10s.

*** This volume is supplementary to all editions of the work.

ROXBURGHE BALLADS, edited by John Payne Collier, post 4to, beautifully printed by Whittingham, and embellished with 50 curious Woodcuts, half bound morocco, in the Roxburgh style (pub. at 1l. 4s.), 12s. 1847

SCOTT'S (SIR WALTER) POETICAL WORKS. Containing Lay of the Last Minstrel, Marmion, Lady of the Lake, Don Roderic, Rokeby, Ballads, Lyrics, and Songs, with Notes and a Life of the Author, complete in one elegantly printed vol. 18mo, Portrait and Frontispiece (pub. at 5s.), cloth, 3s. 6d. 1843

SHAKESPEARE'S PLAYS AND POEMS. Valpy's Cabinet Pictorial Edition, with Life, Glossarial Notes, and Historical Digests of each Play, &c. 15 vols. fcap. 8vo, with 171 Plates engraved on Steel after designs of the most distinguished British Artists, also Fac-similes of all the known Autographs of Shakespeare (pub. at 3l. 15s.), cloth, richly gilt, 2l. 5s. 1843

SHAKSPEARE'S PLAYS AND POEMS, in 1 vol. 8vo, with Explanatory Notes, and a Memoir by Dr. Johnson, portrait (pub. at 15s.), cloth, 7s. 6d.

SHAKSPEARE'S PLAYS AND POEMS, Pocket Edition, with a Life by Alexander Chalmers, complete in 1 thick vol. 12mo, printed in a Diamond type, with 40 steel Engravings (pub. at 10s. 6d.), cloth, 5s. 1848

SHERIDAN'S (THE RIGHT HON. R. BRINSLEY) SPEECHES, with a Sketch of his Life, Edited by a Constitutional Friend. New and handsome library Edition, with Portrait, complete in 3 vols. 8vo (pub. at 2l. 5s.), cloth, 18s. 1842

"Whatever Sheridan has done, has been *par excellence*, always the *best* of its kind. He has written the *best* comedy (School for Scandal), the *best* drama (The Duenna), the *best* farce (The Critic), and the *best* address (Monologue on Garrick); and to crown all, delivered the very best oration (the famous Begum Speech) ever conceived or heard in this country."—*Byron.*

SHIPWRECKS AND DISASTERS AT SEA; narratives of the most remarkable Wrecks, Conflagrations, Mutinies, &c. comprising the "Loss of the Wager," "Mutiny of the Bounty," &c. 12mo, frontispiece and vignette (pub. at 6s.), cloth, 3s. 1846

SMOLLETT'S WORKS, Edited by Roscoe. Complete in 1 vol. (Roderick Random, Humphrey Clinker, Peregrine Pickle, Launcelot Greaves, Count Fathom, Adventures of an Atom, Travels, Plays, &c.) Medium 8vo, with 21 capital Plates, by Cruikshank (pub. at 1l. 4s.), cloth gilt, 14s. 1845

"Perhaps no books ever written excited such peals of inextinguishable laughter as Smollett's."—*Sir Walter Scott.*

SOUTHEY'S LIVES OF UNEDUCATED POETS. To which are added, "Attempts in Verse," by John Jones, an Old Servant. Crown 8vo (pub. at 10s. 6d.), cloth, 4s. 6d. *Murray*, 1836

SPENSER'S POETICAL WORKS. Complete, with Introductory Observations on the Faerie Queen, and Glossarial Notes, handsomely printed in 5 vols. post 8vo, fine Portrait (pub. at 2l. 12s. 6d.), cloth, 1l. 1s. 1845

STERNE'S WORKS, complete in 1 vol. 8vo, Portrait and vignette (pub. at 18s.), cloth, 10s. 6d.

ST. PIERRE'S WORKS, including the "Studies of Nature," "Paul and Virginia," and the "Indian Cottage," with a Memoir of the Author, and Notes, by the Rev. E. Clarke, complete in 2 thick vols. fcap. 8vo, Portrait and Frontispieces (pub. at 18s.), cloth, 7s. 1846

SWIFT'S WORKS, Edited by Roscoe. Complete in 2 vols. Medium 8vo, Portrait (pub. at 1l. 12s.), cloth gilt, 1l. 4s. 1849

"Whoever in the three kingdoms has any books at all, has Swift."—*Lord Chesterfield.*

TAYLOR'S (W. B. S.) HISTORY OF THE UNIVERSITY OF DUBLIN, numerous Wood Engravings of its Buildings and Academic Costumes (pub. at 1l.), cloth, 7s. 6d. 1845

THIERS' HISTORY OF THE FRENCH REVOLUTION, the 10 parts in 1 thick vol. royal 8vo, handsomely printed, cloth lettered (pub. at 1l. 5s.), 10s.

——— the same, the parts separately, each (pub. at 2s. 6d.) 1s. 6d.

THIERS' HISTORY OF THE CONSULATE AND EMPIRE OF NAPOLEON, the 10 parts in 1 thick volume, royal 8vo, handsomely printed, cloth lettered (pub. at 1l. 5s.), 10s.

——— the same, the parts separately, each (pub. at 2s. 6d.) 1s. 6d.

TUCKER'S LIGHT OF NATURE PURSUED. Complete in 2 vols. 8vo (pub. at 1l. 10s.), cloth, 15s. 1842

"The 'Light of Nature' is a work which, after much consideration, I think myself authorized to call the most original and profound that has ever appeared on moral philosophy."—*Sir James Mackintosh.*

TYTLER'S ELEMENTS OF GENERAL HISTORY, New Edition, thick 12mo (526 closely printed pages), steel frontispiece (pub. at 5s.) cloth, 3s. 6d. 1847

WADE'S BRITISH HISTORY, CHRONOLOGICALLY ARRANGED. Comprehending a classified Analysis of Events and Occurrences in Church and State, and of the Constitutional, Political, Commercial, Intellectual, and Social Progress of the United Kingdom, from the first Invasion by the Romans to the Accession of Queen Victoria, with very copious Index and Supplement. New Edition. 1 large and remarkably thick vol. royal 8vo (1200 pages), cloth, 18s. 1847

WATERSTON'S CYCLOPÆDIA OF COMMERCE, MERCANTILE, LAW, FINANCE, COMMERCIAL, GEOGRAPHY AND NAVIGATION. New Edition, including the New Tariff (complete to the present time); the French Tariff, as far as it concerns this country; and a Treatise on the Principles, Practice, and History of Commerce, by J. R. M'Culloch. 1 very thick closely printed vol. 8vo (900 pages), with 4 Maps (pub. at 1*l.* 4*s.*), extra cloth, 10*s.* 6*d.* 1847

"This capital work will be found a most valuable manual to every commercial man, and a useful book to the general reader.

WEBSTER'S ENLARGED DICTIONARY OF THE ENGLISH LANGUAGE, Containing the whole of the former editions, and large additions, to which is prefixed an Introductory Dissertation on the connection of the languages of Western Asia and Europe, edited by Chauncey A. Goodrich, in one thick elegantly printed volume, 4to., cloth, 2*l.* 2*s.* (The most complete dictionary extant). 1848

WHITE'S FARRIERY, improved by Rosser, 8vo, with plates engraved on Steel (pub. at 14*s.*), cloth, 7*s.* 1847

WHYTE'S HISTORY OF THE BRITISH TURF, FROM THE EARLIEST PERIOD TO THE PRESENT DAY. 2 vols. 8vo, Plates (pub. at 1*l.* 8*s.*), cloth, 12*s.* 1840

WILLIS'S PENCILLINGS BY THE WAY. A new and beautiful Edition, with additions, fcap. 8vo, fine Portrait and Plates (pub. at 6*s.*), extra red Turkey cloth, richly gilt back, 3*s.* 6*d.*

"A lively record of first impressions, conveying vividly what was seen, heard, and felt, by an active and inquisitive traveller, through some of the most interesting parts of Europe. His curiosity and love of enterprise are unbounded. The narrative is told in easy, fluent language, with a poet's power of illustration."—*Edinburgh Review.*

WORCESTER'S NEW CRITICAL AND PRONOUNCING DICTIONARY OF THE ENGLISH LANGUAGE, to which is added Walker's Key, and a Pronouncing Vocabulary of modern Geographical Names, thick imperial 8vo (pub. at 1*l.* 5*s.*), cloth, 18*s.* 1847

*** The most extensive catalogue of words ever produced.

WRANGELL'S EXPEDITION TO SIBERIA AND THE POLAR SEA, edited by Lieut.-Col. Sabine, thick 12mo, large map and port. (pub. at 6*s.*), cloth, 4*s.* 6*d.* 1844

WRIGHT'S COURT HAND RESTORED, or the Student assisted in reading old charters, deeds, &c. small 4to, 23 plates (pub. at 1*l.* 6*s.*), cloth, 15*s.* 1846

Theology, Morals, Ecclesiastical History, &c.

BINGHAM'S ANTIQUITIES OF THE CHRISTIAN CHURCH. New and improved Edition, carefully revised, with an enlarged Index. 2 vols. impl. 8vo, cloth, 1*l.* 11*s.* 6*d.* 1850

"Bingham is a writer who does equal honour to the English clergy and to the English nation, and whose learning is only to be equalled by his moderation and impartiality."—*Quarterly Review.*

BUNYAN'S PILGRIM'S PROGRESS. Quite complete, with a Life and Notes, by the Rev T. Scott. Fcap. 12mo, with 25 fine full-sized Woodcuts by Harvey, containing all in Southey's edition; also a fine Frontispiece and Vignette, cloth, 3*s.* 6*d.* 1844

CALMET'S DICTIONARY OF THE BIBLE, WITH THE BIBLICAL FRAGMENTS, by the late Charles Taylor. 5 vols. 4to, Illustrated by 202 Copper-plate Engravings. Eighth greatly enlarged Edition, beautifully printed on fine wove paper (pub. at 10*l.* 10*s.*), gilt cloth, 4*l.* 14*s.* 6*d.* 1847

"Mr. Taylor's improved edition of Calmet's Dictionary is indispensably necessary to every Biblical Student. The additions made under the title of 'Fragments' are extracted from the most rare and authentic Voyages and Travels into Judea and other Oriental countries; and comprehend an assemblage of curious and illustrative descriptions, explanatory of Scripture incidents, customs, and manners, which could not possibly be explained by any other medium. The numerous engravings throw great light on Oriental customs."—*Horne.*

CALMET'S DICTIONARY OF THE HOLY BIBLE, abridged, 1 large vol. imperial 8vo, Woodcuts and Maps (pub. at 1*l.* 4*s.*), cloth, 15*s.* 1847

CARY'S TESTIMONIES OF THE FATHERS OF THE FIRST FOUR CENTURIES, TO THE CONSTITUTION AND DOCTRINES OF THE CHURCH OF ENGLAND, as set forth in the XXXIX Articles, 8vo (pub. at 12*s.*), cloth, 7*s.* 6*d.*

Oxford, Talboys.

"This work may be classed with those of Pearson and Bishop Bull; and such a classification is no mean honour."—*Church of England Quarterly.*

CHARNOCK'S DISCOURSES UPON THE EXISTENCE AND ATTRIBUTES OF GOD. Complete in 1 thick closely printed vol. 8vo, with Portrait (pub. at 14*s.*), cloth, 6*s.* 6*d.* 1846

"Perspicuity and depth, metaphysical sublimity and evangelical simplicity, immense learning but irrefragable reasoning, conspire to render this performance one of the most inestimable productions that ever did honour to the sanctified judgment and genius of a human being."—*Toplady.*

CHRISTIAN EVIDENCES. Containing the following esteemed Treatises, with Prefatory Memoirs by the Rev. J. S. Memes, L.L.D. viz:—Watson's Apology for Christianity; Watson's Apology for the Bible; Paley's Evidences of Christianity; Paley's Horæ Paulinæ; Jenyn's Internal Evidence of the Christian Religion; Leslie's Truth of Christianity Demonstrated; Leslie's Short and Easy Method with the Deists; Leslie's Short and Easy Method with the Jews; Chandler's Plain Reasons for being a Christian; Lyttleton on the Conversion of St. Paul; Campbell's Dissertation on Miracles; Sherlock's Trial of the Witnesses, with Sequel; West on the Resurrection. In 1 vol. royal 8vo (pub. at 14s.), cloth, 10s. 1845

CHRISTIAN TREASURY. Consisting of the following Expositions and Treatises, Edited by Memes, viz:—Magee's Discourses and Dissertations on the Scriptural Doctrines of Atonement and Sacrifice; Witherspoon's Practical Treatise on Regeneration; Boston's Crook in the Lot; Guild's Moses Unveiled; Guild's Harmony of all the Prophets; Less's Authenticity, Uncorrupted Preservation, and Credibility of the New Testament; Stuart's Letters on the Divinity of Christ. In 1 vol. royal 8vo (pub. at 12s.), cloth, 8s. 1844

CRUDEN'S CONCORDANCE TO THE OLD AND NEW TESTAMENT, revised and condensed by G. H. Hannay, thick 18mo, beautifully printed (pub. at 6s.), cloth, 3s. 6d. 1844

"An extremely pretty and very cheap edition. It contains all that is useful in the original work, omitting only prepositions, conjunctions, &c. which can never be made available for purposes of reference. Indeed it is all that the Scripture student can desire."—*Guardian.*

FULLER'S (REV. ANDREW) COMPLETE WORKS; with a Memoir of his Life, by his Son, 1 large vol. imperial 8vo, New Edition, Portrait (pub. at 1l. 10s.), cloth, 1l. 5s. 1845

GREGORY'S (DR. OLINTHUS) LETTERS ON THE EVIDENCES, DOCTRINES, AND DUTIES OF THE CHRISTIAN RELIGION, addressed to a Friend. Eighth Edition, with many Additions and Corrections. Complete in 1 thick well-printed vol. fcap. 8vo (pub. at 7s. 6d.), cloth, 5s. 1846

"We earnestly recommend this work to the attentive perusal of all cultivated minds. We are acquainted with no book in the circle of English Literature which is equally calculated to give young persons just views of the evidence, the nature, and the importance of revealed religion."—*Robert Hall.*

GRAVES'S (DEAN) LECTURES ON THE PENTATEUCH. 8vo, New Edition (pub. at 13s.), cloth, 9s. 1846

HALL'S (BISHOP) ENTIRE WORKS, with an account of his Life and Sufferings. New Edition, with considerable Additions, a Translation of all the Latin Pieces, and a Glossary, Indices, and Notes, by the Rev. Peter Hall, 12 vols. 8vo, Portrait (pub. at 7l. 4s.), cloth, 5l. *Oxford, Talboys,* 1837-39

HALL'S (THE REV. ROBERT) COMPLETE WORKS, with a Memoir of his Life, by Dr. Olinthus Gregory, and Observations on his Character as a Preacher, by John Foster, Author of Essays on Popular Ignorance, &c. 6 vols. 8vo, handsomely printed, with beautiful Portrait (pub. at 3l. 16s.), cloth, contents lettered, 1l. 11s. 6d.

The same, printed in a smaller size, 6 vols. fcap. 8vo, 1l. 1s. cloth, lettered.

"Whoever wishes to see the English language in its perfection must read the writings of that great Divine, Robert Hall. He combines the beauties of Johnson, Addison, and Burke, without their imperfections."—*Dugald Stewart.*

"I cannot do better than refer the academic reader to the immortal works of Robert Hall. For moral grandeur, for Christian truth, and for sublimity, we may doubt whether they have their match in the sacred oratory of any age or country."—*Professor Sedgwick.*

"The name of Robert Hall will be placed by posterity among the best writers of the age, as well as the most vigorous defenders of religious truth, and the brightest examples of Christian charity."—*Sir J. Mackintosh.*

HENRY'S (MATTHEW) COMMENTARY ON THE BIBLE, by Bickersteth. In 6 vols. 4to, New Edition, printed on fine paper (pub. at 9l. 9s.), cloth, 3l. 13s. 6d. 1849

HILL'S (REV. ROWLAND) MEMOIRS, by his Friend, the Rev. W. Jones, Edited, with a Preface, by the Rev. James Sherman (Rowland Hill's Successor as Minister of Surrey Chapel). Second Edition, carefully revised, thick post 8vo, fine Steel Portrait (pub. at 10s.) cloth, 5s. 1845

HOPKINS'S (BISHOP) WHOLE WORKS, with a memoir of the Author, in 1 thick vol. royal 8vo (pub. at 18s.), cloth, 14s. The same, with a very extensive general Index of Texts and Subjects, 2 vols. royal 8vo (pub. at 1l. 4s.), cloth, 18s. 1841

"Bishop Hopkins's works form of themselves a sound body of divinity. He is clear, vehement, and persuasive."—*Bickersteth.*

HOWE'S WORKS, with Life, by Calamy, 1 large vol. imperial 8vo, Portrait (pub. at 1l. 16s.), cloth, 1l. 10s. 1838

"I have learned far more from John Howe than from any other author I ever read. There is an astonishing magnificence in his conceptions. He was unquestionably the greatest of the puritan divines."—*Robert Hall.*

HUNTINGDON'S (COUNTESS OF) LIFE AND TIMES. By a Member of the Houses of Shirley and Hastings. Sixth Thousand, with a copious Index. 2 large vols. 8vo, Portraits of the Countess, Whitefield, and Wesley (pub. at 1l. 4s.), cloth, 14s. 1844

HUNTINGDON'S (REV. W.) WORKS, Edited by his Son, 6 vols. 8vo, Portraits and Plates (pub. at 3l. 18s. 6d.), cloth, 2l. 5s.

LEIGHTON'S (ARCHBISHOP) WHOLE WORKS; to which is prefixed a Life of the Author, by the Rev. N. T. Pearson. New Edition, 2 thick vols. 8vo, Portrait (pub. at 1l. 4s.) extra cloth, 16s. The only complete Edition. 1849

LEIGHTON'S COMMENTARY ON PETER; with Life, by Pearson, complete in 1 thick handsomely printed vol. 8vo, Portrait (pub. at 12s.), cloth, 9s. 1849

LIVES OF THE ENGLISH SAINTS. By the Rev. J. H. Newman and others, 14 vols. 12mo (pub. at 2l. 8s.), sewed in ornamented covers, 1l. 1s. 1844-5

M'CRIE'S LIFE OF JOHN KNOX, with Illustrations of the History of the Reformation in Scotland. New Edition with numerous Additions, and a Memoir, &c. by Andrew Crichton. Fcap. 8vo (pub. at 5s.), cloth, 3s. 6d. 1847

MAGEE'S (ARCHBISHOP) WORKS, comprising Discourses and Dissertations on the Scriptural Doctrines of Atonement and Sacrifice; Sermons, and Visitation Charges. With a Memoir of his Life, by the Rev. A. H. Kenny, D.D. 2 vols. 8vo (pub. at 1l. 6s.), cloth, 18s. 1842

"Discovers such deep research, yields so much valuable information, and affords so many helps to the refutation of error, as to constitute the most valuable treasure of biblical learning, of which a Christian scholar can be possessed."—*Christian Observer.*

MORE'S (HANNAH) LIFE, by the Rev. Henry Thomson, post 8vo, printed uniformly with her works, Portrait, and Wood Engravings (pub. at 12s.), extra cloth, 6s. *Cadell,* 1838

"This may be called the official edition of Hannah More's Life. It brings so much new and interesting matter into the field respecting her, that it will receive a hearty welcome from the public. Among the rest, the particulars of most of her publications will reward the curiosity of literary readers."—*Literary Gazette.*

MORE'S (HANNAH) SPIRIT OF PRAYER, fcap. 8vo, Portrait (pub. at 6s.), cloth, 4s. *Cadell,* 1843

MORE'S (HANNAH) STORIES FOR THE MIDDLE RANKS OF SOCIETY, and Tales for the Common People, 2 vols. post 8vo (pub. at 14s.), cloth, 9s. *Cadell,* 1830

MORE'S (HANNAH) POETICAL WORKS, post 8vo (pub. at 8s.), cloth, 3s. 6d. *Cadell,* 1829

MORE'S (HANNAH) MORAL SKETCHES OF PREVAILING OPINIONS AND MANNERS, Foreign and Domestic, with Reflections on Prayer, post 8vo (pub. at 9s.), cloth, 4s. *Cadell,* 1830

MORE'S (HANNAH) ESSAY ON THE CHARACTER AND PRACTICAL WRITINGS OF ST. PAUL, post 8vo (pub. at 10s. 6d.), cloth, 5s. *Cadell,* 1837

MORE'S (HANNAH) CHRISTIAN MORALS. Post 8vo (pub. at 10s. 6d.), cloth, 5s. *Cadell,* 1836

MORE'S (HANNAH) PRACTICAL PIETY; Or, the Influence of the Religion of the Heart on the Conduct of the Life, 32mo, Portrait, cloth, 2s. 6d. 1850

The only complete small edition. It was revised just before her death, and contains much improvement, which is copyright.

MORE'S (HANNAH) SACRED DRAMAS, chiefly intended for Young People, to which is added "Sensibility," an Epistle, 32mo (pub. at 2s. 6d.), gilt cloth, gilt edges, 2s. 1850

This is the last genuine edition, and contains some copyright editions, which are not in any other.

MORE'S (HANNAH) SEARCH AFTER HAPPINESS; with Ballads, Tales, Hymns, and Epitaphs, 32mo (pub. at 2s. 6d.), gilt cloth, gilt edges, 1s. 6d. 1850

NEFF (FELIX) LIFE AND LETTERS OF, translated from the French of M. Bost, by M. A. Wyatt, fcap. 8vo, Portrait (pub. at 6s.), cloth, 3s. 6d. 1843

PALEY'S WORKS, in 1 vol. consisting of his Natural Theology, Moral and Political Philosophy, Evidences of Christianity, Horæ Paulinæ, Clergyman's Companion in Visiting the Sick, &c. 8vo, handsomely printed in double columns (pub. at 10s. 6d.), cloth, 5s. 1849

PALEY'S COMPLETE WORKS, with a Biographical Sketch of the Author, by Rev. D. S. Wayland, 5 vols. 8vo (pub. at 1l. 15s.), cloth, 18s. 1837

PASCAL'S THOUGHTS ON RELIGION, and Adam's Private Thoughts on Religion, edited by the Rev. E. Bickersteth, fcap. 8vo (pub. at 5s.), cloth, 3s. 6d. 1847

PICTORIAL DICTIONARY OF THE HOLY BIBLE, Or, a Cyclopædia of Illustrations, Graphic, Historical, and Descriptive of the Sacred Writings, by reference to the Manners, Customs, Rites, Traditions, Antiquities, and Literature of Eastern Nations, 2 vols. 4to (upwards of 1430 double column pages in good type), with upwards of 1000 illustrative Woodcuts (pub. 2l. 10s.), extra cloth, 1l. 5s. 1846

SCOTT'S (REV. THOMAS) COMMENTARY ON THE BIBLE, with the Author's last Corrections and Improvements, and 84 beautiful Woodcut Illustrations and Maps. 3 vols. imperial 8vo (pub. at 4l. 4s.), cloth, 1l. 16s. 1850

SIMEON'S WORKS, including his Skeletons of Sermons and Horæ Homileticæ, or Discourses digested into one continued Series, and forming a Commentary upon every Book of the Old and New Testament; to which are annexed an improved edition of Claude's Essay on the Composition of a Sermon, and very comprehensive Indexes, edited by the Rev. Thomas Hartwell Horne, 21 vols. 8vo (pub. at 10l. 10s.), cloth, 7l. 7s.

The following miniature editions of Simeon's popular works are uniformly printed in 32mo, and bound in cloth:

THE CHRISTIAN'S ARMOUR, 9*d.*
THE EXCELLENCY OF THE LITURGY, 9*d.*
THE OFFICES OF THE HOLY SPIRIT, 9*d.*
HUMILIATION OF THE SON OF GOD: TWELVE SERMONS, 9*d.*
APPEAL TO MEN OF WISDOM AND CANDOUR, 9*d.*
DISCOURSES ON BEHALF OF THE JEWS, 1*s.* 6*d.*

"The works of Simeon, containing 2536 discourses on the principal passages of the Old and New Testament will be found peculiarly adapted to assist the studies of the younger clergy in their preparation for the pulpit; they will likewise serve as a Body of Divinity; and are by many recommended as a Biblical Commentary, well adapted to be read in families."—*Lowndes.*

SMYTH'S (REV. DR.) EXPOSITION OF VARIOUS PASSAGES OF HOLY SCRIPTURE, adapted to the Use of Families, for every Day throughout the Year, 3 vols. 8vo (pub. at 1*l.* 11*s.* 6*d.*), cloth, 9*s.* 1842

SOUTH'S (DR. ROBERT) SERMONS: to which are annexed the chief heads of the Sermons, a Biographical Memoir, and General Index, 2 vols. royal 8vo (pub. at 1*l.* 4*s.*), cloth, 18*s.* 1844

STEBBING'S HISTORY OF THE CHURCH OF CHRIST, from the Diet of Augsburg, 1530, to the present Century, 3 vols. 8vo (pub. at 1*l.* 16*s.*), cloth, 12*s.* 1839

STURM'S MORNING COMMUNING WITH GOD, OR DEVOTIONAL MEDITATIONS FOR EVERY DAY IN THE YEAR, translated from the German. New Edition, post 8vo, cloth, 5*s.* 1847

TAYLOR'S (JEREMY) COMPLETE WORKS, with an Essay, Biographical and Critical, 3 large vols. imperial 8vo, Portrait (pub. at 3*l.* 15*s.*), cloth, 3*l.* 3*s.* 1836

TAYLOR'S (ISAAC OF ONGAR) NATURAL HISTORY OF ENTHUSIASM. Tenth Edition, fcap. 8vo, cloth, 5*s.* 1845

"It is refreshing to us to meet with a work bearing, as this unquestionably does, the impress of bold, powerful, and original thought. Its most strikingly original views, however, never transgress the bounds of pure Protestant orthodoxy, or violate the spirit of truth and soberness; and yet it discusses topics constituting the very root and basis of those furious polemics which have shaken repeatedly the whole intellectual and moral world."—*Athenæum.*

TAYLOR'S (ISAAC) FANATICISM. Third Edition, carefully revised. Fcap, 8vo, cloth, 6*s.* 1843

"It is the reader's fault if he does not rise from the perusal of such a volume as the present a wiser and a better man."—*Eclectic Review.*

TAYLOR'S (ISAAC) SATURDAY EVENING. Seventh Edition. Fcap. 8vo, cloth, 5*s.* 1844

"'Saturday Evening,' and 'Natural History of Enthusiasm,' are two noble productions."—*Blackwood's Magazine.*

TAYLOR'S (ISAAC) ELEMENTS OF THOUGHT, or concise Explanations, alphabetically arranged, of the principal Terms employed in the usual Branches of Intellectual Philosophy. Ninth Edition. 12mo, cloth, 4*s.* 1849

TAYLOR'S (ISAAC) ANCIENT CHRISTIANITY, AND THE DOCTRINES OF THE OXFORD "TRACTS FOR THE TIMES." Fourth Edition, with a Supplement and Indexes. 2 vols. 8vo (pub. at 1*l.* 4*s.*), cloth, 18*s.* 1844

TAYLOR'S (ISAAC) LECTURES ON SPIRITUAL CHRISTIANITY. 8vo (pub. at 4*s.* 6*d.*), cloth, 3*s.* 1841

TOMLINE'S (BISHOP) ELEMENTS OF CHRISTIAN THEOLOGY, Fourteenth Edition, with additional Notes and Summary, by STEBBING. 2 vols. 8vo, cloth, lettered (pub. at 1*l.* 1*s.*), 10*s.* 6*d.*

TOMLINE'S (BISHOP) INTRODUCTION TO THE STUDY OF THE BIBLE, OR ELEMENTS OF CHRISTIAN THEOLOGY. Containing Proofs of the Authenticity and Inspiration of the Holy Scriptures; a Summary of the History of the Jews; an Account of the Jewish Sects; and a brief Statement of the Contents of the several Books of the Old and New Testaments. Nineteenth Edition, elegantly printed on fine paper. 12mo, (pub. at 5*s.* 6*d.*), cloth, 3*s.* 6*d.* 1845

"Well adapted as a manual for students in divinity, and may be read with advantage by the most experienced divine."—*Marsh's Lectures.*

WADDINGTON'S (DEAN OF DURHAM) HISTORY OF THE CHURCH, FROM THE EARLIEST AGES TO THE REFORMATION. 3 vols. 8vo (pub. at 1*l.* 10*s.*), cloth boards, 1*l.* 1*s.*

WADDINGTON'S (DEAN OF DURHAM) HISTORY OF THE CHURCH, DURING THE REFORMATION. 3 vols. 8vo (pub. at 1*l.* 11*s.* 6*d.*), cloth boards, 18*s.* 1841

WILBERFORCE'S PRACTICAL VIEW OF CHRISTIANITY. With a comprehensive Memoir of the Author, by the Rev. T. PRICE, 18mo. printed in a large handsome type (pub. at 6*s.*) gilt cloth, 2*s.* 6*d.* 1845

WILLMOTT'S (R. A.) PICTURES OF CHRISTIAN LIFE. Fcap. 8vo (pub. at 6*s.*), cloth, 2*s.* 6*d.* *Hatchard,* 1841

Foreign Languages and Literature;

INCLUDING

CLASSICS AND TRANSLATIONS, CLASSICAL CRITICISM, DICTIONARIES, GRAMMARS, COLLEGE AND SCHOOL BOOKS.

ATLASES.—WILKINSON'S CLASSICAL AND SCRIPTURAL ATLAS, with Historical and Chronological Tables, imperial 4to, New and improved Edition, 53 maps, coloured (pub. at 2*l.* 4*s.*), half bound morocco, 1*l.* 11*s.* 6*d.* 1842

WILKINSON'S GENERAL ATLAS. New and improved Edition, with all the Railroads inserted, Population according to the last Census, Parliamentary Returns, &c. imperial 4to, 46 Maps, coloured (pub. at 1*l.* 16*s.*), half bound morocco, 1*l.* 5*s.* 1842

AINSWORTH'S LATIN DICTIONARY, by Dr. JAMIESON, an enlarged Edition, containing all the words of the Quarto Dictionary. Thick 8vo, neatly bound (pub. at 14*s.*), 9*s.* 1847

BENTLEY'S (RICHARD) WORKS. Containing Dissertations upon the Epistles of Phalaris, Themistocles, Socrates, Euripides, and the Fables of Æsop; Epistola ad Jo. Millium; Sermons; Boyle Lecture; Remarks on Free-thinking; Critical Works, &c. Edited, with copious Indices and Notes, by the Rev. ALEXANDER DYCE. 3 vols. 8vo; a beautifully printed Edition (pub. at 1*l.* 18*s.*), cloth, 1*l.* 1*s.* 1836-38

BIBLIA HEBRAICA, EX EDITIONE VANDER HOOGHT. Recognovit J. D. ALLEMAND. Very thick 8vo, handsomely printed (pub. at 1*l.* 5*s.*), cloth, 10*s.* 6*d.* *Lond. Duncan,* 1850

BIOGRAPHIE UNIVERSELLE, Ancienne et Moderne. Nouvelle Edition, revue, corrigée et augmentée par une Société de Gens de Lettres et de Savants, 21 vols. imperial 8vo (printed in a compressed manner in double columns, but very clear type), sewed (pub. at 10*l.* 10*s.*), 5*l.* 5*s.* *Bruxelles,* 1843-47

BOURNE'S (VINCENT) POETICAL WORKS, Latin and English, 18mo (pub. at 3*s.* 6*d.*), cloth, 2*s.* 6*d.* 1838

——— the same, large paper, an elegant volume, 12mo (pub. at 5*s.*), cloth, 3*s.* 6*d.* 1838

CICERO'S LIFE, FAMILIAR LETTERS, AND LETTERS TO ATTICUS, by MIDDLETON, MELMOTH, and HEBERDEN, complete in one thick vol. royal 8vo, portrait, (pub. at 1*l.* 4*s.*), cloth, 12*s.* 1848

CORPUS POETARUM LATINORUM. Edidit G. S. WALKER. Complete in 1 very thick vol. royal 8vo (pub. at 2*l.* 2*s.*), cloth, 18*s.*
This comprehensive volume contains a library of the poetical Latin classics, correctly printed from the best texts, viz:—

Catullus,	Virgil,	Lucan,	Sulpicia,	Calpurnius Siculus,
Tibullus,	Ovid,	Persius,	Statius,	Ausonius,
Propertius,	Horace,	Juvenal	Silius Italicus,	Claudian.
Lucretius,	Phædrus,	Martial,	Valerius Flaccus,	

DAMMII LEXICON GRÆCUM, HOMERICUM ET PINDARICUM. Cura DUNCAN, royal 4to, New Edition, printed on fine paper (pub. at 5*l.* 5*s.*), cloth, 1*l.* 1*s.* 1842
"An excellent work; the merits of which have been universally acknowledged by literary characters."—*Dr. Dibdin.*

DEMOSTHENES, translated by LELAND, the two vols. 8vo, complete in 1 vol. 12mo, handsomely printed in double columns, in pearl type, portrait (pub. at 5*s.*), cloth, 3*s.*

DONNEGAN'S GREEK AND ENGLISH LEXICON, enlarged; with examples, literally translated, selected from the classical authors. Fourth edition, considerably enlarged, carefully revised, and materially improved throughout; thick 8vo (1752 pages) (pub. at 2*l.* 2*s.*), cloth, 1*l.* 1*s.* 1846

GAELIC-ENGLISH AND ENGLISH-GAELIC DICTIONARY, with Examples, Phrases, and Etymological Remarks, by two Members of the Highland Society. Complete in 1 thick vol. 8vo. New Edition, containing many more words than the 4to Edition (pub. at 1*l.* 1*s.*), cloth, 10*s.* 6*d.* 1845

GRAGLIA'S ITALIAN-ENGLISH AND ENGLISH-ITALIAN DICTIONARY, with a compendious Italian Grammar and Supplementary Dictionary of Naval Terms, 18mo, roan (pub. at 8*s.*), 4*s.* 6*d.* 1848

HERMANN'S MANUAL OF THE POLITICAL ANTIQUITIES OF GREECE, Historically considered, translated from the German, 8vo (pub. at 15*s.*), cloth, 10*s.* 6*d.* *Oxford, Talboys,* 1836
"Hermann's Manual of Greek Antiquities is most important."—*Thirlwall's Hist. of Greece,* vol. i. p. 443.

HERODOTUS, CARY'S (REV. H.) GREEK AND ENGLISH LEXICON TO HERODOTUS, adapted to the Text of Gaisford and Baehr, and all other Editions, 8vo, cloth (pub. at 12*s.*), 8*s.*

LEMPRIERE'S CLASSICAL DICTIONARY. Miniature Edition, containing a full Account of all the Proper Names mentioned in Ancient Authors, and much useful information respecting the uses and habits of the Greeks and Romans. New and complete Edition, elegantly printed in pearl type, in 1 very thick vol. 18mo (pub. at 7*s.* 6*d.*), cloth, 4*s.* 6*d.* 1846

LEE'S HEBREW GRAMMAR, compiled from the best Authorities, and principally from Oriental Sources, designed for the use of Students in the Universities. New Edition, enriched with much original matter. Sixth Thousand, 8vo (pub. at 12s.), cloth, 8s. *Lond. Duncan,* 1840

LEE'S HEBREW, CHALDEE, AND ENGLISH LEXICON. Compiled from the best Authorities, Oriental and European, Jewish and Christian, including Buxtorf, Taylor, Parkhurst, and Gesenius; containing all the Words, with their Inflections, Idiomatic Usages, &c. found in the Hebrew and Chaldee Text of the Old Testament; with numerous corrections of former Lexicographers and Commentators, followed by an English Index, in 1 thick vol. 8vo. Third Thousand (pub. at 1l. 5s.), cloth, 15s. *London,* 1844

LEVERETT'S LATIN-ENGLISH AND ENGLISH-LATIN LEXICON, compiled from Facciolati and Scheller. Thick royal 8vo (pub. at 1l. 11s. 6d.), cloth, 1l. 3s. 1847

LIVII HISTORIA, EX RECENSIONE DRAKENBORCHII ET KREYSSIG; Et Annotationes Crevierii, Strothii, Ruperti, et aliorum; Animadversiones Niebuhrii, Wachsmuthii, et suas addidit Travers Twiss, J. C. B. Coll. Univ. Oxon. Socius et Tutor. Cum Indice amplissimo, 4 vols. 8vo (pub. at 1l. 18s.), cloth, 1l. 8s. *Oxford,* 1841

This is the best and most useful edition of Livy ever published in octavo, and it is preferred in all our universities and classical schools.

LIVY. Edited by Prendeville. Livii Historiæ libri quinque priores, with English Notes, by Prendeville. New Edition, 12mo, neatly bound in roan, 5s. 1845

——— the same, Books I to III, separately, cloth, 3s. 6d.

——— the same, Books IV and V, cloth, 3s. 6d.

NEWMAN'S PRACTICAL SYSTEM OF RHETORIC; or, the Principles and Rules of Style, with Examples. Sixth Edition, 12mo (pub. at 5s. 6d.), cloth, 4s. 1846

NIEBUHR'S HISTORY OF ROME, epitomized (for the use of colleges and schools), with Chronological Tables and Appendix, by Travers Twiss, B.C.D. complete in 2 vols. bound in 1, 8vo (pub. at 1l. 1s.), cloth, 10s. 6d. *Oxford, Talboys,* 1837

"This edition by Mr. Twiss is a very valuable addition to classical learning, clearly and ably embodying all the latest efforts of the laborious Niebuhr."—*Literary Gazette.*

OXFORD CHRONOLOGICAL TABLES OF UNIVERSAL HISTORY, from the earliest Period to the present Time; in which all the great Events, Civil, Religious, Scientific, and Literary, of the various Nations of the World are placed, at one view, under the eye of the Reader in a Series of parallel columns, so as to exhibit the state of the whole Civilized World at any epoch, and at the same time form a continuous chain of History, with Genealogical Tables of all the principal Dynasties. Complete in 3 Sections; viz:—I. Ancient History. II. Middle Ages. III. Modern History. With a most complete Index to the entire work, folio (pub. at 1l. 16s.), half bound morocco, 1l. 1s.

The above is also sold separately, as follows:—

THE MIDDLE AGES AND MODERN HISTORY, 2 parts in 1, folio (pub. at 1l. 2s. 6d.), sewed, 15s.

MODERN HISTORY, folio (pub. at 12s.), sewed, 8s.

PLUTARCH'S LIVES, by the Langhornes. Complete in 1 thick vol. 8vo (pub. at 15s.), cloth, 7s. 6d.

RAMSHORN'S DICTIONARY OF LATIN SYNONYMES, for the Use of Schools and Private Students. Translated and Edited by Dr. Lieber. Post 8vo (pub. at 7s.), cloth, 4s. 6d. 1841

RITTER'S HISTORY OF ANCIENT PHILOSOPHY, translated from the German, by A. J. W. Morrison, B.A. Trinity College, Cambridge. 4 vols. 8vo, now completed, with a General Index, cloth, lettered (pub. at 3l. 4s.), 2l. 2s. *Oxford,* 1846

The Fourth Volume may be had separately. Cloth, 16s

"An important work: it may be said to have superseded all the previous histories of philosophy, and to have become the standard work on the subject. Mr. Johnson is also exempt from the usual faults of translators."—*Quarterly Review.*

SCHOMANN'S HISTORY OF THE ASSEMBLIES OF THE ATHENIANS, translated from the Latin, with a complete Index, 8vo (pub. at 10s. 6d.), cloth, 5s. *Camb.* 1838

A book of the same school and character as the works of Heeren, Boeckh, Schlegel, &c.

ELLENDT'S GREEK AND ENGLISH LEXICON TO SOPHOCLES, translated by Cary. 8vo (pub. at 12s.), cloth, 6s. 6d. *Oxford, Talboys,* 1841

STUART'S HEBREW CHRESTOMATHY, designed as an Introduction to a Course of Hebrew Study. Third Edition, 8vo (pub. at 14s.), cloth, 9s. *Oxford, Talboys,* 1834

This work, which was designed by its learned author to facilitate the study of Hebrew, has had a very extensive sale in America. It forms a desirable adjunct to all Hebrew Grammars, and is sufficient to complete the system of instruction in that language.

TACITUS, CUM NOTIS BROTIERI, CURANTE A. J. VALPY. Editio nova, cum Appendice. 4 vols. 8vo (pub. at 2l. 16s.), cloth, 1l. 5s.

The most complete Edition.

TACITUS, A NEW AND LITERAL TRANSLATION. 8vo (pub. at 16s.), cloth, 10s. 6d. *Oxford, Talboys,* 1839.

TENNEMANN'S MANUAL OF THE HISTORY OF PHILOSOPHY, translated from the German, by the Rev. ARTHUR JOHNSON, M.A. Professor of Anglo-Saxon in the University of Oxford. In 1 thick closely printed vol. 8vo (pub. at 14s.), boards, 9s. *Oxford, Talboys,* 1832

"A work which marks out all the leading epochs in philosophy, and gives minute chronological information concerning them, with biographical notices of the founders and followers of the principal schools, ample texts of their works, and an account of the principal editions. In a word, to the student of philosophy, I know of no work in English likely to prove half so useful."—*Hayward, in his Translation of Goethe's Faust.*

TERENTIUS, CUM NOTIS VARIORUM, CURA ZEUNII, cura GILES; acced. Index copiosissimus. Complete in 1 thick vol. 8vo (pub. at 16s.), cloth, 8s. 1837

TURNER'S (DAWSON W.) NOTES TO HERODOTUS, for the Use of College Students. 8vo, cloth, 12s. 1847

VALPY'S GREEK TESTAMENT, WITH ENGLISH NOTES, accompanied by parallel passages from the Classics. Fifth Edition, 3 vols. 8vo, with 2 maps (pub. at 2l.), cloth, 1l. 5s. 1847

VIRGIL. EDWARDS'S SCHOOL EDITION. Virgilii Æneis, cura EDWARDS, et Questiones Virgilianæ, or Notes and Questions, adapted to the middle forms in Schools, 2 vols. in 1, 12mo, bound in cloth (pub. at 6s. 6d.), 3s.

*** Either the Text or Questions may be had separately (pub. at 3s. 6d.), 2s. 6d.

WILSON'S (JAMES, PROFESSOR OF FRENCH IN ST. GREGORY'S COLLEGE) FRENCH-ENGLISH AND ENGLISH-FRENCH DICTIONARY, containing full Explanations, Definitions, Synonyms, Idioms, Proverbs, Terms of Art and Science, and Rules of Pronunciation in each Language. Compiled from the Dictionaries of the Academy, BOWYER, CHAMBAUD, GARNER, LAVEAUX, DES CARRIERES and FAIN, JOHNSON and WALKER. 1 large closely printed vol. imperial 8vo (pub. at 2l. 2s.), cloth, 1l. 8s. 1841

XENOPHONTIS OPERA, GR. ET LAT. SCHNEIDERI ET ZEUNII, Accedit Index (PORSON and ELMSLEY'S Edition), 10 vols. 12mo, handsomely printed in a large type, done up in 5 vols. (pub. at 4l. 10s.), cloth, 18s. 1841

——— The same, large paper, 10 vols. crown 8vo, done up in 5 vols. cloth, 1l. 5s.

XENOPHON'S WHOLE WORKS, translated by SPELMAN and others. The only complete Edition, 1 thick vol. 8vo, portrait (pub. at 15s.), cloth, 10s.

Novels, Works of Fiction, Light Reading.

AINSWORTH'S WINDSOR CASTLE. An Historical Romance, Illustrated by GEORGE CRUIKSHANK and TONY JOHANNOT. Medium 8vo, fine Portrait, and 105 Steel and Wood Engravings, gilt, cloth, 5s. 1843

BREMER'S (MISS) HOME: OR, FAMILY CARES AND FAMILY JOYS, translated by MARY HOWITT. Second Edition, revised, 2 vols. post 8vo (pub. at 1l. 1s.), cloth, 7s. 6d. 1843

THE NEIGHBOURS, A STORY OF EVERY DAY LIFE. Translated by MARY HOWITT. Third Edition, revised. 2 vols. post 8vo (pub. at 18s.), cloth, 7s. 6d. 1843

CRUIKSHANK "AT HOME;" a New Family Album of Endless Entertainment, consisting of a Series of Tales and Sketches by the most popular Authors, with numerous clever and humorous Illustrations on Wood, by CRUIKSHANK and SEYMOUR. Also, CRUIKSHANK'S ODD VOLUME, OR BOOK OF VARIETY. Illustrated by Two Odd Fellows—SEYMOUR and CRUIKSHANK. Together 4 vols. bound in 2, fcap. 8vo (pub. at 2l. 18s.), cloth, gilt, 10s. 6d. 1845

HOWITT'S (WILLIAM) LIFE AND ADVENTURES OF JACK OF THE MILL A Fireside Story. By WILLIAM HOWITT. Second Edition. 2 vols. fcap. 8vo, with 46 Illustrations on Wood (pub. at 15s.), cloth, 7s. 6d. 1845

HOWITT'S (WILLIAM) WANDERINGS OF A JOURNEYMAN TAILOR, THROUGH EUROPE AND THE EAST, DURING THE YEARS 1824 to 1840. Translated by WILLIAM HOWITT. Fcap. 8vo, with Portrait (pub. at 6s.), cloth, 3s. 6d. 1844

HOWITT'S (WILLIAM) GERMAN EXPERIENCES. Addressed to the English, both Goers abroad and Stayers at Home. 1 vol. fcap. 8vo (pub. at 6s.), cloth, 3s. 6d. 1844

JANE'S (EMMA) ALICE CUNNINGHAME, or, the Christian as Daughter, Sister, Friend, and Wife. Post 8vo (pub. at 5s.), cloth, 2s. 6d. 1846

JOE MILLER'S JEST-BOOK; being a Collection of the most excellent Bon Mots, Brilliant Jests, and Striking Anecdotes in the English Language. Complete in 1 thick and closely but elegantly printed vol. fcap. 12mo, Frontispiece (pub. at 4s.), cloth, 3s. 1840

JERROLD'S (DOUGLAS) CAKES AND ALE, A Collection of humorous Tales and Sketches. 2 vols. post 8vo with Plates, by GEORGE CRUIKSHANK (pub. at 15s.), cloth gilt, 8s. 1842

LAST OF THE PLANTAGENETS, an Historical Narrative, illustrating the Public Events, and Domestic and Ecclesiastical Manners of the 15th and 16th Centuries. Fcap. 8vo, Third Edition (pub. at 7s. 6d.), cloth, 3s. 6d. 1829

LEVER'S ARTHUR O'LEARY; HIS WANDERINGS AND PONDERINGS IN MANY LANDS. Edited by HARRY LORREQUER. CRUIKSHANK'S New Illustrated Edition. Complete in 1 vol. 8vo (pub. at 12s.), cloth, 9s. 1845

LOVER'S LEGENDS AND STORIES OF IRELAND. Both Series. 2 vols. fcap. 8vo, Fourth Edition, embellished with Woodcuts, by HARVEY (pub. at 15s.), cloth, 6s. 6d. 1847

LOVER'S HANDY ANDY. A Tale of Irish Life. Medium 8vo. Third Edition, with 24 characteristic Illustrations on Steel (pub. at 13s.), cloth, 7s. 6d. 1849

LOVER'S TREASURE TROVE; OR L. S. D. A Romantic Irish Tale of the last Century. Medium 8vo. Second Edition, with 26 characteristic Illustrations on Steel (pub. at 14s.), cloth, 9s. 1846

MARRYAT'S (CAPT.) POOR JACK, Illustrated by 46 large and exquisitely beautiful Engravings on Wood, after the masterly designs of CLARKSON STANFIELD, R.A. 1 handsome vol. royal 8vo (pub. at 14s.), gilt cloth, 9s. 1850

MARRYAT'S PIRATE AND THE THREE CUTTERS, 8vo, with 20 most splendid line Engravings, after STANFIELD, Engraved on Steel by CHARLES HEATH (originally pub. at 1l. 4s.), gilt cloth, 10s. 6d. 1849

MILLER'S GODFREY MALVERN, OR THE LIFE OF AN AUTHOR. By the Author of "Gideon Giles," "Royston Gower," "Day in the Woods," &c. &c. 2 vols in 1, 8vo, with 24 clever Illustrations by PHIZ (pub. at 13s.), cloth, 6s. 6d. 1843

"This work has a tone and an individuality which distinguish it from all others, and cannot be read without pleasure. Mr. Miller has the forms and colours of rustic life more completely under his control than any of his predecessors."—*Athenæum.*

MITFORD'S (MISS) OUR VILLAGE; complete in 2 vols. post 8vo, a Series of Rural Tales and Sketches. New Edition, beautiful Woodcuts, gilt cloth, 10s.

PHANTASMAGORIA OF FUN, Edited and Illustrated by ALFRED CROWQUILL. 2 vols. post 8vo, illustrations by LEECH, CRUIKSHANK, &c. (pub. at 18s.), cloth, 7s. 6d. 1843

PICTURES OF THE FRENCH. A Series of Literary and Graphic Delineations of French Character. By JULES JANIN, BALZAC, CORMENIN, and other celebrated French Authors. 1 large vol. royal 8vo, Illustrated by upwards of 230 humorous and extremely clever Wood Engravings by distinguished Artists (pub. at 1l. 5s.), cloth gilt, 10s. 1840

This book is extremely clever, both in the letter-press and plates, and has had an immense run in France, greater even than the Pickwick Papers in this country.

POOLE'S COMIC SKETCH BOOK; OR, SKETCHES AND RECOLLECTIONS BY THE AUTHOR OF PAUL PRY. Second Edition, 2 vols., post 8vo., fine portrait, cloth gilt, with new comic ornaments (pub. at 18s.), 7s. 6d. 1843

SKETCHES FROM FLEMISH LIFE. By HENDRIK CONSCIENCE. Square 12mo, 130 Wood Engravings (pub. at 6s.), cloth, 4s. 6d.

TROLLOPE'S (MRS.) LIFE AND ADVENTURES OF MICHAEL ARMSTRONG, THE FACTORY BOY, medium 8vo, with 24 Steel Plates (pub. at 12s.), gilt cloth, 6s. 6d. 1840

TROLLOPE'S (MRS.) JESSIE PHILLIPS. A Tale of the Present Day, medium 8vo, port. and 12 Steel Plates (pub. at 12s.), cloth gilt, 6s. 6d. 1844

UNIVERSAL SONGSTER, Illustrated by CRUIKSHANK, being the largest collection of the best Songs in the English language (upwards of 5,000), 3 vols. 8vo, with 87 humorous Engravings on Steel and Wood, by GEORGE CRUIKSHANK, and 8 medallion Portraits (pub. at 1l. 16s.), cloth, 13s. 6d.

Juvenile and Elementary Books, Gymnastics, &c.

ALPHABET OF QUADRUPEDS, Illustrated by Figures selected from the works of the Old Masters, square 12mo, with 24 spirited Engravings after BERGHEM, REMBRANDT, CUYP, PAUL POTTER, &c. and with initial letters by Mr. SHAW, cloth, gilt edges (pub. at 4s. 6d.), 3s. 1850

——— the same, the plates coloured, gilt cloth, gilt edges (pub. at 7s. 6d.) 5s.

CRABB'S (REV. G.) NEW PANTHEON, or Mythology of all Nations; especially for the Use of Schools and Young Persons; with Questions for Examination on the Plan of PINNOCK. 18mo, with 30 pleasing lithographs (pub. at 3s.), cloth, 2s. 1847

CROWQUILL'S PICTORIAL GRAMMAR. 16mo, with 120 humorous illustrations (pub. at 5s.), cloth, gilt edges, 2s. 6d. 1844

DRAPER'S JUVENILE NATURALIST, or Country Walks in Spring, Summer, Autumn, and Winter, square 12mo, with 80 beautifully executed Woodcuts (pub. at 7s. 6d.), cloth, gilt edges, 4s. 6d. 1845

ENCYCLOPÆDIA OF MANNERS AND ETIQUETTE, comprising an improved edition of Chesterfield's Advice to his Son on Men and Manners; and the Young Man's own Book; a Manual of Politeness, Intellectual Improvement, and Moral Deportment, 24mo, Frontispiece, cloth, gilt edges, 2s. 1843

EQUESTRIAN MANUAL FOR LADIES, by Frank Howard. Fcap. 8vo, upwards of 50 beautiful Woodcuts (pub. at 4s.), gilt cloth, gilt edges, 2s. 6d. 1844

GAMMER GRETHEL'S FAIRY TALES AND POPULAR STORIES. translated from the German of Grimm (containing 42 Fairy Tales), post 8vo, numerous Woodcuts by George Cruikshank (pub. at 7s. 6d.), cloth gilt 5s 1849

GOOD-NATURED BEAR, a Story for Children of all Ages, by R. H. Horne. Square 8vo, plates (pub. at 5s.) cloth, 3s., or with the plates coloured, 4s. 1850

GRIMM'S TALES FROM EASTERN LANDS. Square 12mo, plates (pub. at 5s.), cloth, 3s. 6d., or plates coloured, 4s. 6d. 1847

HALL'S (CAPTAIN BASIL) PATCHWORK, a New Series of Fragments of Voyages and Travels, Second Edition, 12mo, cloth, with the back very richly and appropriately gilt with patchwork devices (pub. at 15s.), 7s. 6d. 1841

HOLIDAY LIBRARY, Edited by William Hazlitt. Uniformly printed in 3 vols. plates (pub. at 19s. 6d.), cloth, 10s. 6d., or separately, viz:—Orphan of Waterloo, 3s. 6d. Holly Grange, 3s. 6d. Legends of Rubezahl, and Fairy Tales, 3s. 6d. 1845

HOWITT'S (WILLIAM) JACK OF THE MILL. 2 vols. 12mo (pub. at 15s.), cloth gilt, 7s. 6d. 1844

HOWITT'S (MARY) CHILD'S PICTURE AND VERSE BOOK, commonly called "Otto Speckter's Fable Book;" translated into English Verse, with French and German Verses opposite, forming a Triglott, square 12mo, with 100 large Wood Engravings (pub. at 10s. 6d.), extra Turkey cloth, gilt edges, 5s. 1845

This is one of the most elegant juvenile books ever produced, and has the novelty of being in three languages.

LAMB'S TALES FROM SHAKSPEARE, designed principally for the use of Young Persons (written by Miss and Charles Lamb), Sixth Edition, embellished with 20 large and beautiful Woodcut Engravings, from designs by Harvey, fcap. 8vo (pub. at 7s. 6d.), cloth gilt, 5s. 1843

"One of the most useful and agreeable companions to the understanding of Shakspeare which have been produced. The youthful reader who is about to taste the charms of our great Bard, is strongly recommended to prepare himself by first reading these elegant tales."—*Quarterly Review.*

L. E. L. TRAITS AND TRIALS OF EARLY LIFE. A Series of Tales addressed to Young People. By L. E. L. (Miss Landon). Fourth Edition, fcap. 8vo, with a beautiful Portrait Engraved on Steel (pub. at 5s.), gilt cloth, 3s. 1845

LOUDON'S (MRS.) ENTERTAINING NATURALIST, being popular Descriptions, Tales and Anecdotes of more than 500 Animals, comprehending all the Quadrupeds, Birds, Fishes, Reptiles, Insects, &c. of which a knowledge is indispensable in Polite Education; Illustrated by upwards of 500 beautiful Woodcuts, by Bewick, Harvey, Whimper, and others, post 8vo, gilt cloth, 7s. 6d. 1850

MARTIN AND WESTALL'S PICTORIAL HISTORY OF THE BIBLE, the letter-press by the Rev. Hobart Caunter, 8vo, 144 extremely beautiful Wood Engravings by the first Artists (including reduced copies of Martin's celebrated Pictures, Belshazzar's Feast, The Deluge, Fall of Nineveh, &c.), cloth gilt, gilt edges, reduced to 12s. Whole bound mor. richly gilt, gilt edges, 18s. 1846

A most elegant present to young people.

PARLEY'S (PETER) WONDERS OF HISTORY. Square 16mo, numerous Woodcuts (pub. at 6s.), cloth, gilt edges, 3s. 6d. 1846

PERCY TALES OF THE KINGS OF ENGLAND; Stories of Camps and Battle-Fields, Wars, and Victories (modernized from Holinshed, Froissart, and the other Chroniclers), 2 vols. in 1, square 12mo. (Parley size.) Fourth Edition, considerably improved, completed to the present time, embellished with 16 exceedingly beautiful Wood Engravings (pub. at 9s.), cloth gilt, gilt edges, 5s. 1850

This beautiful volume has enjoyed a large share of success, and deservedly.

ROBIN HOOD AND HIS MERRY FORESTERS. By Stephen Percy. Square 12mo, 8 Illustrations by Gilbert (pub. at 5s.), cloth, 3s. 6d., or with coloured Plates, 5s. 1850

STRICKLAND'S (MISS) EDWARD EVELYN, a Tale of the Rebellion of 1745; to which is added "The Peasant's Tale," by Jefferys Taylor, fcap. 8vo, 2 fine Plates (pub. at 5s.), cloth gilt, 2s. 6d. 1849

TOMKIN'S BEAUTIES OF ENGLISH POETRY, selected for the Use of Youth, and designed to Inculcate the Practice of Virtue. Twentieth Edition, with considerable additions, royal 18mo, very elegantly printed, with a beautiful Frontispiece after Harvey, elegant gilt edges, 3s. 6d. 1847

WOOD-NOTES FOR ALL SEASONS (OR THE POETRY OF BIRDS), a Series of Songs and Poems for Young People, contributed by Barry Cornwall, Wordsworth, Moore, Coleridge, Campbell, Joanna Baillie, Eliza Cook, Mary Howitt, Mrs. Hemans, Hogg, Charlotte Smith, &c. fcap. 8vo, very prettily printed, with 15 beautiful Wood Engravings (pub. at 3s. 6d.), cloth, gilt edges, 2s. 1842

YOUTH'S (THE) HANDBOOK OF ENTERTAINING KNOWLEDGE, in a Series of Familiar Conversations on the most interesting productions of Nature and Art, and on other Instructive Topics of Polite Education. By a Lady (Mrs. Palliser, the Sister of Captain Marryat), 2 vols. fcap. 8vo, Woodcuts (pub. at 15s.), cloth gilt, 6s. 1846

This is a very clever and instructive book, adapted to the capacities of young people, on the plan of the Conversations on Chemistry, Mineralogy, Botany, &c.

Music and Musical Works.

THE MUSICAL LIBRARY. A Selection of the best Vocal and Instrumental Music, both English and Foreign. Edited by W. AYRTON, Esq. of the Opera House. 8 vols. folio, comprehending more than 400 pieces of Music, beautifully printed with metallic types (pub. at 4l. 4s.), sewed, 1l. 11s. 6d.
The Vocal and Instrumental may be had separately, each in 4 vols. 16s.

MUSICAL CABINET AND HARMONIST. A Collection of Classical and Popular Vocal and Instrumental Music; comprising Selections from the best productions of all the Great Masters; English, Scotch, and Irish Melodies; with many of the National Airs of other Countries, embracing Overtures, Marches, Rondos, Quadrilles, Waltzes, and Gallopades; also Madrigals, Duets, and Glees; the whole adapted either for the Voice, the Piano-forte, the Harp, or the Organ; with Pieces occasionally for the Flute and Guitar, under the superintendence of an eminent Professor. 4 vols. small folio, comprehending more than 200 pieces of Music, beautifully printed with metallic types (pub. at 2l. 2s.), sewed, 16s.
The great sale of the Musical Library, in consequence of its extremely low price, has induced the Advertiser to adopt the same plan of selling the present capital selection. As the contents are quite different from the Musical Library, and the intrinsic merit of the selection is equal, the work will no doubt meet with similar success.

MUSICAL GEM; a Collection of 200 Modern Songs, Duets, Glees, &c. by the most celebrated Composers of the present day, adapted for the Voice, Flute, or Violin (edited by JOHN PARRY), 2 vols. in 1, 8vo, with a beautifully engraved Title, and a very richly illuminated Frontispiece (pub. at 1l. 1s.), cloth gilt, 10s. 6d. 1841
The above capital collection contains a great number of the best copyright pieces, including some of the most popular songs of Braham, Bishop, &c. It forms a most attractive volume.

Medicine, Surgery, Anatomy, Chemistry, Physiology, &c.

BARTON AND CASTLE'S BRITISH FLORA MEDICA; Or, History of the Medicinal Plants of Great Britain, 2 vols. 8vo, upwards of 200 finely coloured figures of Plants (pub. at 3l. 3s.), cloth, 1l. 16s. 1845
An exceedingly cheap, elegant, and valuable work, necessary to every medical practitioner.

BATEMAN AND WILLAN'S DELINEATIONS OF CUTANEOUS DISEASES. 4to, containing 72 Plates, beautifully and very accurately coloured under the superintendence of an eminent Professional Gentleman (Dr. CARSWELL), (pub. at 12l. 12s.), half bound mor. 5l. 5s. 1840
"Dr. Bateman's valuable work has done more to extend the knowledge of cutaneous diseases than any other that has ever appeared."—*Dr. A. T. Thompson.*

BEHR'S HAND-BOOK OF ANATOMY, by BIRKETT (Demonstrator at Guy's Hospital), thick 12mo, closely printed, cloth lettered (pub. at 10s. 6d.), 3s. 6d. 1846

BOSTOCK'S (DR.) SYSTEM OF PHYSIOLOGY, comprising a Complete View of the present state of the Science. 4th Edition, revised and corrected throughout, 8vo (900 pages), (pub. at 1l.), cloth, 8s. 1836

BURNS'S PRINCIPLES OF MIDWIFERY, tenth and best edition, thick 8vo, cloth lettered, (pub. at 16s.), 5s.

CELSUS DE MEDICINA, Edited by E. MILLIGAN, M.D. cum Indice copiosissimo ex edit. Targæ. Thick 8vo, Frontispiece (pub. at 16s.), cloth, 9s. 1831
This is the very best edition of Celsus. It contains critical and medical notes, applicable to the practice of this country; a parallel Table of ancient and modern Medical terms, synonymes, weights, measures, &c. and, indeed, everything which can be useful to the Medical Student; together with a singularly extensive Index.

HOPE'S MORBID ANATOMY, royal 8vo, with 48 highly finished coloured Plates, containing 260 accurate Delineations of Cases in every known variety of Disease (pub. at 5l. 5s.), cloth, 3l. 3s. 1834

LAWRENCE'S LECTURES ON COMPARATIVE ANATOMY, PHYSIOLOGY, ZOOLOGY, AND THE NATURAL HISTORY OF MAN. New Edition, post 8vo, with a Frontispiece of Portraits, engraved on Steel, and 12 Plates, cloth, 5s.

LAWRENCE (W.) ON THE DISEASES OF THE EYE. Third Edition, revised and enlarged. 8vo (820 closely printed pages), (pub. at 1l. 4s.), cloth, 10s. 6d. 1844

LEY'S (DR.) ESSAY ON THE CROUP, 8vo, 5 Plates (pub. at 15s.), cloth, 3s. 6d. 1836

LIFE OF SIR ASTLEY COOPER, interspersed with his Sketches of Distinguished Characters, by BRANSBY COOPER. 2 vols. 8vo, with fine Portrait, after Sir Thomas Lawrence (pub. at 1l. 1s.), cloth, 10s. 6d. 1843

NEW LONDON SURGICAL POCKET-BOOK thick royal 18mo (pub. at 12s.), hf. bd. 5s. 1844

NEW LONDON CHEMICAL POCKET-BOOK; adapted to the Daily use of the Student, royal 18mo, numerous Woodcuts (pub. at 7s. 6d.), hf. bd. 3s. 6d. 1844

NEW LONDON MEDICAL POCKET-BOOK, including Pharmacy, Posology, &c. royal 18mo (pub. at 8s.), hf. bd. 3s. 6d. 1844

PARIS' (DR.), TREATISE ON DIET AND THE DIGESTIVE FUNCTIONS, 5th edition (pub. 12s.), cloth, 5s.

PLUMBE'S PRACTICAL TREATISE ON THE DISEASE OF THE SKIN. Fourth edition, Plates, thick 8vo (pub. at 1l. 1s.), cloth, 6s. 6d.

SINCLAIR'S (SIR JOHN) CODE OF HEALTH AND LONGEVITY; Sixth Edition, complete in 1 thick vol. 8vo, Portrait (pub. at 1l.), cloth, 7s. 1844

SOUTH'S DESCRIPTION OF THE BONES, together with their several connexions with each other, and with the Muscles, specially adapted for Students in Anatomy, numerous Woodcuts, third edition, 12mo, cloth lettered (pub. at 7s.), 3s. 6d. 1837

STEPHENSON'S MEDICAL ZOOLOGY AND MINERALOGY; including also an account of the Animal and Mineral Poisons, 45 coloured Plates, royal 8vo (pub. at 2l. 2s.), cloth, 1l. 1s. 1838

TYRRELL ON THE DISEASES OF THE EYE, being a Practical Work on their Treatment, Medically, Topically, and by Operation, by F. TYRRELL, Senior Surgeon to the Royal London Ophthalmic Hospital. 2 thick vols. 8vo, illustrated by 9 Plates, containing upwards of 60 finely coloured figures (pub. at 1l. 16s.), cloth, 1l. 1s. 18[illegible]

WOODVILLE'S MEDICAL BOTANY. Third Edition, enlarged by Sir W. JACKSON HOOKER. 5 vols. 4to, with 310 Plates, Engraved by SOWERBY, most carefully coloured (pub. at 10l. 10s.), half bound morocco, 5l. 5s. The Fifth, or Supplementary Volume, entirely by Sir W. J. HOOKER, to complete the old Editions. 4to, 36 coloured Plates (pub. at 2l. 12s. 6d.), boards, 1l. 11s. 6d. 1832

Mathematics.

BRADLEY'S GEOMETRY, PERSPECTIVE, AND PROJECTION, for the use of Artists. 8 Plates and numerous Woodcuts (pub. at 7s.), cloth, 5s. 1846

EUCLID'S SIX ELEMENTARY BOOKS, by Dr. LARDNER, with an Explanatory Commentary, Geometrical Exercises, and a Treatise on Solid Geometry, 8vo, Ninth Edition, cloth, 6s.

EUCLID IN PARAGRAPHS: The Elements of Euclid, containing the first Six Books, and the first Twenty-one Propositions of the Eleventh Book, 12mo, with the Planes shaded, (pub. at 6s.), cloth, 3s. 6d. *Camb.* 1845

JAMIESON'S MECHANICS FOR PRACTICAL MEN, including Treatises on the Composition and Resolution of Forces; the Centre of Gravity; and the Mechanical Powers; illustrated by Examples and Designs. Fourth Edition, greatly improved, 8vo (pub. at 15s.), cloth, 7s. 6d. 1850

"A great mechanical treasure."—*Dr. Birkbeck.*

BOOKS PRINTED UNIFORM WITH THE STANDARD LIBRARY.

JOYCE'S SCIENTIFIC DIALOGUES, enlarged by PINNOCK, for the Instruction and Entertainment of Young People. New and greatly improved and enlarged Edition, by WILLIAM PINNOCK, completed to the present state of knowledge (600 pages), numerous Woodcuts, 5s.

STURM'S MORNING COMMUNINGS WITH GOD, or Devotional Meditations for every Day in the Year, 5s. 1847

CHILLINGWORTH'S RELIGION OF PROTESTANTS. 500 pp. 3s. 6d.

CARY'S TRANSLATION OF DANTE. (Upwards of 600 pages), extra blue cloth, with a richly gilt back, 7s. 6d. 1847

MAXWELL'S VICTORIES OF THE BRITISH ARMIES, enlarged and improved, and brought down to the present time; several highly finished Steel Portraits, and a Frontispiece, extra gilt cloth, 7s. 6d. 1847

MICHELET'S HISTORY OF THE FRENCH REVOLUTION, translated by C. COCKS, 2 vols. in 1, 4s.

ROBINSON CRUSOE, including his further Adventures, with a Life of Defoe, &c. upwards of 60 fine Woodcuts, from designs by HARVEY and WHIMPER, 5s.

STARLING'S (MISS) NOBLE DEEDS OF WOMAN, or Examples of Female Courage, Fortitude, and Virtue, Third Edition, enlarged and improved, with two very beautiful Frontispieces, elegant in cloth, 5s. 1848

LONDON: PRINTED BY HARRISON AND SON, ST. MARTIN'S LANE.