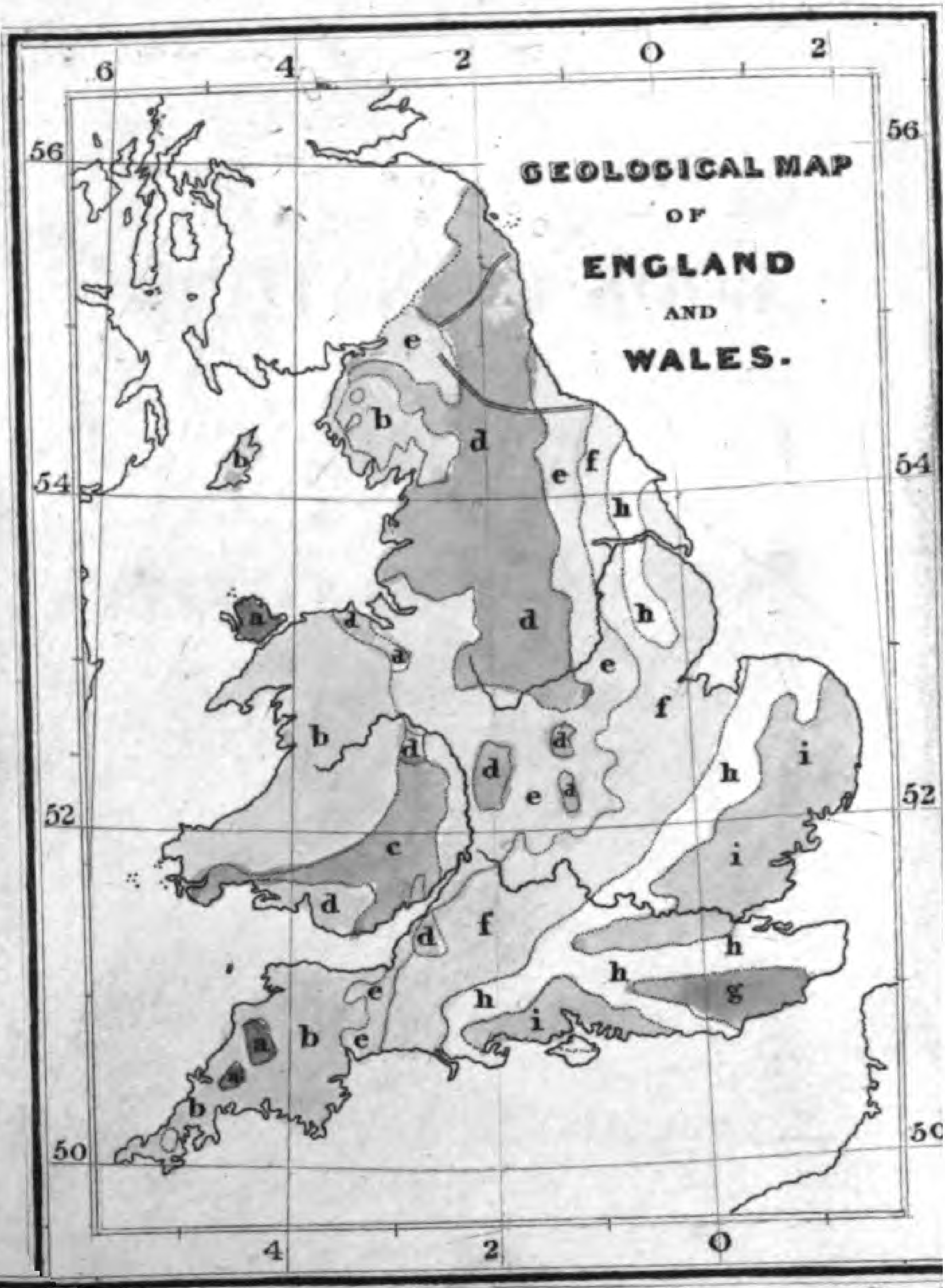
[illegible]


GEOLOGICAL MAP
OF
ENGLAND
AND
WALES.
6
4
2
0
2
56
54
52
50
4
2
0
a
b
c
d
e
f
g
h
i

See p.

THE LITTLE

BOOK OF NATURE.

COMPRISING THE

ELEMENTS

OF

GEOLOGY, MINERALOGY,
CONCHOLOGY,
MARINE BOTANY, AND
ENTOMOLOGY.

LONDON:

DARTON AND CLARK,

HOLBORN HILL.

THE LITTLE

GEOLOGIST.

PRINTED IN COLORS BY GREGORY & COLLINS
14 ST. JAMES STREET CLERKENWELL

CONTENTS.

CONTENTS.

INTRODUCTION.

THERE is good reason to believe that the Earth is a solid SPHEROID, and that the density of its entire substance is greater than that of the various bodies which exist at its surface. Its circumference is about 22,000 miles. The inequalities of its surface, by which a portion of it exists as dry land, and the rest forms the bottom of the ocean, do not bear a much greater proportion to its entire bulk than the thickness of a sheet of writing paper to a globe of common dimensions; so that, by carefully scraping off the paper in spots from the surface of a terrestrial globe, a correct representation might be formed of the deepest valleys and excavations; while small pieces of paper stuck on, would exhibit the comparative elevation of the highest mountains. From this it may be judged how very superficial are the sources of our knowledge of the interior of the Globe.

The inquiries connected with the position of the Earth, in relation to the Sun and the other bodies of the solar system, belong to Astronomy.

The description of the relative distribution of land and water, the state of the surface, as it regards mountains, springs, rivers, and lakes ; inquiries connected with the weather, with the currents, and other particulars of the ocean, and with the living produce of each district, constitute PHYSICAL GEOGRAPHY.

The classification of minerals, (which are substances that have not assumed their present form by the operation of organic life,) is called MINERALOGY.

THE OBJECTS OF GEOLOGY are to inquire into the past states of the surface of the earth, and into the causes of the successive changes which have taken place.

It will be seen that MINERALOGY is a necessary part of GEOLOGY, though a slight and compendious knowledge of it is all that is necessary for the young geologist. It may also be observed, that PHYSICAL GEOGRAPHY and GEOLOGY bear a close and important relationship to each other, and that the descriptions of many facts and phenomena belong equally to both of them. The line of distinction between them is this:—the branch of PHYSICAL GEOGRAPHY which interferes with GEOLOGY, is merely a description of rocks or soils, as exerting an influence on the vegetable produce: while Geology considers the same substances in reference to a history of the changes which have happened to the crust of the earth, and an inquiry into the causes of those changes.

It follows that Geology comprises the following three heads :—

I. A description of the substances existing on or under the surface of the earth, excepting those which, at present, form the bodies of animals or vegetables.

II. The inquiry into the causes which have operated, or which now operate, in effecting changes of position in those substances.

III. The deduction of conclusions respecting the past states of the globe, from the indications to which we now have access.

It is not desirable, in pursuing the study of Geology, to keep these heads formally distinct. As we proceed, it will be found much simpler, as well as much more interesting, to illustrate each of them by the others. We propose in this little book to follow out the first-named in order, and only to introduce the other two occasionally; not because they are less important or interesting, but because a knowledge of facts should at all times be the first step in the acquirement of any branch of natural history.

The Little Geologist.

CHAPTER I.

OF THE CLASSIFICATIONS OF THE FORMATIONS.

If we examine any considerable tract of country—such, for example, as the whole of England—we find the surface of the ground composed of various sorts of rocks and soils, arranged in beds, which, although each is not uniform in its composition throughout its whole mass, are yet clearly distinguished from each other by certain particulars to be hereafter explained. These beds, or, (as they are generally called) *formations*, take a general direction in England from north-east to south-west, and are of very various widths, as may be seen by looking at the map.

It is known from the exposed surfaces of cliffs and hills, and from artificial excavations, that the separations of these formations are not generally in planes perpendicular to the surface, but are inclined in various degrees; resting, as it were, one against the other, like a pack of cards set on end, and then suffered to fall down. The inclination or *dip*, as it is called, of the strata, may in most cases be nearly ascertained. Fig. 1, Plate II, represents the ordinary position of the strata.

It will be observed that at *a* there is a mass standing up, from the opposite sides of which the strata *(b c d)* dip in a contrary direction. In the loftiest mountains, these central masses, against which the other formations rest, are generally of Granite.

From this peculiarity of position, it was formerly supposed that the earth once existed with the stratified formations surrounding, with considerable regularity, a mass of Granite, like the outer coats of an onion; and that, when the land was separated from the water, some force from beneath elevated those portions which constitute mountains, while the strata reclined upon their sides in that uniform succession in which they had been originally deposited. There was probably a great deal of truth in this theory; but it seems that it was a groundless presumption to suppose, that a certain succession of formations would be found to prevail all over the world, and that the age of a similar formation in two distant countries would necessarily be the same. Upon such a view was founded the old classification of the formations into Primary, Secondary, and Tertiary.

Subsequent observation has taught us that the universal extension of the formations was a mere fancy, and that the succession of formations in distant countries, and often in different parts of the same country, varies considerably. It has been found that the comparative ages of rocks are not to be determined merely by the class to which they may belong; for example, many instances occur in which the rocks called Primary are of later formation than those of the Tertiary class, with which they are in contact. Indeed, it has been clearly proved that cases have occurred, in which members of each of the great classes of rocks may have been in the course of formation at the same time.

It has therefore been considered desirable to adopt a new mode of classification, founded, not on the supposed ages of the formations, but upon some circumstance certainly known, connected either with the mode of their formation, or with their external characters.

The first step in classification is the division of rocks into three great groups, the Crystalline or Plutonic, the Sedimentary or Aqueous, and the Volcanic.

The PLUTONIC ROCKS comprise all sorts of Granite, known under the various names of Granite, Sienite, &c. They contain no traces of animal or vegetable life.

The SEDIMENTARY ROCKS are those comprising lime-stones, beds of clay, sand and gravel, which evidently owe their origin to the action of water. They contain numerous remains of animals and vegetables, and may be looked upon as the records and monuments of the natural history of past ages.

The VOLCANIC ROCKS are those which plainly owe their origin to volcanoes, either extinct, or at present in action. They comprise Lava, Basalt, Trachyte, and their numerous varieties.

There appears to be no room to doubt that the Plutonic rocks owe their origin to fire, and the Sedimentary rocks to water. There is an intermediate class, which it is necessary to notice, containing various sorts of Slate and Gneiss, and the kind of marble called Statuary Marble, or Primitive Lime-stone, neither of which show traces of animal remains. They seem to have principally originated as Sedimentary rocks, and afterwards to have been altered by the action of heat and pressure. For these the name METAMORPHIC (meaning *changed* or *altered*) has been proposed. Like the Plutonic, they are crystalline; but they are generally *laminated* in their texture, and are *stratified*, while the others are *unstratified*.

The following table exhibits the recent mode of classification, compared with the old one, as well as the principal subdivisions.

OLD NAMES.		MODERN NAMES.	
Primary	Unstratified Primary.	Plutonic	Crystalline or Hypogene.
	Stratified Primary.	Metamorphic	
Transition		Cambrian group Silurian do.	Sedimentary or Aqueous.
Secondary		Old red sandstone do. Carboniferous do. New red sandstone do. Oolitic do. Wealden do. Cretaceous do.	
Tertiary		Eocene do. Miocene do. Pliocene do.	
Volcanic or Trap		Volcanic.	

There are, in addition to the formations included in this classification, extensive beds of earth and gravel, irregularly diffused over the surface of the ground, of more modern date, and, in many instances, the production of causes which are now in operation. These are called ALLUVIUM and DILUVIUM. The former containing the remains of animals the species of which have become extinct; the latter, those only of races which are now living.

Having thus laid down a classification which may be applied universally, we shall nearly restrict our future descriptions to the strata of our own country.

CHAPTER II.

THE PLUTONIC AND METAMORPHIC ROCKS.

THE districts occupied by these two classes of rocks are coloured pink and marked *a* in the map. It will there be seen that they are small portions of Cornwall, Wales, Cumberland,

and Devonshire. In most foreign countries they are much more extensively developed. It is in the study of these rocks that some knowledge of mineralogy is most required.

By far the most extensively diffused of the Plutonic Rocks is GRANITE, which consists of an intermixture of crystalline grains of Quartz, Felspar, and Mica: when Hornblende is added to these substances, the rock is called SIENITE, from Syene, a place in Egypt, where it abounds. HORNBLENDE ROCK and GREENSTONE are mixtures of the same kind, with a great predominance of Hornblende, or of Augite, a substance nearly allied to it. PORPHYRY and AMYGDALOID are names given to intermixtures of two of these substances, when grains of one are completely imbedded in the other. SERPENTINE, STEATITE, and other substances, belonging principally to the Plutonic rocks, are described in "The Little Mineralogist."

The METAMORPHIC ROCKS comprise the

formations of GNEISS, MICA SLATE, PRIMITIVE or SACCHARINE LIMESTONE, and the finer sort of CLAY SLATE, in which no fossils are found.

GNEISS contains the same substances as Granite, but in flattened or *lenticular* grains, so as to give to the rock a somewhat slaty texture. MICA SLATE also consists of the same materials, but sometimes with the omission of Felspar, and with a much greater quantity of Mica; in consequence, it is of a much looser texture. PRIMITIVE or SACCHARINE LIMESTONE derives its latter name from its resemblance to loaf sugar. It is commonly termed Statuary Marble. ROOFING SLATE is too familiarly known to need a description.

It is in the Plutonic and Metamorphic rocks that the greatest variety of minerals, and most of the metals, are found. They will therefore be seen in the map to exist in those counties to which we are most indebted for copper, and several other metals.

Both classes being free from Organic Remains, and existing chiefly in mountainous districts, and having several other characters in common, it has been found useful to comprise the two under the name HYPOGENE, or *produced underneath*, from the circumstances under which their formation appears to have taken place.

There can be little doubt that they are the result of volcanic agency, variously modified in its operation. Many experiments and observations have been made, tending to show that the same substances, which, thrown out from the craters of volcanoes, become LAVA, BASALT, and TRACHYTE, when urged by the subterranean force into fissures and caverns far beneath the surface, and, having thus to cool under tremendous pressure, become GRANITE, SIENITE, and other rocks of similar natures. The propriety of applying the term *Hypogene* will therefore be apparent.

CHAPTER III.

THE SEDIMENTARY OR AQUEOUS ROCKS.

WE have stated before that these rocks owe their origin to the action of water. In some instances they have evidently been formed at the bottom of a salt sea; by the same sort of action as is now going on at the bottom and on the shores of the ocean, by the operation of tides, winds, and changes of temperature, and the growth of marine animals and vegetables.

In other cases the strata have been formed beneath great bodies of fresh water, like the present vast lakes of North America.

Other formations have resulted from the action of rivers. A great stream of water will, as its volume increases or diminishes by the changes of season, wash down earth, stones, and vegetable substances from the banks in great quantities, and when the waters become impeded by meeting another stream, or reaching the sea at its mouth, these substances will be dropped, and sink to the bottom. A stratum will thus be formed in more or less time, and of more or less extent, according to the rapidity and magnitude of the river, and the nature of the country through which it flows. In this manner vast beds are in the course of formation, at the present time, at the mouths of the rivers Ganges, Nile, and Mississippi. It will easily be seen that an intermixture of fresh-water productions brought down by the rivers, with shells, corals, and other marine productions, must take place under such circumstances.

SECT. 1.—The two first or oldest groups of formations of this division are the CAMBRIAN and SILURIAN, which, according to the old system, are termed Transition formations, from their being, in general appearance, something between the Primary and Secondary rocks; for the most part being compactand somewhat crystalline like the former, and containing organic remains (though comparatively but few and unimportant) like the latter. Those called Cambrian derive their name from the ancient name of Wales; and those called Silurian from the Silures, an ancient British people, who lived on the borders of Wales. The two classes are coloured blue, and marked *b*, in the map, and will be seen to occupy the greater portion of Wales, and parts of Shropshire, Cumberland, Cornwall, and Devonshire.

The CAMBRIAN FORMATIONS consist chiefly of Clay Slate, which is that commonly used for roofing. They contain few and imperfect fossil remains, which are exclusively shells.

The SILURIAN STRATA contain a much greater variety of fossils, comprising the scales and bones of fish, various shells, and the remains of a very remarkable animal of an extinct family, called the Trilobite, two species of which are represented Plate 3, Fig. 9 & 10. This fossil is found also in some more recent formations. It is sometimes called the Dudley fossil, from its being found in great abundance near Dudley.

There has been much discussion as to the nature of the animal of which this is the relic. After close examination, and an extensive comparison of it with living animals, it has been concluded, with a near approach to certainty, that it was an animal of the crab kind, and much resembling the Limulus, or King crab. From the absence of legs in all the specimens which are known, it has been conjectured that it possessed organs of motion of a very delicate structure, similar to those of certain kinds of animals which breathe through their feet. The back of the creature was formed of a number of successive plates, lapping over each other, and it is known that some species had the power of rolling themselves up like the common wood-louse, and the shell-fish called *Chiton*, several specimens having been found in that position. The two furrows along the back, which exist in various degrees of distinctness in all the species, divided it into *three lobes*, from whence it takes its name. It must once have existed in immense quantities, for its remains are found plentifully distributed over many parts of Europe, Africa, and North and South America.

SECT. 2.—The space coloured of a dull red, and marked *c* in the map, are occupied by the formation of OLD RED SANDSTONE, which forms a considerable tract in South Wales, and several of the adjoining counties of England. It exists to a large extent in Scotland, and, in small spots, in several parts of England. Its name indicates that it consists for the most part of sandstone of a reddish colour. The colour is owing to the presence of oxide of iron. It contains but few fossils, amongst which are some peculiar kinds of fish, in several respects resembling the Trilobite.

SECT. 3.—Immediately upon the Old Red Sandstone follows the very important series of strata called the CARBONIFEROUS (or *Coal-bearing*) GROUP, from their comprising the beds of that most useful mineral, from which we derive our chief supplies. The space which they occupy is shewn in the map by an Indian ink tint, marked *d*. The group consists principally of Limestone, Sandstone, and a sort of slaty hardened clay, called Shale. Its average thickness in England has been estimated at 3000 feet, of which the beds of Coal do not occupy more than sixty feet. Iron is found associated with the Coal in great quantities, and this most favourable circumstance may be taken as one of the proofs of the wisdom with which the earth has been constructed as the dwelling-place of man. In spots close to each other, there are found the Iron ore, the Coal which is necessary to work it, and the Limestone which is required in the furnaces to perform the part of what chemists call a flux.

It was for a long time disputed, to what Coal owed its origin. But at present, from very extensive and minute observations, there seems to be little room to doubt that it is the remains of ancient forests and coppices, changed by peculiar chemical agencies under the surface of the ground. The forms of a great number of species of plants, more or less like those now in existence, have been distinguished in it. The most numerous appear to be Ferns and large plants of the Reed kind. The living Tree Ferns of tropical climates (see Plate 2, Fig. 2,) appear closely to resemble many of those found in the Coal. The plants called Horse Tail are some of the most numerous of the Reed kind. The species called *Cannæformis* may be seen Fig. 3. There are occasionally found associated with these vegetable remains, shells, and the teeth and bones of fish, some of them very different from the kinds which are now in existence, but evidently adapted to live in fresh water.

In the MOUNTAIN LIMESTONE, as it is called, which is united with the Coal, the most numerous fossils are those of certain shell fish of the Nautilus and other kinds, and of various sorts of Coral, bearing a general resemblance to the productions of the present seas of hot climates. There are likewise contained in it immense quantities of the remains of those remarkable creatures termed ***Encrinites.*** Three species are represented in Plate 2, Figs. 4, 5, & 6. The parts which exist in a fossil state are the bones. From their general appearance, they would rather suggest the notion of a plant than of an animal; but it seems that they were once covered with a fleshy skin, and had stomachs and other organs belonging to animal bodies. They were furnished with *tentacula* or feelers, (as represented in Fig. 7,) with which they caught their prey, and conveyed it to their mouths. At the period in which the Mountain Limestone was deposited, these creatures must have been prodigiously numerous, as whole rocks, of large extent, are entirely composed of them. The family to which they belong appears now to be nearly extinct, a very few individuals, only, having been found in the seas surrounding the West Indies. Some of the extinct species must have possessed more than 30,000 bones.

It is evident, from the almost universal character of the fossils of the carboniferous group, that they were produced when the portion of the surface of the earth on which we now live, was very much warmer than it is at present; and possessed all the general features of those parts of the tropical regions, where vegetation has been allowed to go on, uninterrupted and unimproved by the hand of man. It has also been conjectured that the immense accumulations of drift wood, and other vegetable substances, annually brought down in flood times by the great rivers of Asia and America to their mouths, and there deposited at the bottom, afford a representation of the mode in which the Coal beds were originally formed.

SECT. 4.—The formation which lies on the carboniferous group is that of NEW RED SANDSTONE, or RED MARL, associated with a stratum of Limestone, called MAGNESIAN LIMESTONE, from its containing a considerable portion of magnesia. The Magnesian Limestone occupies but a small tract of country compared with that of the New Red Sandstone, and is remarkably distinguished from it, by its surface affording an exceedingly sterile soil, while the other is generally fertile. The contrast may be seen very obviously in the counties of Durham and Yorkshire. The Sandstone contains remains of fish, shells, and plants, as well as vast beds of Salt, often giving rise to Salt springs. Salt is obtained from this formation at Nantwich, Droitwich, and several other places. But perhaps the most interesting particular, connected with this formation, is its containing the earliest known traces of quadrupeds. These are no more than the impressions of the feet of an animal evidently allied to the kind called *Marsupial*, which includes the Kangaroo and Opossum, now known in a natural state only in Australia. This family of animals is marked by a very great difference between the size of its fore and hind feet, and having a disposition of the toes, in some degree, resembling that of the human fingers. The animal which seems to have been among the first four-footed inhabitants of this region of the globe, of which our knowledge is so very limited, has been termed Chiro-therium, from two Greek words, signifying *a hand* and *a wild beast*. Some of its curious foot-marks are represented in Plate 3, Fig. 1, which were evidently impressed on the Sandstone when it was in the state of mud.

SECT. 5.—The OOLITIC SERIES of formations (distinguished in the map by a yellow tint marked *f*) consists of beds of Limestones, Sand, and Clays. It derives the name *Oolitic* from the Greek word for *an egg*, because the limestones which it contains are formed of egg-shaped particles. It comprises the four formations of the Upper, Middle, and Lower Oolite, and the Lias. The great bulk of the beds was evidently deposited at the bottom of salt water, and in many places they seem wholly to consist of the remains of corals and marine shells and animals. Fossil wood and vegetables are found occasionally. It is from this group that the greater part of the stones used for paving and building are derived. The kinds called Purbeck and Portland stone are well known.

At the time when the Oolitic group was in the course of formation, we are warranted in concluding, that the climate of this part of the world, was (like that of the coal period) as hot as that of the tropical countries at present. From the characters of some of the animal and vegetable remains, we learn that there was dry land with trees upon it, probably watered by rivers and lakes. Amongst the vast abundance and variety of its fossils, there are some which merit our particular attention.

BELEMNITE.—The fossil of the Belemnite is generally known merely as a lengthened cone of calcareous spar, of a radiated texture, with a cavity at the base. It was for a long time disputed what kind of animal this curious organ could have belonged to, and it was not until very lately that the discovery of a single specimen, in a state of greater perfection than is common, enabled us to determine the question with tolerable certainty. It was thus known that the stony cone was united to a horny cup, divided into chambers, similar in their purpose and construction to those of the shell of the nautilus; see Fig. 2, Plate 3. From this peculiar structure, and the discovery also of some traces of other parts of the animal, it has been concluded that the Belemnite was an animal of the Sepia or Cuttle fish kind, having its internal bone or shell in the form of a cone instead of its being flat, like that of the recent cuttle fish. It is interesting to know that the reason why we were so long ignorant of this fact was, that the horny cup and bony cone were never before found together, in consequence of the former being decomposed in limestone and chalk, in which the latter are generally preserved; while the cone has been almost always decomposed, in the shales and clays in which the cup is often preserved.

AMMONITE.—The Ammonite, or Cornu Ammonis, is a fossil existing in immense quantities in all the strata from the limestone of the Carboniferous series to the Chalk, though now every species of the genus seems to be extinct. It was nearly allied to the modern chambered nautilus, having been, like it, inhabited by an animal of the sepia kind, and divided into chambers arranged in a spiral whorl, connected by openings, the whole of which, taken together, were termed *the Siphuncle*. See Plate 3, Fig. 5. The difference is, however, apparent in the *dissepiments*, or partitions of the chambers, which are undulated, while those of the nautilus are regularly concave. See Fig. 6. The number of species belonging to the genus has been estimated at 270. They are most abundant in the Lias formation, near Whitby, in Yorkshire. Two different species are represented in Figs. 3 & 4.

But by far the most interesting of the fossils of the Oolitic series are the remains of some large animals of the lizard or crocodile kind, which have been found principally in the Lias, at Lyme Regis, in Dorsetshire.

One of these has been termed the ICHTHYOSAURUS, or *Fish Lizard*, from its combining the peculiarities of fish and lizards. See Fig. 1, Plate 4. In general appearance, its skeleton bears most resemblance to that of the crocodile, but it appears to have been in its covering and habits more like the porpoise; as it could not walk on land, though it might have moved over short distances, as seals do. It was distinguished by two enormous eyes, on the sides of its head, (not like those of the crocodile, near the top) which were remarkably fitted, by a peculiar anatomical contrivance, with extraordinary powers of vision, in different degrees of light. Its remains present the backbone of a fish, ribs like those of lizards, eyes resembling those of some kinds of birds, and fins or paddles nearly like those belonging to the whale. The common length of this animal appears to have been about thirty feet, but some few individuals must have been twice that length.

The PLESIOSAURUS, or animal *allied to a lizard*, as its name signifies, (see Fig. 2, Pl. 4,) was remarkable for the length of its neck, which was greater than that of any living animal, not excepting the swan. It appears to have been much less powerful than the

Ichthyosaurus, but was probably more agile in its movements. Its length varied from nine to thirty feet.

There was also existing at this period a large kind of bat, armed with a long snout and sharp teeth, called PTERODACTYLE. See Fig. 3, Pl. 4. The remains of several kinds of insects, bearing various degrees of resemblance to those now living, accompany these remarkable fossils.

SECT. 6.—The space coloured light green (marked *g*) is occupied by what is termed the WEALDEN GROUP, which comprises the formations of Weald Clay and Hastings Sand. It is plain that these beds were originally deposited at the mouth of a great river, in the same manner as beds are now forming at the mouths of the Ganges, Nile, and other large rivers, when their waters meeting those of the sea, and being checked in their current, let fall the earth and other substances which they had washed off the banks in their course. See

p. 23. In support of this view, the remains of animal and vegetable bodies contained in the Wealden formations, are such as would be produced in fresh water, or grow upon the banks of a river. The plants, like those of the formations we have previously described, belong, by their forms and structure, to a hot climate. Amongst the animal remains, the most remarkable are those of the IGUANODON, an enormous lizard, often full seventy feet in length, a restored representation of which may be seen Fig. 4, Plate 4. It derives its name from the Guana, the recent animal which it most nearly resembles, a lizard generally about three feet long, whose flesh is eaten by the inhabitants of Hayti. It differed greatly from the Saurians of the Oolitic period, in being adapted to live principally upon land, and in feeding upon vegetables, instead of the flesh of animals.

It will be seen on the map that the Wealden formations do not lie next to the Oolitic group, but that they are surrounded by the Chalk under which they are found to dip on all sides. This position, which indicates their limited extent under the surface, is illustrated in Fig. 8, Pl. 3, which is a section of the strata of Sussex. The Wealden group forms what is termed *a Saddle*, (*a*) while the Greensand (*b*) and the Chalk (*c*) repose upon it on each side. It is worthy of remark that their limited extent confirms the opinion that they are the *Delta* of some primeval river, raised into their present position by agencies operating long subsequently to their deposition.

SECT. 7.—The CRETACEOUS GROUP, lettered *h* in the map, includes the formations of Chalk, Chalk Marl, and Greensand. It is for the most part strongly marked on the surface of the ground, and can easily be traced; for which reason it was conveniently chosen as the line of demarcation between what were termed the Secondary and Tertiary Formations.

The fossils of this group are wholly marine, including several varieties of Fish, Scallops, Oysters, Belemnites, Ammonites, Echini, or Sea Eggs, Animals of the Encrinite kind, Corals, and Sponges. The Chalk Formation covers a vast extent of country in most parts of the world, and its general character is singularly uniform. Recent observations have rendered it highly probable that it is nothing more than decomposed Coral, imbedding such substances as commonly exist upon coral reefs. Indeed, specimens of coral, worn down by the weather, and the action of the sea, into a paste, and afterwards hardened by the sun, have been taken from coral reefs in the Pacific Ocean, which practised observers could not distinguish from chalk. It seems, if this suggestion be correct, that, at the time to which we owe the Chalk Formation, our country, and perhaps the whole of Europe, formed the bottom of a sea in most respects like that portion of the Pacific Ocean which lies between the tropics, in which coral islands are continually growing up.

SECT. 8.—We now come to the formations formerly called *Tertiary*, which are divided according to the present system into three groups, called the EOCENE, or *Earliest New;* the MIOCENE, or *Less New;* and the PLIOCENE, or *Most New.* These are all distinguished from the preceding formations, by their containing a considerable proportion of shells which belong to living species, and the bones of several kinds of quadrupeds, adapted to live upon dry land. All the former species, of which we have sufficient knowledge to determine, appear to have been amphibious or aquatic.

A very laborious examination of the shells of these groups has been made, with a view of ascertaining how many species each contains, identical with those of our present seas, and the result has been as follows :—

The Eocene group contains $3\frac{1}{2}$ living species out of a hundred.

The Miocene group, 17 ditto.

The Pliocene group, 70 ditto.

We have mentioned these divisions, from the very important information which they convey respecting the gradual disappearance of some sorts of shells, and the introduction of others. But, as a part of a mode of classification, they are perhaps more adapted for describing the formations of France or Italy, than those of our own country, which are more conveniently distinguished by the old names and divisions, Plastic Clay, London Clay, Crag, Upper and Lower Freshwater and Upper Marine Formations.

The PLASTIC CLAY (so called because it affords the principal part of the clay which is used for making bricks and pottery) consists of beds of gravel, sand, and clay, containing shells which indicate that it was a freshwater deposit.

The London Clay contains many marine remains, comprising those of fish and turtles, together with fruits and vegetable remains belonging to a hot climate. In the Isle of Sheppey, in particular, there have been found a great quantity of fossils resembling coffee berries, figs, &c.

The Crag, which is best developed in the county of Suffolk, is remarkable from its containing a great number of shells with the mouth turned the contrary way from what is usual. See Fig. 7, Pl. 3.

The Upper and Lower Freshwater Formations are seen to great advantage in the Isle of Wight, where they abound with shells closely resembling those found in our present ponds and ditches. They consist of a loose kind of limestone, which is used for building.

The Upper Marine Formation, which may also be best observed in the Isle of Wight, consists chiefly of beds of clay, enclosing numerous shells of kinds no longer found on our coasts, but resembling some living in the Mediterranean Sea.

In the formations of the Continent, which appear nearly to correspond in age with the above, the remains of several genera of quadrupeds are found, of very remarkable characters.

The PALÆOTHERIUM, (Fig. 5, Pl. 4,) varied in size, from that of a dog, to that of a small horse. It must have borne a strong resemblance to the Tapir of America, and like that animal, had a small trunk at the end of its snout.

The ANOPLOTHERIUM (Fig. 6) seems to have been a timid creature, with slender limbs, but a very large tail. In the latter particular, and in its general disposition, it was perhaps much like the Kangaroo, though it is evident that there was not the same disproportion between the fore and hind feet, and it was adapted for walking on all-fours.

The bones of these animals are associated with the remains of Tortoises, Crocodiles, Insects, and Trees and Plants of various kinds, belonging to a climate certainly much warmer than that of Europe in our times, though probably not so hot as that in which the dense forests grew, which now form our beds of coal.

SECT. 9.—It is to the latest of the periods of which we have been speaking, that the remains belong of those enormous creatures, the DINOTHERIUM, MEGATHERIUM, and PRIMÆVAL ELEPHANT, or, as it was formerly termed, the Mammoth.

The DINOTHERIUM (Fig. 7, Pl. 4,) was, as far as we know, the largest quadruped that ever lived upon the earth. It was evidently amphibious, like the Hippopotamus. Its general form and singular tusks, bending downwards from the lower jaw, may be best known from the plate. Its body was about eighteen feet in length.

The MEGATHERIUM was a gigantic animal of the Sloth kind, the fore feet of which appear to have been adapted for digging in the earth. Its skeleton is represented Fig. 8, Pl. 4.

The PRIMEVAL ELEPHANT did not differ in any very striking particulars from the recent one; but it appears to have been somewhat larger.

It was probably in a period more recent than the Pliocene, that there lived in our own country the Irish or Gigantic Elk, and the Caledonian or Gigantic Ox, both species much larger than any of the same genera now existing. The remains of the Beaver, and of the Roebuck, which are now only known in distant regions, are also found in the Peat beds of the British Islands.

It is only in the irregular and unstratified formations of this last period, (which may be looked upon as the commencement of the one in which we live,) that the bones of men are known to exist. From all we can learn from fossil remains, the earth, in the previous ages, was inhabited by the brute creation alone.

CHAPTER IV.

OF THE VOLCANIC ROCKS.

SOMETHING has already been said respecting this class of rocks, in reference to the Hypogene or Primitive formations. They are what are considered to have been cast out by volcanoes in a melted state, and to have assumed their present form and aspect upon, or near, the surface of the earth. LAVA, in all its varieties, PUMICE, and OBSIDIAN, are the principal kinds of rocks, strictly VOLCANIC—that is, the product of Volcanoes now in operation. The TRAP ROCKS owe their name to a word signifying *a stair*, from the form which they frequently assume. It is now universally admitted that they owe their origin to volcanoes, which have long been extinct. Their principal varieties are Basalt and Trachyte. Columnar Basalt is a remarkable form of the first: it may be seen to most advantage in the island of Staffa, and on the north coast of Ireland, where, from the regularity of its form and its peculiar position, it has almost the appearance of an artificial structure. This form seems to have been given to it by the melted mass gradually cooling down under the influence of a sort of crystallization. The columns are remarkably straight and true, generally having six sides, and fitting quite closely together. In the same manner common starch divides into six-sided prisms.

There are found, in many places, in the formations of all ages, extensive clefts or fissures filled with Basalt, which has evidently been forced up from below in a melted state. These are called *Dykes*, and one may be seen in the map of England, running through a part of Yorkshire, Durham, and Northumberland.

CHAPTER V.

OF THE CAUSES WHICH HAVE OCCASIONED THE PRESENT POSITION OF THE STRATA.

SECT. 1.—It has been seen in the slight sketch which we have given of the *fossiliferous* formations, that they serve as a series of historical records from which we may learn what were the principal animals and plants living, the climate, and in some degree the distribution of land, sea, and fresh water, at the successive periods in which they were formed. The origin of by far the greater number of them has been referred to the bottom of the sea, and it is evident that the whole must have been originally deposited in nearly a horizontal position. If they had so continued, it must be plain that we could never have lived upon them, or investigated their nature as we have done. We find, accordingly, that they have been raised in certain parts above the level of the sea, and disturbed in various manners. The sort of position in which they generally lie may be seen in almost any section obtained by an artificial excavation, (as in cutting through a hill for a road or railway,) or in a cliff where the edges of the strata have become exposed by natural means. We have already given an illustration of greater extent than can generally be seen, at one view, in nature, in Fig. 1, Plate 2. We propose in the present chapter to make some inquiry into the causes of this elevation of position, by which the dry land has been separated from the water, and the globe, altogether, rendered fit for the support of man and the terrestrial animals and plants.

Living, as each man does, but a comparatively short period, and seeing but a very small portion of the surface of the earth at any one time, it is perhaps somewhat difficult to conceive that the action of volcanoes and earthquakes can have had any general effect in changing the position of the land and water. We occasionally hear of a volcanic eruption or an earthquake, and for the most part look upon it as something partial, and, on the whole, unimportant. There is, however, strong ground to believe that volcanoes and earthquakes are the operations of a power which is everywhere present beneath the surface, in which we all have an interest, and to which we owe the circumstance of the land being raised above the waters. The question is disputed by geologists whether this agency was once more potent and generally extended in its operations, or whether the present state of things has been slowly brought about in a long succession of ages; but it is now almost universally admitted, that to it, in one way or the other, we must ascribe the variations of land and sea, hill and valley.

If what has been stated respecting the origin of Granite and of the Trap Rocks be true, there are very few spots in the world, of much extent, which do not bear indisputable proofs of having been the seats of actual volcanic eruption. In France especially, there are long chains of hills which, from their form and composition are most plainly extinguished volcanoes. In our own country, the Basalt of numerous dykes; in Scotland, the entire substance of several of the Western Islands, and of many portions of the mainland; in Ireland, the Giant's Causeway; and in many other countries, masses of a similar character, bear witness to the same fact.

We shall select a very few occurrences, of which we have certain historical accounts, to illustrate the exercise of volcanic power in altering the surface of the earth, both as to mode and extent. One class of these facts is intended to show what changes have been effected by substances ejected from volcanoes; and the other class, the mode in which the same agency has raised and disturbed the strata without forcing volcanic matter through the surface.

The following are some examples of the quantities of matter thrown out at times by a single eruption.

In the year 1783, the volcanic mountain Skaptar Yokul, in Iceland, threw out two streams of lava, one of which was fifty miles in length, and the other forty. The average width of the two streams was about nine miles, and the thickness above one hundred feet.

In the year 1759, a single volcanic eruption threw up, on a plain in Mexico, six volcanic hills, the least of which was 300 feet in height, and the largest, called Jorullo, was 1600 feet.

Mount Vesuvius appears, from indisputable evidences, to have been a volcano in very early times; but from the remotest historical period, till about seventy years after the Christian æra, it was in a quiescent state.

About that time, it again burst into eruption, and streams of lava, and copious showers of ashes and pumice, covered a vast extent of country, and completely enveloped the two important cities, Herculaneum and Pompeii. The volcanic matter over the former city lies to the depth of above seventy feet.

Mount Vesuvius had been quiet for many years during the sixteenth century; but in the year 1538, the volcanic power tore open a chasm in a plain neighbouring to the volcano, and in a single night threw out a quantity of matter, which now constitutes the hill called the *Monte Nuovo*, the height of which is 440 feet.

It is generally known that volcanic eruptions proceed at the bottom of the sea almost as violently as in the air. In consequence of this, the substances ejected often constitute new islands; and from observation it seems, that many islands, which are now inhabited, have so originated. Rhodes, and others in the

Grecian Archipelago, are in this number. Sabrina, one of the Azores, was thrown up to the height of 300 feet above the sea in the year 1811. Graham Island, in the Mediterranean, is a recent instance of the same kind. The two latter islands, having been of very loose texture, were speedily washed away by the waves. When lava, as well as ashes, has been ejected, it has mostly given the mass stability. One of the Aleutian Islands, with a peak 3000 feet in height, was formed in one eruption, which lasted for some months, in the year 1814.

An eruption of a volcano, in the island of Sumbawa, threw out ashes to the distance of 300 miles, and in another direction 220 miles, in sufficient quantities to darken the air. At the same time, a mass of pumice and cinders fell upon the sea, of many miles in extent, above two feet thick, through which vessels could not make their way.

It is not so easy to bring striking instances of the changes of level occasioned by earthquakes raising up existing strata; because slight alterations in level are not readily estimated. There have, however, been enough cases, carefully observed, to prove that the same kind of agency is sufficient to account for the elevation of all the strata, which are now above the level of the ocean.

There was an earthquake which shook nearly the whole of Chili in 1822. After the shocks had ceased, it was found that the sea coast, for a distance of some hundred miles, had been raised considerably above its former level. The observation was first made in reference to the wreck of a ship, which at first was below low water mark; but, after the earthquake, it could be approached on dry land. A considerable quantity of shell fish was also left dry upon the shore. It was subsequently ascertained that the elevation was generally about four feet, and in some parts, seven. The extent of country over which this alteration took place is 100,000 square miles.

An earthquake had previously taken place in Chili in the year 1750, in which it is certain that a considerable tract of land was raised twenty-four feet. This was known, amongst other proofs, by the soundings in Conception Bay; a part which, with a hard rocky bottom, had previously been five fathoms in depth, was, after the shocks, only seven feet.

The identity of the cause to which volcanoes and earthquakes owe their activity is clearly shown by the facts, that the same tracts of country are subject to the ravages of both, and that many examples have occurred of a volcanic eruption putting an end to a series of earthquake shocks. From this it appears, that volcanoes are a sort of safety valves to the power which causes earthquakes, and which, were it not for them, would probably keep the surface of the earth in universal and perpetual agitation.

It would seem as if, upon a great scale, our Creator had intended that earthquakes and volcanoes should be a counteraction to the operation of the sea, rivers, and the weather, which are continually tending to smooth the irregularities of the surface of the Globe, and to carry the land to the bottom of the sea.

SECT. 2.—We will now apply the principles which we have stated in the preceding pages, to account for a very interesting position of the strata, which occurs at Alum Bay, in the Isle of Wight. (See Fig. 8. Pl. 2.) First, we find in the cliff which stands behind the Needle Rocks, the formation of CHALK standing quite perpendicularly.(*a*) Next to it, stand the beautifully variegated beds of sand and shale, with the clay and gravel of the PLASTIC CLAY, (*b*) also perpendicular; and then follows the LONDON CLAY, (*c*) which is inclined in a very slight degree: this forms one side of a little valley, (that appears to have been in part excavated by a running stream,) of which the bottom is nearly on a level with the sea shore. The opposite side of this valley is formed by Headon Hill, in which the strata are horizontally placed. A bed of sand is at the bottom, and on it rests first the LOWER FRESHWATER formation, (*d*) then the UPPER MARINE, (*e*) and then the UPPER FRESHWATER, (*f*) upon which rests a thin capping of alluvial soil. We may, without presumption, deduce from these remarkable phenomena, a history of the geological changes of this spot and its vicinity.

When the CHALK was formed, this part of the earth's surface must have constituted the bottom of an ocean abounding with corals, sponges and shells, of kindred genera with those now existing in the Indian and Pacific Oceans. Coral islands must have risen in great numbers above the surface, and the sea must have presented a similar appearance, teeming with insect life, to that described

ong
that
very

n to
art of
on ef-
e globe
eral pro-
and, sea,
it so well
our species;
nd gratify the
thousands of
people the land,

by those who have witnessed the coral islands of the Pacific.

Submarine movements of volcanic agency may perhaps have assisted the growth of the coral to form dry land, which must have risen to a great extent above the sea, and must have enclosed a fresh-water lake, bearing resemblance to Lake Superior, and the other great lakes of North America, at the bottom of which the PLASTIC CLAY was deposited.

This lake was probably fed by numerous rivers, and in consequence of a great flood time, and, it may be, the co-operation of an earthquake, the bank, which separated it from the ocean was broken down, and it became an arm of the sea, still receiving the waters of several rivers. Such changes have been known to occur in modern times. The water seems to have been, from the mixture of the water of the rivers, brackish rather than salt. It contained sea shells and various kinds of fish, the remains of which became mixed with fruits and vegetables from the shore, and the bones of crocodiles and tortoises. Under such circumstances, the LONDON Clay must have been deposited. It is certain that a formation, containing nearly the same combination of animal and vegetable substances, is at present going on near the mouth of the River Ganges.

A tremendous convulsion, or a series of convulsions, then occurred, and, either gradually or suddenly, the volcanic agency must have forced up the Chalk, Plastic Clay, and London Clay, into their present vertical position.

These formations must then have formed a part of the land which enclosed a lake, at the bottom of which was formed the LOWER FRESHWATER BEDS. Animals lived upon its banks like those described in Chap. III., Sects. 8 & 9, of which the bones are now found in the quarries at Binstead; and probably there were thick woods of palm trees, and other vegetation belonging to a hot climate.

A convulsion must have again admitted the ocean, and, at the bottom of a tranquil sea, countless myriads of delicate sea shells must have become imbedded in the UPPER MARINE FORMATION.

A complete basin must have been afterwards renewed (perhaps by the drifting of shingle, in the way which is frequent at the mouth of arms of the sea), and to it, the Upper FRESHWATER FORMATION, containing many genera of shells, now existing in the neighbouring rivers, ponds, and ditches, owes its origin.

The mass of formations must then have undergone a series of elevatory movements, such as those which have raised the coast of Chili, until they attained their present level. The surface has, without doubt, been since greatly modified by the action of running water, and of the weather.

We do not presume to conjecture the time which these changes may have occupied, but whether the period was comparatively long or short, we are warranted in concluding, that the mode of their occurrence was not very different from what we have described.

These revolutions, great as they seem to us, formed but a most inconsiderable part of those mighty changes which have been effected, for the purpose of endowing the globe with those varieties of soil and of mineral production, of hill and valley, and of land, sea, and fresh water, which render it so well adapted for the dwelling-place of our species; and to supply the necessities, and gratify the appetites, of the innumerable thousands of living creatures which now people the land, the sea, and the air.

GLOSSARY.

Argillaceous, consisting of clay.

Aqueous, in the language of geology, produced by the action of water. See p. 23.

Calcareous, consisting of lime, or chalk, which is a carbonate of lime.

Cambrian group. See p. 24.

Carboniferous, containing coal.

Delta, the land formed by deposition at the mouth of a river, which is mostly of a triangular shape, like the Greek *Delta*. See p. 23.

Dip. See p. 14.

Eocene, or *early recent*, the oldest formations of the most recent class.

Formation, a collection of beds of earth or rock, the production of which is ascribed to any one period, during which no great convulsion or change in the general character of things took place.

Fossiliferous, containing fossils.

Hypogene. See p. 22.

Laminated, slaty, or existing in thin plates or tables.

Lenticular, in the shape of a lens or magnifying glass.

Limestone, stone consisting of carbonic acid and lime; the sort commonly used for paving and building.

Miocene, or *less recent*, the middle formations of the most recent class.

Oolite. See p. 33.

Pliocene, or *most recent*, the latest stratified formations containing any extinct animals.

Sedimentary, resulting from sediment. See p. 23.

Siliceous, consisting of silex, which is the substance of flint and sand.

Silurian group. **See p. 25.**
Spheroid, a compressed globe, like an orange.
Stratum, (*plural* Strata,) means simply a layer.
Unstratified, existing in irregular masses, not in strata.


1
a
2
3
4
5
6
7
8
f
e
d
c
b
a

EXPLANATION OF THE PLATES.

PLATE I.

GEOLOGICAL MAP OF ENGLAND AND WALES.

Hypogene Rocks (a)
Cambrian and Silurian group (b)
Old Red Sandstone (c)
Carboniferous group (d)
New Red Sandstone (e)
Oolitic group (f)
Wealden group (g)
Chalk group (h)
Tertiary group (i)

PLATE II.

Fig. 1. Section, showing the ordinary position of the Strata
2. Tree Ferns
3. Calamites Cannæformis
4. Lily Encrinite
5. Pentacrinite

PLATE III.

PLATE IV.


1
2
5
3
4
6
9
10
7
8
c
a
c

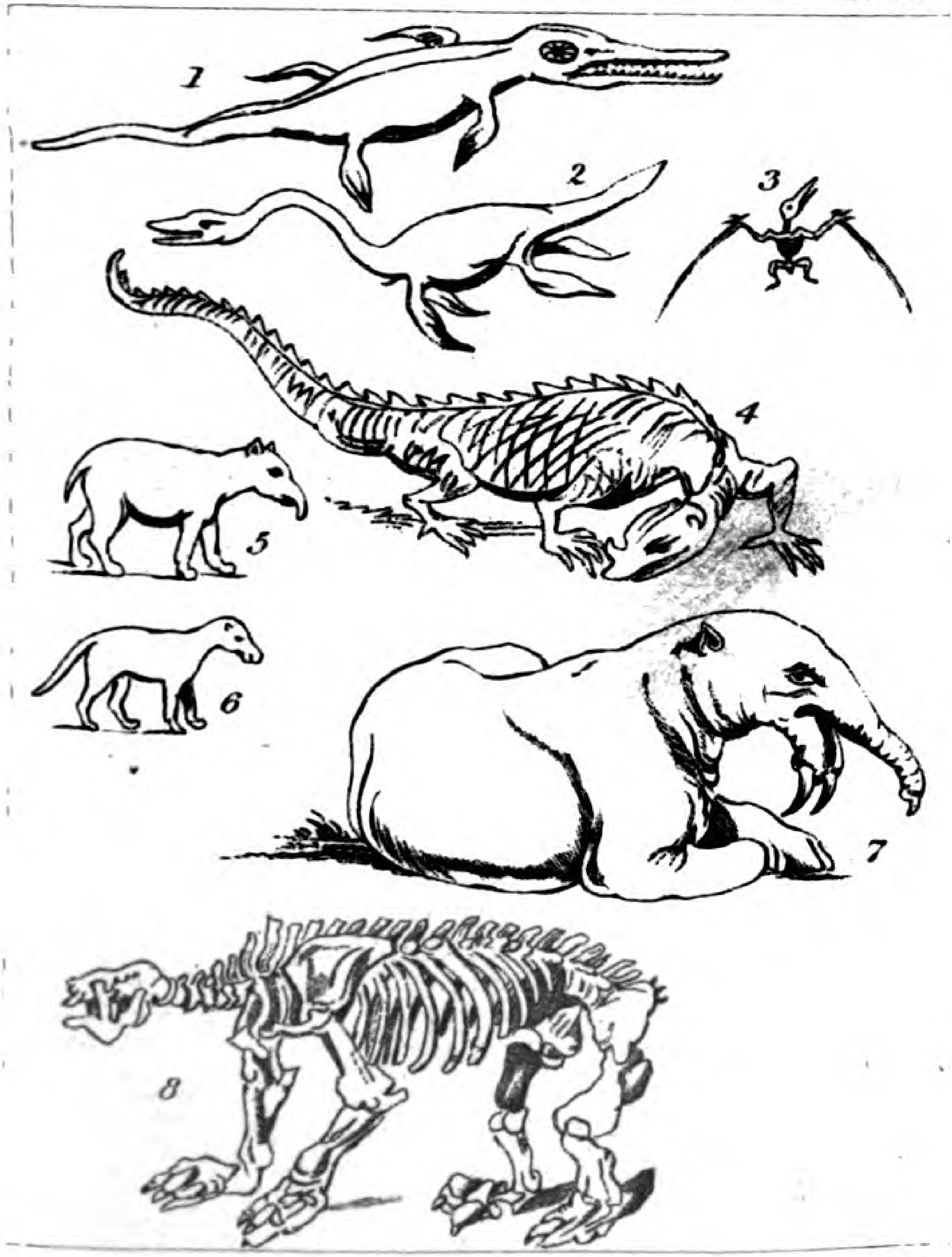
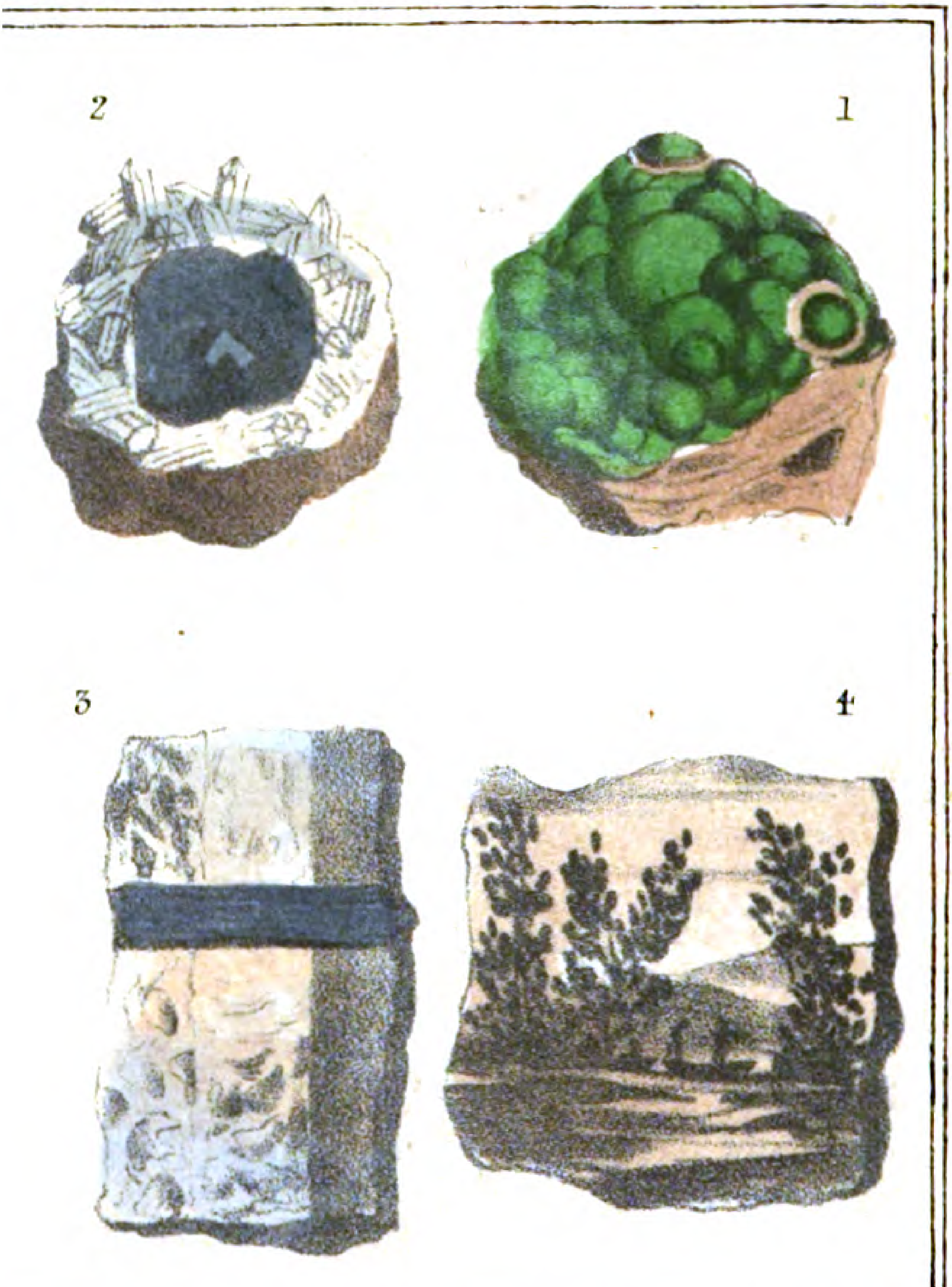

1
2
3
4
5
6
7
8

Plate. IV.



THE LITTLE MINERALOGIST.

PRINTED IN COLORS BY GREGORY & COLLINS
16 ST. JAMES STREET CLERKENWELL

CONTENTS.

INTRODUCTION.

EARTHY MINERALS.

ALKALINE EARTHY MINERALS.

ACIDIFEROUS EARTHY MINERALS.

METALLIC ORES.

COMBUSTIBLE MATERIALS.

THE mode of arrangement followed in this little book is that of Mr. PHILLIPS, in his excellent "Elements of Mineralogy." The Minerals most particularly described are such as would be likeliest to come in the way of a young Collector, such substances as are used in jewellery, and the most important English Minerals. It is hoped that the information here given, restricted as it necessarily must be, is sufficient to habituate a learner to a correct habit of observation of the characters of Minerals, and to enable him to arrange a very interesting collection.

INTRODUCTION.

I. THE term *Mineral*, is applied to all the substances found in the earth, which do not owe their form or structure to the operation of organic life. The forms of animal and vegetable bodies existing under the surface of the earth, whatever may be their chemical composition, are distinguished by the names of *Fossils*, or *Organic, Remains*.

Mineralogy is that branch of knowledge which enables us to recognize and to classify Minerals according to their form, structure, and other characters.

Geology is distinguished from *Mineralogy* by its taking notice of the larger masses of the crust of the earth, and deducing from them the history of past changes by the action of water, of volcanic agency, of the weather, and by animals and vegetables. It requires as a groundwork a knowledge of Organic Remains, as well as of Minerals, but it is distinct from both.

II. There are two entirely distinct methods of arranging or classifying Minerals, which have been resorted to by distinguished Mineralogists. One of these is, to group those substances together which present similar outward characters of form, hardness, colour, &c.; the other, to associate those only which afford the same results, when chemically analysed.

Each of these modes has its advantages. As a mere system of arrangement, it is perhaps of little importance which we use; but it would be found extremely difficult to adhere strictly to either. In this work, therefore, which is intended as a first step to the knowledge of Minerals, we shall adopt the Classification which seems to us to be the most readily intelligible, in part depending on their chemical composition, and in part upon their external characters.

III. Before we proceed to the Classification, it will be necessary for us to make some rather lengthened remarks upon the individual characters on which it must depend. These are *Chemical Composition, Form, Structure, Streak, Fracture, Frangibility, Hardness, Transparency, Lustre,* and some others which need no explanation; such as *Colour, Weight,* &c. with some of only occasional application, such as *Elasticity, Taste, Smell.*

IV. Chemical Composition.—It is convenient in pursuing the study of Mineralogy to consider Minerals in general, as divided into two great classes: viz. *Earthy Minerals* and

Metallic Ores. The latter comprise those bodies of which the bases, or predominating constituent substances, are what are commonly known as *metals;* and the former, all other Minerals, except those which have the combustible elements for their bases.

It is one proper object of the study of Chemistry to investigate the chemical composition of Minerals more minutely, and it would be out of place for us here to enlarge upon it, except as helping us to a simple and convenient mode of Classifying. It will, however, be best to prevent mistakes just to observe that nearly all these Minerals which are termed *earthy*, have metals for their bases intimately combined with oxygen. This is a discovery of modern times; and the metals of the earths, or as they are termed, *Metallic Bases,* are never met with except when separated from the mixtures in which they occur in nature, by very artificial and difficult processes, known to chemists.

When we have divided Minerals into earthy and metallic, some very easy sub-divisions suggest themselves immediately; such as the Minerals which have alkalies mixed with the earths, or those which contain acids: the ores of *iron*, or those of *copper*, *tin*, *silver*, &c. This mode of division will form the outline of our arrangement in the following work.

V. Form.—Every substance in nature, has a tendency to assume some determinate form peculiar to itself. When this operation, in bodies divested of life, from the activity of the principle in the substance, takes place in a very perfect manner, it is called Crystalization. It should be observed, that the natural forms of bodies are very liable to be disturbed by causes which operate while the process is going on, and of course are very liable to be broken afterwards. Still nearly every substance which the Mineralogist collects, may be obtained as a crystal, and the study of

Crystalization is a most important part of the Science.

The flat surfaces which form the sides of a crystal, are called *planes*, and the meeting of two *planes*, forms what is termed an *edge*.

The figures of crystals are the *cube*, (*Fig.* 1, *Plate* 1) consisting of six square sides; the *pyramid* consisting of three, four, or more triangular planes, meeting in a point or *apex*; (*Figs.* 2-3, *Plate* 1) and the *prism*, consisting of three or more sides, with parallel edges, (*Figs.* 4-5, *Plate* 1). The two latter figures may be distinguished by the number of their sides, as a four-sided pyramid, a three-sided prism, &c. There are also the octahedron, *Fig.* 6, and the dodecahedron, *Fig.* 7, and other figures which will be seen in the plate. It is necessary in some cases to notice the angles which the sides of crystals form with each other, which is done by means of an instrument called a *Goniometer*. This need not claim the attention of the young student, till he has acquired the habit of discriminating the more common Minerals, by the most obvious characters.

VI. Structure.—This character in crystalized bodies is derived from the particular direction in which a crystal can be cloven or divided by a knife, or a succession of gentle blows of a hammer, so as to present a natural plane surface. It will be best understood by an example: if a cubical crystal of *fluor spar* (*Plate* 1, *Fig*. 1) have the corners taken off by a knife, a figure may be obtained consisting of two four-sided pyramids united at the base, called an octahedron, (*Fig*. 6, *Plate* 1) while this may be very easily done, a knife will scarcely make any impression on the substance in any other direction. The crystal which is obtained by these cleavages, carried on to their full extent, so as to leave a regular figure, is called a primitive crystal.

In substances which are not perfectly crystallized, the structure may be *granular*, or consisting of small particles aggregated together; *fibrous* consisting of what are termed *acicular* or *needle-shaped* crystals united together at the sides; and *slaty* or *schistose*, or ready to split into planes in one direction only, like common slate.

VII. Streak.—The colour of a Mineral often differs from that of its powder, and a very important character is thus obtained. The usual mode of determining it is to rub the Mineral which may be under examination on a surface of porcelain biscuit, and observe the colour of the *streak* which it leaves. It is of greater importance to notice this, than the colour of the Mineral itself, as it is in general more uniform in any particular substance.

VIII. Fracture.—If a Mineral is liable, when broken, to present one convex and one concave surface, tolerably regular and smooth, so as in some degree to resemble a shell, the fracture is said to be *conchoidal.* If it leaves little half-detached fragments, it is called *splintery.* Sometimes it is said to be *even* or *uneven.*

IX. FRANGIBILITY.—This means the readiness with which a Mineral may be broken, not in the lines of its regular cleavage. A Mineral may be said to be in various degrees *brittle* or *tough.*

X. HARDNESS.—This is a very important character: it has been reduced to a system, by taking some generally known substances of remarkably uniform textures as the standards, and describing other Minerals as of the same hardness, as some one of them; or by merely stating the figure which belongs to it in a certain arrangement; thus if "hardness 4," is put in the description of a Mineral, it may be known that it means that it is of the same hardness as fluor spar. The use of the knife or the file, with a little experience, will soon enable the young Mineralogist to apply this character with accuracy. The following is the table of standard substances, beginning with the softest :

1. Talc, of a White or Green Colour.
2. Rock Salt, or Gypsum.
3. Calcareous Spar.
4. Fluor Spar.
5. Apatite, or Asparagus Stone.
6. Adularia.
7. Rock Crystal.
8. Topaz.
9. Corundum Stone.
10. Diamond.

XI. Transparency.—If you can see objects distinctly through a Mineral, it is called *transparent;* if you see them indistinctly, *semi-transparent ;* if only light can be seen through, it is termed *translucent ;* some Minerals are *translucent on the edges;* and if light does not pass through them, they are called *Opaque.*

The mode and degree in which transparent Minerals refract the rays of light are also to be observed, when a refined investigation is pursued: but it is not needful to attend to this, until a considerable proficiency in applying the simpler characters has been obtained.

XII. LUSTRE.—The various kinds of lustre are described by words which are sufficiently intelligible; such as *metallic, pearly, silky,* or *resinous.*

XIII. A very important character may be sometimes obtained by the use of the blow-pipe. Of this instrument there are various sorts, but the most simple, and by far the most useful, is a tube for directing the breath through a small aperture upon the flame of a lamp or candle. The general mode of using it is to take a very small piece of the substance to be examined, and place it in a cavity in a piece of charcoal; and then to direct the flame impelled by the blow-pipe upon it. The flame of an ordinary candle will do very well for most purposes in which the blow-pipe is used. The cotton should be snuffed moderately short, and turned a little on one side towards the specimen to be operated on, so that the current from the nozzle of the blow-pipe should pass for a little distance in a line parallel with it, and just above it. The breath should then be blown steadily through the blow-pipe in such a manner as to obtain a flame consisting of a distinct blue cone, surrounded by a transparent reddish one. A little practice will easily enable the operator to produce this, and sustain it without trouble or fatigue to the lungs. The hottest point is just at the tip of the blue flame; but no substance should be suddenly brought to that point. It is better to direct the flame at first a little above it, so as to heat it gradually, as many substances are apt to *decrepitate*, or fly off suddenly in fragments, and thus become lost. If the substance is fusible at the heat applied, a little bead of it will be seen in a short time melted at the bottom of the cavity in the charcoal. Further particulars relating to the use of the blow-pipe may be found in most books on chemistry.

The character obtained by the operation is expressed by stating either what is the mode in which the Mineral is affected while the action of the heat is continued; or more frequently, by describing its appearance after it has been *melted*.

XIV. An attentive perusul of the foregoing remarks will enable the student to describe in a manner that will be intelligible to Mineralogists, most of the Minerals that are commonly met with ; and to understand most of the descriptions contained in books of Mineralogy.

The following descriptions are for the most part of Minerals, of which specimens are easy to be obtained, and which it is most necessary to learn to distinguish. Specimens should, when practicable, be attentively examined in comparison with the description ; both, in order that a correct notion of each particular character should be formed, which may be applied to other substances, and that the Mineral itself should become familiarly known.

EARTHY MINERALS.

EARTHY MINERALS are those which have some one of the substances called earths for their bases, with various mixtures of metals, acids, and alkalies in less proportions. There are nine simple earths, of all of which the natural colour is white; whatever other colours are found in Minerals, are owing to the metals they contain.

The names of the earths are *Silex*, *Alumine*, *Zircon*, *Glucine*, *Yttria*, *Barytes*, *Strontian*, *Lime*, *Magnesia*.

Silex or *Silica* is the most abundant of all the earths, and is almost the only constituent of flints and sand. Substances which have it for a basis are often called *Silicious Minerals.*

Alumine is a chief component of Alum, and exists in considerable quantities in clays of all sorts, and many other Minerals. Its presence may generally be detected by substances in which it is contained emitting a peculiar smell, when breathed upon.

Zircon, Glucine, and *Yttria,* exist in small quantities in some precious stones.

Barytes is found in various combinations with acids, particularly the sulphuric and carbonic. Both the sulphate and carbonate are distinguished by their weight, and the form is often called *Heavy Spar.*

Strontian is usually found in the same combinations.

Lime, next to *Silex,* is the most abundantly diffused of the earths. Its commonest form is in combination with carbonic acid, with which it constitutes chalk, lime-stone, and calcareous spar, of each of which the varieties are very numerous.

Magnesia is found in several clays and stones. The form in which it is usually known is the carbonate of magnesia.

QUARTZ.

QUARTZ in its simplest form is pure Silica; it often contains minute portions of metallic oxides, which give it a variety of forms, colours, degrees of transparency and lustre: it is universally distinguished by being hard enough to scratch glass, and not yielding to the knife; it will not fuse before the common blow-pipe; the coloured varieties generally lose their colour from its action.

CRYSTALIZED QUARTZ; OR ROCK CRYSTAL. —The common form is a six-sided prism, terminated by a six-sided pyramid (*see Plate* 1, *Fig*. 8). The crystals may be cleaved in the direction of any one of the planes of the pyramid, and an *obtuse rhomboid* may thus be obtained, (*Fig*. 9) which is considered as the primary form. It is sometimes perfectly transparent, and is then used for making spectacles under the name of *pebble;* more often it is of a milky appearance. If two surfaces of it are rubbed together, a bright phosphorescent light and peculiar smell are produced; this is best shown by means of two Quartz pebbles, such as may frequently be found on the sea shore. The *fracture* is sometimes perfectly conchoidal; but this character is not very uniform in Quartz.

The crystals often called Cornish Diamonds, Snowden Diamonds, Bristol Diamonds, &c. are merely crystals of Quartz. The most beautiful specimens come from the Alps.

MASSIVE QUARTZ.—Quartz in a massive form exists in great abundance in almost every part of the earth. It is found in various degrees of purity as sand-stone, and loose sand, in extensive beds. The sand most sought after for making glass, such as that of Alum Bay in the Isle of Wight, is pure Silex.

The following are varieties of Quartz :—*Prase*, a massive Mineral of a dark green colour. *Amethyst*, or violet Quartz, which is familiarly known from its being used in seals and rings. The best Amethysts come from various parts of Asia, and the common ones from Germany, Sweden, and Ireland. *Fibrous Quartz:* the stone called *Cat's Eye* is a form of this variety. *Spongiform Quartz*, which is so light, in consequence of its numerous pores, that it floats upon water.

OPAL

CONSISTS almost wholly of Silica and water. It is not sufficiently hard to give fire with steel.

NOBLE OR PRECIOUS OPAL presents a beautiful surface, with changeable reflections of various colours. Translucent; fracture, conchoidal; with a resinous lustre; easily frangible; scratches glass; loses its colour before the blow-pipe. *Common Opal* differs from it only in wanting the changeable reflections. *Hydrophane,* is a variety of Opal which is opaque till immersed in water, and then it becomes translucent.

FLINT

Is composed of Silica, with minute quantities of oxide of iron, lime, alumine and water. It is found black and of various shades of grey and yellow. It is rather harder than common Quartz; breaks easily in all directions with a conchoidal fracture and feeble lustre; brittle, when the surfaces are first exposed, but becomes harder by exposure; translucent. It is well known from its use in obtaining fire with steel, and in the manufacture of glass.

CALCEDONY

Is so named from the town of Calcedon, in Asia, from whence the ancients used to collect it. It consists of about four-fifths Silica and one-fifth Alumine, and presents various shades of grey, which is the commonest colour, brown, blue, and green, and is sometimes white. Form, massive and *botry-oidal*, (or in *grape-like*) forms. It is semi-transparent and has a very flat conchoidal fracture; harder than flint; found in various parts of Great Britain and most other countries.

The following are varieties:—*Heliotrope*, or blood-stone of a dark green colour, with bright red spots; *Onyx*, consisting of alternate layers of brown and white, of which Cameos are made; *Chrysoprase*, of a light green colour, often used in jewellery; *Cornelian* is found in grey masses, which are first for a long time exposed to the sun, and are then subjected to heat, by which it becomes white or of various shades of red, as it is seen in seals and other jewels; *Agate, Mocha Stone,* and *Moss Agate,* occur with a beautiful variety of markings, and are susceptible of a high polish; often used for snuff boxes and other purposes.

JASPER

Differs from Calcedony in being perfectly opaque, and in containing a larger proportion of iron. Its prevailing colours are red, yellow, brown, and green; found in Cornwall and many parts of Scotland. Its principal varieties are *Ribbon Jasper,* which is marked by stripes of different colours; and *Egyptian Jasper,* or *Egyptian Pebble,* which is generally yellow or brown, and presents black *dendritic,* (or tree-like) appearances.

GARNET.

THERE are several substances called Garnets, with important differences of composition and other characters; but they agree in being generally crystalized in *rhombic dodecahedrons* (*Plate* 1, *Fig.* 10); in mostly being of a dark brown or red colour, and in containing a large portion of oxide of iron and alumina.

PRECIOUS GARNET is well known to jewellers; colour red, of various shades, with an occasional tinge of yellow and blue. Lustre, resinous; fracture, conchoidal. The blowpipe reduces it to a black substance, which acts upon the Magnet. It is supposed to be the Carbuncle of the Ancients.

COMMON GARNET is either quite opaque, or much less transparent than the preceding; it is less hard, and breaks with an uneven fracture; occurs in most countries of primitive formation in considerable quantities.

Pyreneite, is quite black; as is also another variety called *Melanite; Topazolite* is yellow.

PREHNITE

Is of a pale green or yellowish colour; with a somewhat pearly lustre; somewhat translucent; it occurs massive, fibrous, and in irregular crystals. Found in Staffordshire, Cornwall, various parts of the Continent of Europe, and the Cape of Good Hope.

CLAYS

All agree in having an earthy texture, and a peculiar odour when breathed upon. Silica is their principal ingredient, but they are distinguished by containing variable proportions of alumina, from whence their smell: they sometimes have small quantities of lime, magnesia, and alkali; they are of very extensive use in the arts and manufactures. The following are the most important varieties.

POTTER'S, or PLASTIC CLAY, is of a brownish red, blueish, or greenish colour, and has a greasy feel when dry. It contains 44 parts of silica, 34 alumina, 3 lime, 1 iron, 18 water. From its use in making bricks and pottery (for which purpose it is mixed with siliceous sand), and common occurrence, it is well known.

PIPE CLAY is of a greyish or white colour; has a greasy feel; adheres strongly to the tongue; and is infusible except at very high temperatures.

SLATE CLAY, or SHALE, is generally of a dark grey colour; it is found amongst beds of coal. In one direction its fracture is earthy, in the other slaty. Impressions of ferns, and reeds, are often found in it. BLACK and BROWN BITUMINOUS SHALE is distinguished by burning with a black smoke and bituminous smell, leaving a red or white flaky ash. Found frequently in common coal.

FULLER'S EARTH is usually of a greenish brown or drab colour. Occurs in many parts of England, and is well known from the purpose for which it is used by fullers and others.

TRIPOL: contains 90 parts of silica, 7 of alumina, and 3 of iron. It was named from Tripoli in Africa, from whence it was originally brought to this country, but it has since been found in Italy and Germany. It is generally seen as a red powder, and is used to polish various substances. Recent discoveries have proved it to consist of the fossilized bodies of very minute animalcula.

BLACK CHALK probably owes its colour to a quantity of carbon which it contains. It is used for drawing, and is brought from several parts of France, Spain, and Italy.

AUGITE, OR PYROXENE,

TAKES the first name from a Greek word, signifying brightness, from the brilliancy of its crystals; and the second from two words, meaning *the guest of fire*, from its continuing unaltered in a very high temperature. It contains 50 parts silica, 20 lime, 15 oxide of iron, and the rest magnesia, alumina, and manganese. Occurs crystalized, in grains and amorphous. Its primary form is an oblique rhombic prism (*Fig.* 11, *Plate* 1). Colour dark green, brown, or black; somewhat resinous lustre. Before the blow-pipe it fuses with difficulty, but more readily by the addition of borax. It is very often found amongst volcanic productions, embedded in basalt and lava.—DIOPSIDE is a variety of Augite, which is either transparent, or green of several shades.—SAHLITE, another variety, is in prismatic crystals of four or eight sides, of a greenish grey, feebly translucent; scratches glass slightly.

HORNBLENDE.

Occurs crystalized and massive in the rocks, called Sienite and Greenstone, both of which are very extensively diffused. The crystals cleave readily with brilliant surfaces, leaving the primary form a rhombic prism. Colour dark bottle green, brownish, or black—when reduced to powder of a greyish green; opake, or translucent on the edges, shewing a red colour, in a very slight degree; very tough, which renders the rocks of which it is an ingredient very durable as a building stone; the black variety contains a considerable quantity of iron, and affects the magnetic needle in a slight degree. It emits a peculiar smell when breathed upon.

ASBESTUS.

Common Asbestus occurs in masses, consisting of fibres of a greenish colour; breaks with splintery fragments; is not flexible; by which it is mainly distinguished from the variety to be next described; easily fusible; found in several parts of England.

AMIANTHUS, or MOUNTAIN FLAX, occurs in long and very delicate fibres, which are easily separated, and are considerably flexible. Of a white, light green, or red colour; feels greasy; lustre, silky; slightly translucent; the single fibres melt in the flame of a candle, but collectively a mass of it fires with difficulty. It is said to have been used for making napkins by the Romans.

MOUNTAIN LEATHER, MOUNTAIN CORK, and MOUNTAIN WOOD, are also varieties of Asbestus.

CORUNDUM.

THERE are three varieties of Corundum, the chemical composition of which are nearly similar. They contain from 85 to 98 parts of alumina out of one hundred: the remainder being silica and oxide of iron.

SAPPHIRE, or PERFECT CORUNDUM, is found of two colours. The stone, commonly known as the *sapphire*, is mostly blue, but sometimes yellow, or yellowish green; the other variety, called the *oriental ruby*, is of a light rose-red hue. It is beautifully transparent; next in hardness to the diamond; it is not acted upon by acids; suffers no change before the common blow-pipe unless mixed with borax, when it melts into a colourless glass; it becomes electric when rubbed. The crystals cleave easily in one direction, but with great difficulty on the others. The sapphire is a precious stone, of great value when of considerable size. The largest known to exist is in the crown of the Queen of Great Britain.

COMMON CORUNDUM, or ADAMANTINE SPAR, is generally of a greenish grey tint, but sometimes colourless; translucent; in six-sided prisms, or hexahedral pyramids.

EMERY is of a dark blue grey colour ; it occurs in fine grained masses : found amongst granite rocks in Italy, Spain, and Greece.

KYANITE

CONSISTS of about 55 parts alumina, 30 silicia, 6 oxide of iron, and 9 of lime, magnesia, and water. It occurs mostly in four-sided prisms of a lightish blue colour, in mica-slate and other primitive rocks. Most of the specimens seen in this country come from the Alps, and a few from Banff-shire, in Scotland. Before the blow-pipe it is infusible by itself, but mixed with borax, fuses with difficulty. A variety of it, called Rhœtizite, is cut and polished for jewellery.

STAUROLITE

CONSISTS of nearly the same substances as Kyanite, with a greater proportion of oxide of iron. It is generally of a dull brown colour, and either opaque or but slightly translucent: lustre, resinous; fracture, conchoidal. Takes its name from the Greek word for a cross, as the prismatic crystals often cross each other in the manner represented, (*Plate* 2, *Fig.* 1). It is chiefly found in Switzerland and North America.

TOPAZ

Is a compound of 47 parts alumina, 45 parts Silica, and 8 parts fluoric acid. It is much used in jewellery; but its colour has in general been previously much altered by heat. When taken from the earth it is mostly either transparent or a greenish yellow, in rounded masses, or crystalized in prisms, of which the primary form is the right rhombic. (*Fig.* 12, *Plate* 1). It takes its name from an island whence it was obtained by the ancients. It is generally found in granite, in most of the primitive districts of the globe. *Pycnite* and *Physalite* are varieties of it. Topaz becomes electric by friction or heat.

CHRYSOBERYL

CONSISTS chiefly of alumina, silica, and lime. It occurs crystalized, but is more frequently found in rolled fragments in the beds of rivers. The primary form is a rectangular prism which may be readily obtained as the planes of the crystal yield readily to mechanical division. It is sometimes used in jewellery.

CHRYSOLITE.

A COMBINATION of magnesia, silica, and oxide of iron. It is found in angular or rounded masses, and in prismatic crystals.

Its ordinary colour is bright yellow, sometimes tinged with green or brown; transparent; infusible before the blow-pipe, except when mixed with borax. The best specimens of it come from the neighbourhood of Constantinople, and are used as gems.

OLIVINE is a variety of Chrysolite which is found abundantly in some sorts of lava and basalt. It is distinguished by its dark olive colour.

SERPENTINE.

THIS Mineral derives its common name, (as well as that by which some Mineralogists have called it, *Ophite*,) from the resemblance which it bears to the skin of a serpent. It consists mainly of silica and magnesia, and a considerable portion of water. It is found in considerable masses in most primitive rocks. The varieties which have a uniform green colour, are translucent, are susceptible of a polish, and are termed NOBLE SERPENTINE. Those with a more earthy texture, opaque, and containing other substances and various colours, are termed COMMON SERPENTINE. Fracture, conchoidal, and slightly splintery; lustre, resinous; somewhat unctuous to the touch, and yields easily to the knife.

SOAPSTONE

Is found massive, of a white or greyish colour, in beds or veins in Cornwall, and other primitive districts. Sometimes it is green or yellow. It often bears a strong resemblance to Asbestus. Consists of silica and magnesia, in nearly equal proportions, and small quantities of water and oxide of iron. It is distinguished by a peculiarly soapy feel; fracture, splintery, or earthy, sometimes slaty, slightly translucent on the edges. Some sorts of it are used in the manufacture of Porcelain. According to some authors, the softest varieties are used by the Arabs instead of soap; and Humboldt relates that a race of Indians inhabiting the banks of the river Oronoko, swallow, it in order to prevent the sensation of hunger. POTSTONE is a species of it, which from its tenacity is often wrought into vessels for culinary uses. It may be easily turned in a lathe.

EMERALD

CONSISTS principally of silica, with portions of alumina and glucina. Its colour and transparency are well known from its use as an ornament. Its common form is the hexahedral or six-sided prism, terminated by a six-sided pyramid; the primary form is the hexahedral prism; lustre, vitreous; fracture, conchoidal and uneven; assumes the appearance of mother-of-pearl before the blowpipe. The most beautiful crystals of Emerald come from Granada. BERYL and AQUAMARINE are varieties of Emerald.

ALKALINO-EARTHY MINERALS.

The Minerals included in this division consist of several sorts of earths, with various portions of one or more of the alkalies.

MICA.

This substance derives its name from the Latin word Micare, to shine. It consists of nearly half silica, and various proportions of potash, alumina, magnesia, and oxide of iron. The primitive form of the crystal is the oblique rhombic prism. (*Fig.* 11, *Plate* 1). It is capable of almost indefinite separation in one direction into shining luminæ, of a semi-metallic lustre, which are very flexible, and yield to the nail. The colour is various; but most frequently black, grey, white, and yellow. The latter has sometimes nearly the appearance of gold. Some varieties are beautifully transparent, and are used in the manufacture of lanterns. Before the blow-pipe it does not fuse, but loses its transparency. It is one of the regular constituents of granite rocks in masses of various sizes.

LEUCITE.

THE crystals of this Mineral are found imbedded in some lavas of a form of which the planes are twenty-four equal and similar trapeziums. (*See Fig*. 2, *Plate* 2). The primary form is the cube. The colour is generally a dull white. Fracture, imperfectly conchoidal, with a vitreous lustre; does not fuse before the blow-pipe.

FELSPAR

CONSISTS of potash, silica, and alumina. This is a very important and extensively diffused

Mineral, which is found under a great variety of appearances and crystalinc forms. It is supposed to derive its name from the circumstances of its being frequently found in loose masses on the surface of the ground in Germany, hence called there *Feldspath*, *Field-spar*. The following are its principal varieties:

ADULARIA is translucent, of a milk white or greyish white colour, and often iridescent. It is sometimes found in masses and sometimes crystalized. Lustre vitreous, inclining to pearly. Cleavage, very perfect. It sometimes presents a bluish or greenish reflection of light, more or less iridescent, and is then called *Moon Stone*. *Sun Stone* is distinguished by having minute scales of Mica interspersed through it. *Labrador Spar*, as it is often called, is the same, having generally a predominating hue of dark grey.

COMMON FELSPAR is nearly opaque: lustre in the planes of cleavage, vitreous or pearly; in the cross fracture, glimmering. Its colours are white, yellow, red of various shades, blue and green. The crystals yield easily to cleavage, and the primary form is a doubly oblique prism. It is an essential ingredient of granite rocks, and exists in some parts in immense quantities. It is used in the manufacture of porcelain. In a state of decomposition it constitutes some vast beds of clay, of great value in the arts.

GLASSY FELSPAR is generally imbedded in ancient or recent volcanic products, and has the appearance of being cracked in various directions, as if by heat.

ICE SPAR bears considerable resemblance to ice, and is very brittle.

CHLORITE

Occurs in flat six-sided prisms; colours various shades of green, yellowish and white; translucent, presenting various shades of colour when looked at in different directions. Yields to the nail. Streak, white or green. In thin laminæ it is somewhat flexible, but not elastic, which distinguishes it from Mica. It consists of silica, magnesia, oxide of iron, and a small quantity of alumina.

LAPIS LAZULI

Is a combination of silica, alumina, lime, iron, soda, and magnesia. It is generally massive, but sometimes in rhombic dodecahedrons; hard enough to scratch glass; nearly opaque; its colour is a beautiful blue, which is not uniform, but often cloudy and streaky. Before the blow-pipe, on charcoal, it fuses into a white glass. It is used in jewellery, but more extensively in the manufacture of the beautiful blue pigment, called ultra-marine.

PITCHSTONE,

In some of its varieties, bears a strong resemblance to pitch. It occurs of several shades of grey, blue, green, brown, and black; lustre, vitreous; fracture, imperfectly conchoidal; opaque, or slightly translucent on the edges. It is found in some of the islands of Scotland and some parts of England, in veins in granite. Its chemical composition is principally silica and alumina.

PUMICE

Consists of silica and alumina, with small portions of soda, potash, and oxide of iron. It is of a fibrous texture, often of a silky appearance, and extremely porous, so as to float on water. Its colour is greyish, white, or light brown; translucent on the edges; fuses into a green glass. It is a product of volcanoes, and is used extensively in the arts and manufactures, and is therefore well known.

OBSIDIAN

Contains 72 parts silica, 12 alumina, 12 soda, 2 oxide iron, and 2 lime. It occurs in masses of a greenish and brownish black; lustre, shining, vitreous; fracture, large conchoidal; some varieties are transparent, others only translucent on the edges; very brittle. It is found in considerable quantities in most volcanic districts, and specimens of it are frequently to be seen much resembling the *slags*, or waste glass, from glass houses. It is distinguished from Pitchstone, which it considerably resembles, by its clean conchoidal fracture.

TOURMALINE

CONSISTS principally of silica, alumina, and oxide of iron, and contains small portions of soda, manganese, boracic acid, and magnesia. It occurs in prisms with a splendent surface of six or more sides, variously terminated, and in general deeply striated; sometimes the crystals are short and thick, and at times very slender. Colour usually black or dark green; the latter translucent in one direction, and opaque in the other. The primary form of the prism is an obtuse rhomboid. It becomes electric by being heated. Mixed with borax, it fuses into a transparent glass. It is found in primary rocks in many parts of the world. *Schorl* is a variety of Tourmaline, occurring in curved prisms; *Judicolite*, another variety, is blue; and *Rubellite* is red or violet coloured.

ACIDIFEROUS EARTHY MINERALS.

THOSE Minerals which consist principally of acid combined with an earth, are so called.

WAVELLITE

CONTAINS principally alumina and phosphoric acid. It occurs in acicular crystals of a yellowish grey colour, radiating from a centre. (*See Fig*. 3, *Plate* 2.) It is frequently found in clay slate in Devonshire.

CARBONATE OF LIME,

CALLED also CALC SPAR and CALCAREOUS SPAR, is a combination of carbonic acid and lime. It is found in vast quantities crystalized in more than eight hundred different forms; but the primitive crystal is in all cases an obtuse rhomboid (*Fig*. 9, *Plate* 1). It cleaves readily, and easily yields to the knife. Its general colour is white, verging from milkiness to transparency. There is scarcely any sort of rock which does not contain veins of it. *Stalactitic Carbonate of Lime*, or *Calc Sinter*, hangs in long pendulous tubes from the roofs of caverns and old buildings. It is produced by the dropping through of water impregnated with carbonate of lime. When very compact and capable of being worked, this is called Alabaster. *Granular Lime Stone*, is the white statuary marble. The *Verd Antique*, consists of fragments of carbonate of lime imbedded in green serpentine. *Cotham*, or *Landscape Marble*, found near Bristol, and presenting when cut the forms of trees; *Oolite*, or common *Limestone*, used for paving and building; and *Common Chalk*, are other well known varieties of carbonate of lime.

FLUOR SPAR;

OR, *Fluate* of *Lime*, is a compound of fluoric acid and lime. It is found both crystalized and massive. The usual form is a cube, and the most common colour lilac. The primary form is a regular octahedron. (*Fig*. 6, *Plate* 1). When reduced to powder and placed upon a warm iron plate, it becomes luminous. It yields readily to the knife, and is capable of being wrought into various forms for chimney ornaments. It occurs in great quantities in Derbyshire; and is therefore often called Derbyshire Spar.

GYPSUM;

Or, *Sulphate of Lime*, contains sulphuric acid and lime. It exists crystalized, fibrous, granular, and compact. When crystalized, it is called *Selenite*, and is found in flat lozenge-shaped crystals. It easily separates into thin laminæ, and is then flexible, and considerably resembles transparent Mica; but it is not elastic. It may be found in many parts of the country. *Fibrous Gypsum* consists of white silky fibres, somewhat like Asbestus. *Granular* and *Compact Gypsum*, are generally white or pink. They are used in the manufacture of plaster of Paris, and also as manures for some peculiar sorts of soil.

SULPHATE OF BARYTES,

OR *Heavy Spar*, is a combination of sulphuric acid and Barytes. It is found massive and crystalized, of a considerable variety of colours, and both transparent and opaque. It decrepitates before the blow-pipe, and fuses with difficulty into a white enamel. The commonest form in this country is thin laminæ, white, or inclining to red, and opaque, set up edge wise.

CARBONATE OF BARYTES.

CONSISTING of carbonic acid and Barytes, bears a strong resemblance to opaque white carbonate of lime.

METALLIC ORES.

NATIVE GOLD

Is generally alloyed with small quantities of copper, silver, and iron. Its colour is bright yellow; it is found crystalized in the cube and the octahedron, and the former is considered the primary form, but it is not capable of cleavage. It is sometimes found in masses weighing 15 or 16 lbs. in Siberia; but exists generally in very small pieces.

ORES OF SILVER.

NATIVE SILVER

CONTAINS minute portions of copper, antimony, arsenic, and iron. Colour, white; lustre, perfectly metallic, but often tarnished of a greyish black on the surface. Form, the cube and octahedron; does not possess a lamellar structure; and is not, therefore, capable of being cleaved. It also exists in long strings of elongated crystals, forming threads and tree-like forms.

SULPHURET OF SILVER

Is of a lead colour, often with an iridescent blackish tarnish on the surface; primary form, the cube; but it is found also in octahedrons and dodecahedrons; fracture, uneven and fine-grained; with metallic lustre; yields readily to the knife. Before the blowpipe, the sulphur flies off and leaves a bead of pure silver.

RED SILVER,

OR *Ruby Silver*, consists of silver, antimony, and sulphur. It is found crystalized in a great variety of forms, the primary of which is the obtuse rhomboid. Seen by reflected light it appears black or dark grey, but by transmitted light it varies from a bright to a dark red; streak, cochineal-red; yields easily to the knife. It is found in Germany, Hungary, and South America.

MURIATE OF SILVER,

CALLED also *Horn Silver* and *Chloride of Silver*, is usually of a pearl-grey colour, but is commonly tarnished on the surface of a brown colour. Primary form, the cube; found also in acicular prisms; does not cleave; feebly translucent, with a waxy lustre; fracture, conchoidal; yields to the pressure of the nail. In common with all the ores of silver, it can be readily reduced before the blow-pipe. Found in Cornwall.

ORES OF COPPER.

NATIVE COPPER

CONTAINS 99 parts pure copper. The colour is reddish yellow, frequently with a brown tinge and tarnished on the surface. Crystalized in the cube and octahedron; and is also found in filaments in dendritic or tree-like forms, in thin plates filling crevices, and in masses. Tough, malleable, and yielding to the knife. Dissolves in Nitric Acid, which it colours green.

SULPHURET OF COPPER.

Vitreous Copper, or *Copper Glance*. A compound of copper and sulphur. Colour, lead grey, generally with a black or iridescent tarnish on the surface. Crystalized in cubes and six-sided prisms; cleaves without much difficulty; fracture, mostly conchoidal.

Purple Copper, called also *Peacock Copper*, is of a similar composition, with the addition of a portion of iron.

Grey Copper contains also the addition of silver and antimony, and sometimes zinc. Primary form the tetrahedron.

Copper Pyrites, contains 30 parts copper, 30 parts iron, 35 parts sulphur, and 5 parts silica. It has a highly metallic lustre; colour. brass yellow, often with a grey tarnish on the surface; streak, greenish black. Found in octahedrons and several other forms, stalactitic, botryoidal, and massive: yields to the knife; fuses before the blow-pipe, and melts into a black globule, which acts upon the Magnet. This is the most common variety of copper ore, and what is commonly worked in Cornwall.

RED OXIDE OF COPPER.

Octahedral Copper Ore, or *Ruby Copper*, contains 90 parts of copper and 10 of oxygen. Colour by reflected light, dark red, and sometimes of a greyish tinge; translucent, and, seen by transmitted light, of a rich red.

BLUE CARBONATE OF COPPER,

OR *Azure Malachite*, consists of carbonic acid and copper. Colour, a rich blue, with a glossy surface ; crystalized in a great variety of forms, of which the primary is an oblique rhombic prism ; yields readily to the knife.

GREEN CARBONATE OF COPPER,

Or *Malachite*, occurs crystalized, fibrous, and massive; generally translucent on the edges ; colour, various shades of rich green ; lustre, somewhat vitreous ; streak, light green ; brittle. It is often wrought into ornaments, and is the most rare and costly of the *Ores of Copper*. It is found in Cornwall.

ORES OF IRON.

NATIVE IRON.

The primary form is the regular octahedron. Colour, pale steel grey ; lustre, metallic ; acts powerfully on the Magnet, and is soluble in all the acids.

IRON PYRITES.

A COMPOUND of iron and sulphur, is a Mineral of very extensive diffusion. It is found in regular cubes, in which form it does not yield to the knife, by which it may readily be distinguished from Copper Pyrites. It also exists in globular masses, consisting of crystals radiating from a centre, and is then often called Thunderbolt. *White Iron Pyrites* is distinguished by its colour; and *Magnetic Iron Pyrites* by its acting on the Magnet.

SPECULAR IRON

Is so named from its brilliancy. It is highly crystaline, and the surfaces are very beautiful. The finest specimens come from Elba.

RED HŒMATITE,

Or *Red Iron Stone*, consists of a peroxide of iron, with small quantities of silica, lime and water. It mostly occurs in masses resembling the fragments of hollow spheres, with *botryoidal* or grape like marks, convex on the outside, and concave on the inside. The colour of the larger masses is often steel grey, with metallic lustre and very hard, but the smaller pieces are red or brownish, and it is mostly imbedded in red dust. It is found at Ulverstone, in Cumberland, and various parts of Germany.

BROWN HŒMATITE and BLACK HŒMATITE are more rare, finer in their grain, and more brittle than the above.

SPATHOSE IRON,

OR *Carbonate of Iron,* called also, *Brown Spar*, is found in various shades of yellow and brown; it is mostly translucent; lustre, slightly pearly; cleaves readily; is formed in obtuse rhomboids, of which the faces are generally curved or *saddle-shaped;* also in six-sided prisms, octahedrons and lenticular crystals; affects the magnetic needle. It is found in Cornwall, and specimens of it are very common.

ORES OF LEAD.

SULPHURET OF LEAD,

Or *Galena*, contains about 80 parts of lead, 15 or more of sulphur, and the rest of silver. Colour, lead grey; lustre on the surface, bright metallic; crystalized; primary form, the cube; breaks with a flat conchoidal fracture, and little lustre. Found abundantly in Durham.

CARBONATE OF LEAD,

Or *White Lead Ore.* Colour, white or grey, sometimes tinged with green; form, tabular crystals or six-sided prisms. It is also found earthy and massive. It exists in Scotland, Cumberland, and other parts of England.

ORES OF ZINC.

CARBONATE OF ZINC,

Or *Calamine*. Colour, greyish or yellowish. It is generally found in small crystals forming a coating to some sort of rock; yields easily to the knife; translucent; becomes opaque, and does not fuse before the blow-pipe. Is the most abundant Ore of Zinc.

SULPHURET OF ZINC,

Or *Zinc Blende*. Colour generally black, but sometimes brown, yellow, and red. Mostly crystalized; lustre on the planes of cleavage very bright; yields very easily to the knife. Is often found in separate crystals stuck upon the surface of a rock.

COMBUSTIBLE MINERALS.

UNDER this head are included those which have for their base either Sulphur or Carbon.

SULPHUR,

WHEN pure, is of a light yellow colour, but from the mixture of other substances is often red or brown. The primary form of the crystal is a four-sided pyramid. It is found in all volcanic districts.

DIAMOND

Is pure Carbon in a crystaline form. The best Diamonds are colourless, but they are often with a yellow, blue, brown, or red tinge. Primary form the octahedron; always found detached; the faces of the crystals often convex, so as to give them a roundish appearance; yields without much difficulty to cleavage; lustre brilliantly adamantine; the hardest substance in nature; fracture, conchoidal; varying from transparent to opaque. Hindostan and Brazil are the principal localities for the Diamond.

PLUMBAGO

CONSISTS of 90 parts carbon and ten parts iron. Colour, steel grey; mostly occurs in kidney shaped masses, but the primary form is a regular six-sided prism; lustre, glistening metallic; unctuous to the touch, and yields readily to the knife; streak, shining lead coloured. Used extensively under the name Black Lead. Exists in Cumberland.

AMBER

CONSISTS of carbon, hydrogen, and oxygen. It occurs in irregular masses of a transparent yellow or brown. The largest specimens come from Russia, and it is often found in small pieces in the gravel of the neighbourhood of London. Is often used in the manufacture of ornaments. It seems probable that it is nothing more than a sort of fossil gum of vegetable origin.

INDEX.

The following Index contains only the common names of Minerals, and the names of the more important subordinate varieties, referring to the head under which they are described in the preceding pages.

Brown Spar.... CARBONATE OF IRON
Blende.... SULPHURET OF ZINC

Calc Spar.... CARBONATE OF LIME
Cameo, see CALCEDONY
Crystal (Rock).... QUARTZ
Cornish Diamonds.... QUARTZ
Cat's Eye.... QUARTZ
Cornelian.... CALCEDONY
Chrysoprase.... CALCEDONY
Carbuncle.... GARNET
Calc Sinter.... CARBONATE OF LIME
Chalk.... CARBONATE OF LIME
Cotham Marble.... CARBONATE OF LIME
Calamine.... CARBONATE OF ZINC

Derbyshire Spar.... FLUATE OF LIME

Egyptian Pebble.... JASPER
Emery.... CORUNDUM

Fluor Spar.... FLUATE OF LIME

Green Copper....CARBONATE OF COPPER

Heavy Spar....SULPHATE OF BARYTES

Labrador Spar....FELSPAR
Landscape Marble....CARBONATE OF LIME
Lignite, Fossil Wood, in nearly the state of COAL

Moon Stone....FELSPAR
Malachite....CARBONATE OF COPPER
Mocha Stone....CALCEDONY
Mountain Cork....ASBESTUS

Onyx....CALCEDONY
Olivine....CHRYSOLITE
Oolite....CARBONATE OF LIME

Plaster of Paris....GYPSUM
Pyrites... Mixtures of SULPHUR and IRON, or SULPHUR and COPPER
Potstone....SOAP-STONE
Peacock Ore....SULPHURET OF COPPER

Rock Crystal.... QUARTZ
Ruby.... CORUNDUM

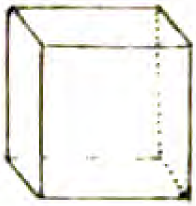
Sand.... QUARTZ
Snowden Diamonds.... QUARTZ
Sahlite.... AUGITE
Sapphire.... CORUNDUM
Sun Stone.... FELSPAR
Schorl.... TOURMALINE
Statuary Marble.... CARBONATE OF LIME
Selenite.... GYPSUM

Thunderbolt.... SULPHURET OF IRON
Tripoli, a variety of CLAY

Verd-antique.... CARBONATE OF LIME

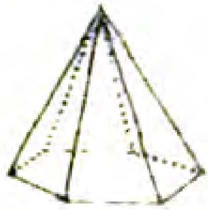
Plate. I.

1



2

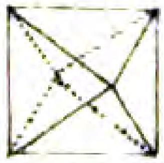
3



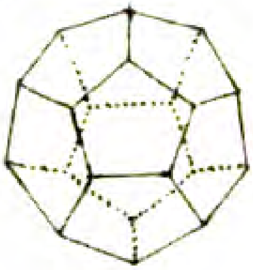
4

5

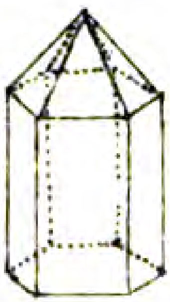
6



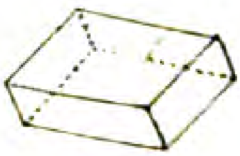
7



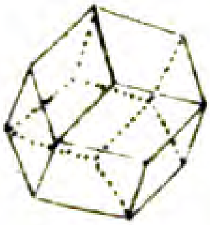
8



9

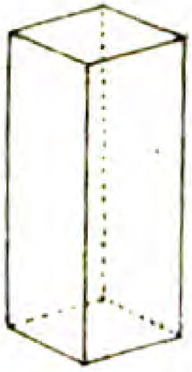


10



11

12



DESCRIPTION OF THE PLATES.

PLATE I.

Fig. 1. The Cube.
,, 2. Three-sided Pyramid, or tetrahedron.
,, 3. Six-sided Pyramid.
,, 4. Three-sided Prism.
,, 5. Six-sided Prism.
,, 6. Octahedron.
,, 7. Dodecahedron.
,, 8. Six-sided Prism, terminated by a Six-sided Pyramid.
,, 9. Obtuse Rhomboid.
,, 10. Rhombic Dodecahedron.
,, 11. Oblique Rhombic Prism.
,, 12. Right Rhombic Prism.

PLATE II.

Fig. 1. Staurolite.
,, 2. Leucite.
,, 3. Wavellite.
,, 4. Selenite.
,, 5. Dendritic Silver.
,, 6. Crystals of Quartz, often called Cornish Diamonds.

PLATE III.

Fig. 1. The Pitt Diamond,

Now belonging to the King of the French; by whose predecessor it was purchased for £130,000, which is considered to be not more than half its value.

,, 2. The great Diamond,

Originally the eye of a Burmese Idol, stolen by a French soldier, and afterwards sold to the Empress Catharine of Russia for £90,000, and an annuity of £4000.

PLATE IV.—(Frontispiece.)

Fig. 1. Malachite.
,, 2. Tourmaline, with Crystals of Quartz.
,, 3. Ribbon Jasper.
,, 4. Cotham Marble, from a Specimen in the British Museum.

Masters, Printer, 33, Aldersgate Street, London.

Plate. 11.

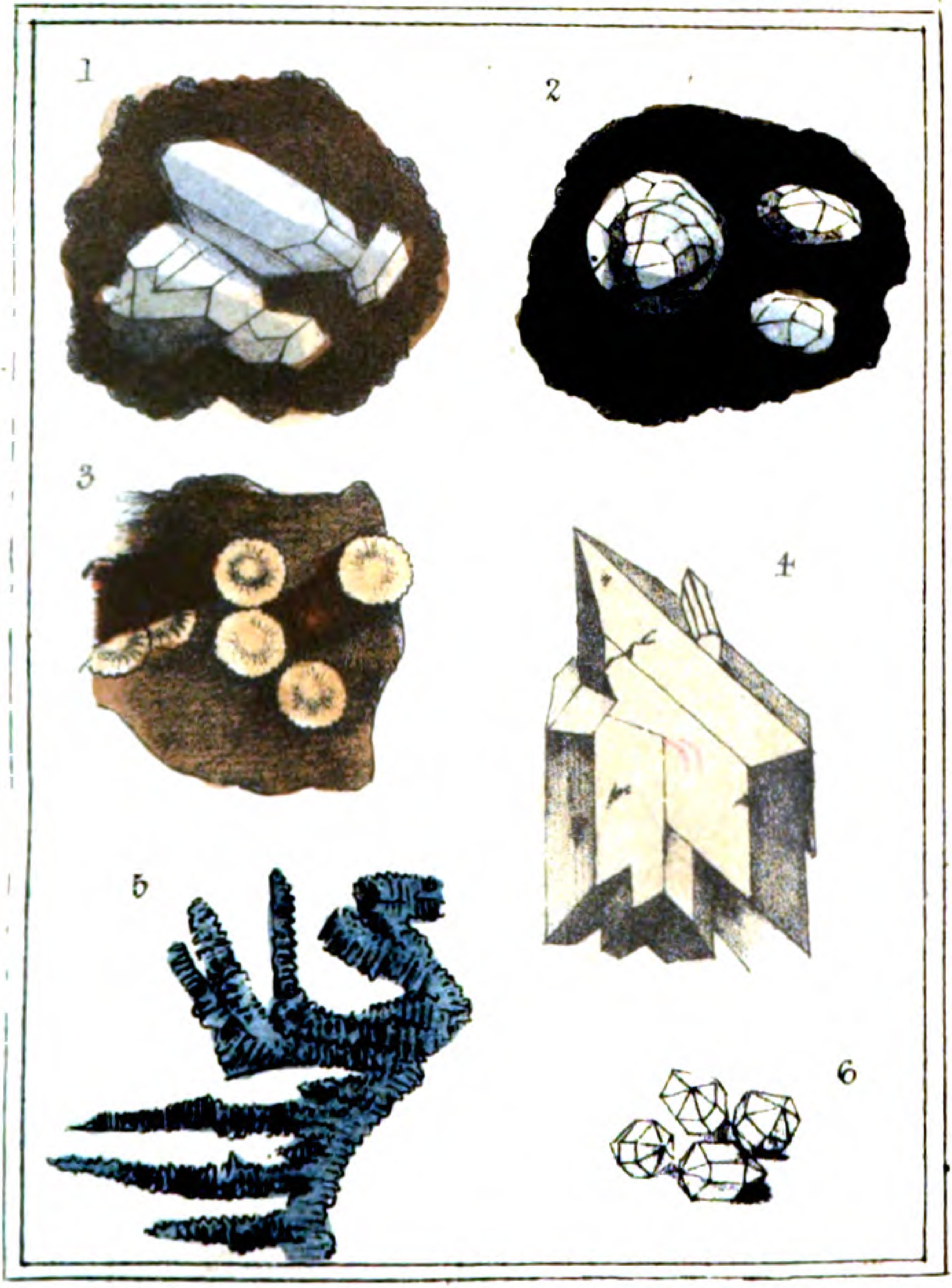
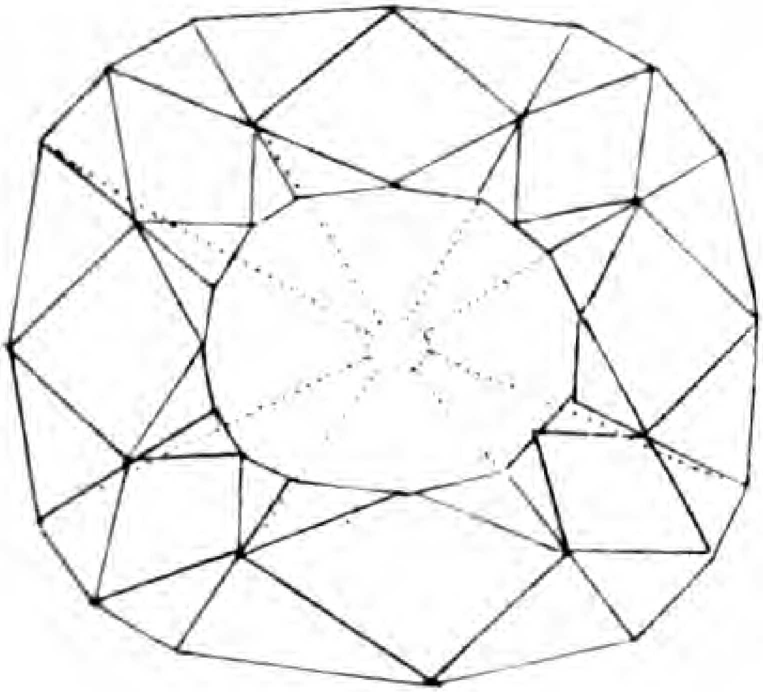
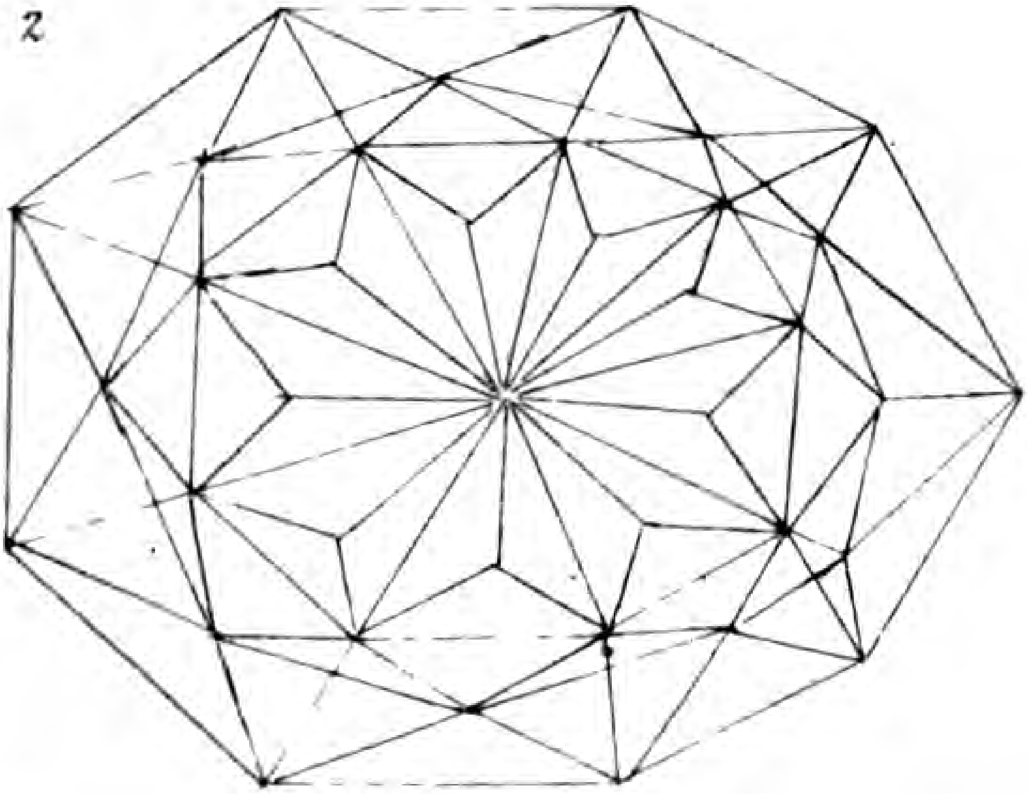


Plate. III.

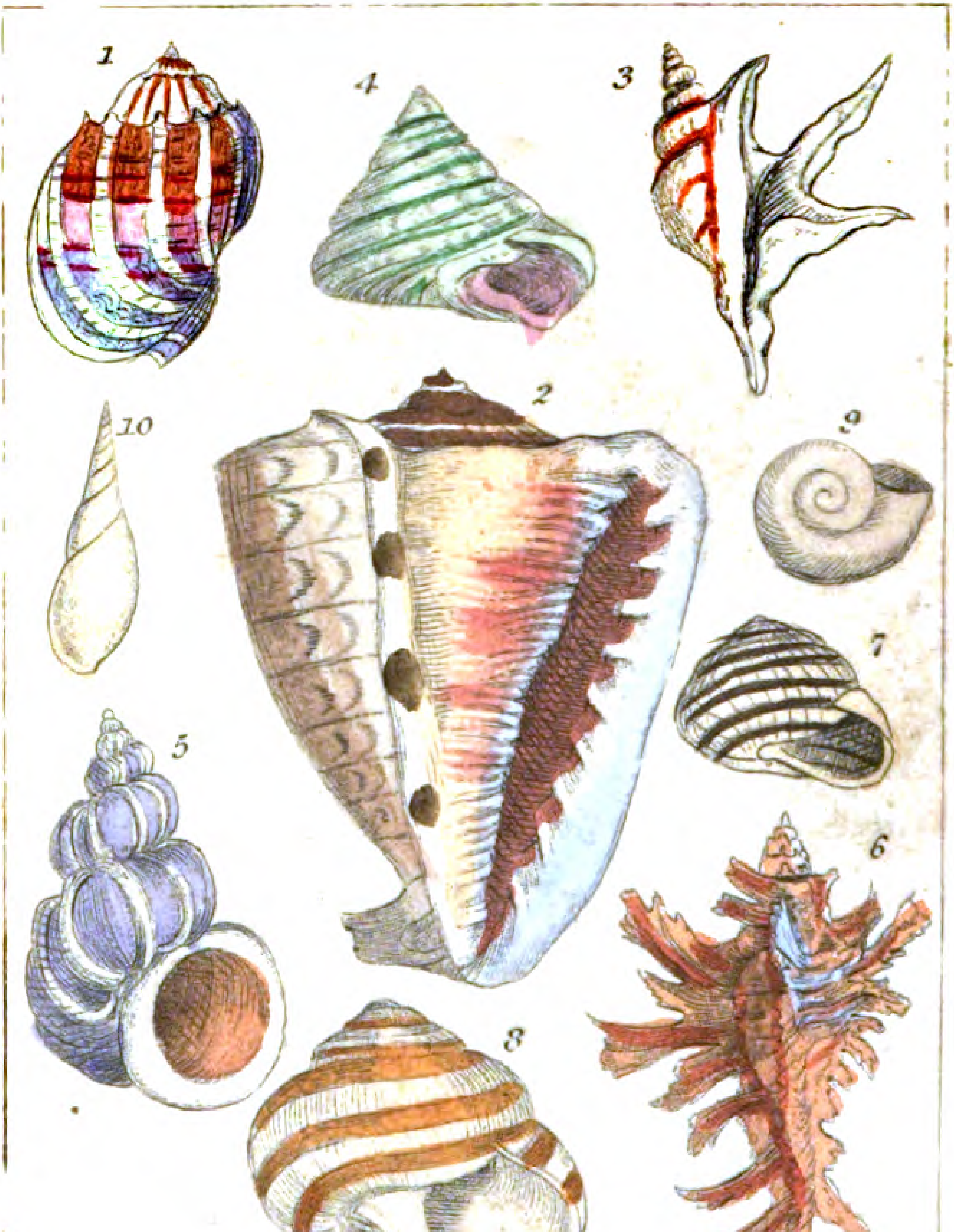
1



2



II



THE LITTLE

CONCHOLOGIST.

PRINTED IN COLORS BY GREGORY & COLLINS
16 ST. JAMES STREET CLERKENWELL

PREFACE.

THE study of Conchology has of late years been redeemed from the charge of being a mere list of hard names, by its having become connected with Geology, as well as from the closer investigation which has been bestowed on the nature and habits of Molluscous Animals. The mere arrangement and naming of Shells could never have a just claim to the name of a Science; but from the associations, which it has thus acquired, it has become a necessary part of some of the most interesting and important branches of Natural History.

The following little book is intended as a manual for constant reference to those who are learning, till they have acquired a ready habit of discriminating the Genera that are found on the British Coasts. It may be well to state, that the *generic* character, that is, the particular traits that are common to all the species included in a Genus, is placed first in each section in a small type;

then follows any remark that may seem necessary, with a notice of the most striking or best known Foreign Species; after which is a list of the British Species, with notices of those that are most easily found, or are most remarkable. Of course such a tiny volume cannot pretend to completeness in regard to particulars; but it is confidently hoped, that it will be found to contain quite as much useful matter as any of the elementary works on the subject, at present before the public, all of which are less portable and much more expensive.

The arrangement adopted is substantially that of Linnæus, as being the most simple, and on the whole the best for beginners. Such alterations have, however, been made as are necessary to adapt it to our present increased knowledge. The use of technical terms has been avoided as far as was compatible with accurate expression.

CONTENTS.

I. UNIVALVES.

HAVING A REGULAR SPIRE.

CONTENTS.

THE LITTLE CONCHOLOGIST.

THE INHABITANTS OF SHELLS.

THE Animals which live in shells are called Testaceous Mollusca. Their bodies are cold and soft, without a skeleton of bones, and covered with a skin from which exudes a slimy liquid. They have muscles, nerves, glands, and a heart with a system of vessels in which a cold white fluid circulates.

They are divided into two classes; one called *Acephala*, or *without a head;* and the other *Cephala*, or *with a head.*

The Acephala have an appearance of great simplicity in their structure, and no distinct organs of sense are perceptible. They inhabit shells consisting of two or more parts. For the most part they are incapable of locomotion, but some of them move by a jerk or spring, produced by opening and then violently shutting their shells.

The Oyster is a well-known example of the Acephala.

The Cephala have a distinct head, and organs of sense more or less perfectly developed. Most of them move from place to place by determinate contractile movements of muscles in a part of their bodies called the foot. The Snail and the Whelk may be taken as examples.

The Cephala are generally in shells consisting of only one piece.

Shells must generally be looked upon as the armour for the tender bodies of the Mollusca. Some animals of a similar character, such as the Actinia (Sea Anemone,) and the Sepia (Cuttle fish,) which are not provided with shells, are covered with a tough skin. There are, however, some instances in which the use of the shell is only to enable the animal to float on the surface, by emptying it of water at pleasure. The connexion between the shell and the animal is in general formed by means of a strong muscle; but in some instances, as the Argonauta, (Paper Nautilus,) it is only by suckers, which cause a vacuum underneath by their close application to the surface of the shell.

The inhabitants of Bivalves and Multivalves are viviparous; those of Univalves, oviparous. The animal is universally furnished with a shell at its birth, or when it issues from the spawn. The subject of the growth of shells has been closely investigated; but it is one of such extreme difficulty, that no very satisfactory results have been obtained. It appears that the animal has the power of covering the edge of the shell with successive layers of a viscous substance, which gradually hardens and becomes a part of the shell, and this process goes on as long as it lives. The extreme regularity of the markings of some shells is very remarkable, considering this mode of formation. The substance of which they are composed is universally carbonate of lime.

Some of the Mollusca live on vegetable substances and some on animal. Most of the former are furnished with horny jaws, and some of them with teeth; a few of the latter have a simple opening to receive such animalcules as the waves may bring to them; but the greater part have a kind of proboscis by which they seize their prey.

Some use this proboscis for the purpose of boring into other shells, so as to get at the body of the fish inside. It has been supposed that this boring is strictly mechanical, and performed by the aid of the little teeth which are usually found at the end of the proboscis. It seems, however, more probable that the creature does it by means of a corrosive fluid, that dissolves the shell which comes in contact with it. There are some genera which make use of this perforating faculty to form their habitations, boring their way into chalk or wood. The Pholas and the Teredo are among the most remarkable of this kind.

CLASSIFICATION OF SHELLS.

Shells are divided into three classes, which may be easily distinguished, as they depend only on the number of parts of which the shell is composed. They are termed,

I. Univalve, or consisting of one part, as the Buccinum (Whelk,) or Turbo (Periwinkle ;) All of this class are inhabited by Mollusca Cephala.

Note.—The small coverings or opercula, usually somewhat flexible, (called in the Periwinkle the cap,) which many univalve shells are furnished with, are not considered as part of the shell.

II. BIVALVE, or consisting of two parts, as the Ostrea (Oyster,) Cardium (Cockle,) or Mytilus (Muscle.) They are inhabited by Mollusca Acephala.

III. MULTIVALVE, or consisting of many parts, as the Lepas (Barnacle,) or the Pholas (Chalk Borer.)

PARTS OF A SHELL.

In order to understand conchological descriptions, it is important to obtain a clear notion of the various parts of a shell. Those of a Univalve are thus distinguished. see Fig. 1. *Plate I.* The example is the *Buccinum Undatum*, or common Whelk.

a The space included in the bracket *a*, is the spire.

b Each turn of the spire is called a whorl, and the largest is called the body whorl.

c The aperture.

d The canal.

e The base; when this part is lengthened out, it is called a beak.

f The outer lip.

g The inner or columellar lip.

h The suture, where the whorls unite with each other.

i The apex.

If the shell is carefully broken, a continuous support will be seen running the whole length of the spire, called the columella, or pillar. See *c c* Fig. 2.

The parts of a bivalve are as follows. See Figs. 3 & 4. The shell is the *Venus Chione*, or Smooth brown Venus.

a The space within the bracket is termed the hinge.

b The beaks.

c The umbo.

d The disk, including the whole outer surface.

e The base.

f The tooth.

g The ligament.

The two parts into which the shell is divided are called right and left valves, and are thus distinguished; when the complete shell is placed with its hinge towards you, and the ligament *g* below the beaks *b b*, the left valve, Fig. 5, is opposite the left hand, and the right valve opposite the right hand.

ALPHABETICAL EXPLANATION OF TERMS.

Anterior Slope, the side of the beaks of a Bivalve where the Ligament is placed, the opposite side being called the *Posterior Slope.*

Apex, in Univalve shells, the top of the Spire. The plural *Apices* is applied to the points of Bivalves, over the hinge, which are also called Beaks.

Base, the part of a shell, whether Univalve or Bivalve, opposite to the Apex.

Canal, see p. 17.

Columella, the line which runs up the middle of the spire of Univalves ; called also the Pillar. See p. 17.

Complicated, folded together.

Convoluted, when the whorls descend from the apex towards the body whorl, so as to form a cone. *Involuted* means that the whorls are included in the body whorl. *Involute* is sometimes used to express the absence of a spire, as in the limpet.

Crenated, notched.

Dessepiment, a division between two chambers of a shell.

Disk, see p. 17.

Effuse, open, having the lips so separated at the base that water would run out before it reached the margin.

Entire, the aperture is said to be entire when the margin all round it is perfectly level, without a canal.

Equilateral, applied to Bivalves, when the sides of the shell on each side of the beaks are alike.—*Inequilateral,* when the sides are unlike.

Equivalve, in Bivalves, having the valves alike.—*Inequivalve,* having them unlike.

Involuted and *Involute,* see *Convolute.*

Inequilateral, see *Equilateral.*

Inequivalve, see *Equivalve.*

Ligament, a cartilage which connects the valves, commonly on one side of the beak.

Lip, see p. 17.

Striated, marked with fine parallel lines, either by ridges and furrows, or by two different colours.

Suture, see p. 17.

Teeth in Univalves are small protuberances on the lips ; but in Multivalves on the hinge. In the latter they are said to be articulated, when that on one shell fits into a cavity in the other.

Umbo, see p. 17.

Whorl, see p. 16.

I. UNIVALVES.

ARGONAUTA.—PAPER SAILOR; OR, PAPER NAUTILUS.

Spiral, one celled.

THE shells of this genus are remarkable for their delicacy and thinness. Their form is extremely elegant, and they are much valued as ornaments. The colour is generally white or of a bluish tinge, running into brown and black towards the outer edge; the size is very various. The A. Argo is sometimes twelve inches in diameter, while there are some species extremely minute.

There are no British species. The most common is the *A. Argo*, or Oriental Nautilus, which mostly comes from the Cape of Good Hope. The *A. Vitrea* is very rare and extremely beautiful.

NAUTILUS.—Pearly Sailor.

With a spire divided into several chambers, communicating with each other by small apertures, which, taken altogether, are called the Siphuncle.

In most of the Nautili the spire is on a plane, so that there is no part of the shell extending beyond the body whorl. In some species the whorls touch, and are partially included in each other, as in the beautiful shell *N. Pompilius*, Chambered Nautilus; in others they are detached, as in the small *N. Spirula*, Spiral Nautilus. Several of these species, like the first mentioned, are of a dingy white, with brown or yellow marks, but some are semi-transparent, of a delicate white, as the Spirula. The fish are of the Sepia, or cuttle-fish kind, provided with several long arms. They use the shell as a sort of float, which, when they want to come to the surface of the sea, they empty of water by means of the Siphuncle.

The English Nautili are all very small. *N. Lævigulatus*, smooth Nautilus.. *N. Rotatus*, wheel Nautilus.. *N. Depressulus*.. *N. Crispus*, keel-edged Nautilus.. *N. Crassulus*, strong Nautilus... All exceedingly minute, with the whorls touching each other.

The following are considerably elongated: *N. Semilituus*.. *N. Cartaniulus*.. *N. Costatus* .. *N. Rectus*. straight Nautilus.. *N. Spinulosus*.

There is one fresh-water species found in Kent, *N. Lacustris*.. sometimes called *Segmentina*. It is about a quarter of an inch in diameter. (*See P. I. Fig.* 8.)

CONUS.—Cone.

Convoluted; aperture longitudinal, effuse; without teeth; pillar smooth; form conical.

This is a very beautiful genus, comprising a very large number of species, all distinguished by their form, and nearly all by their beauty of lustre and colour. There are no British species. The *C. Tesselatus*, or Mosaic Cone, and *C. Ebræus*, or Hebrew Cone, are amongst the best known species.

CYPRÆA.—Cowry.

Involuted; form nearly oval; aperture linear and effuse at each end; lips turned inwards with teeth.

Many of the rich variety of foreign cowries are well known from their use as ornaments; distinguished by their beautiful colours and fine polish.

Cypræa Europea.—Nun Cowry.—Of a pale flesh colour, transversely ribbed; usually about half an inch long,—abounds in the island of Guernsey. (*See P. I. Fig.* 7.)

BULLA.—Dipper or Bubble.

With a spire; form nearly oval, inflated; aperture oblong, longitudinal; without teeth; the base entire; columella oblique and smooth.

In many of the species, the fish is so large as to include, and nearly conceal, the shell. It is provided with a very curious gizzard, which both masticates and digests its food. (*See p. I. Fig.* 6.) There is no operculum, which indeed could be of no use from the form and size of its body in relation to the shell; and in consequence, it always keeps in deep water, out of the reach of crabs and other enemies. The *B. Ovum* (poached egg) and *B. Volva*, (weaver's shuttle) are beautiful foreign species of this genus.

B. Aperta, broad shuttle.. *B. Hydatis*, paper shuttle.. *B. Plumula*.. *B. Catena*.. *B. Lignaria*, wood dipper.. Involuted, of a yellow or brownish colour, with a surface much resembling the grain of wood.. *B. Akera*, all distinguished by thin shells and broad openings.

These have a prominent spire: *B. Fontinalis* .. *B. Rivalis*.. *B. Hypnorum*, fresh-water shells found both in streams and pools; known also as the genus *Physa;* they are remarkable for a sort of convulsive rapidity in their motions.

VOLUTA.—Volute.

Convoluted; no beak; often effuse; columella curiously twisted, so as to produce several plaits or teeth on the columellar lip.

This genus includes the shells commonly known by the names of Mitres, Melons, and Olives. The *V. Musica*, music shell, is one of the most beautiful species; but nearly all are remarkable for symmetry and beauty of surface. The British species are among the smallest and plainest.

These are minute shells with a thick outer margin, *V. Pallida*.. With a depressed spire and effuse, *V. Catenata*.. *V. Lævis*.

V. Denticulata and *V. Triplicata*, toothed Volute, and three-toothed Volute, found chiefly in the Island of Guernsey.. *V. Alba*, white Volute, on the coast of Kent.. *V. Pellucida*.. *V. Unidentata*.. *V. Insculpta*.. *V. Interstincta*, in the West of England.

BUCCINUM.—Whelk or Trumpet.

Convoluted; form gibbous; aperture nearly oval, ending in a short canal turning away from the outer lip; columellar lip expanded.

This genus includes the shells called Tuns, Helmets, Harps, Needles, and Scoops.

B. Undatum, a thick coarse shell covered with undulating ribs, striated both longitudinally and transversely. The fish is eaten; and it is, therefore, often seen in our markets.—*B. Lapillus*, has the apex smaller and more pointed; and the fish produces a liquid which dyes of a rich purple. *B. Bilineatum*, smooth net helmet.. *B. Hepaticum*.. *B. Reticulatum*.. *B. Lineatum* and *B. Acicula*, are minute shells.

STROMBUS.—CLAW SHELL.

Convoluted; aperture dilated with the outer lip expanding; a beak turning to the left.

INCLUDES the kinds called Claw shells and many of the Wing shells.

S. Pes Pelicani, the outer lip very like a bird's foot.. (*See P. II. Fig.* 3.) *S. Costatus*, ribbed Strombus, with no teeth.

MUREX.—Rock Shell.

Convoluted; surface rough with spines, or with a sort of fringes called Varices; aperture oval with a nearly straight canal, and in many species with a very long beak.

This genus comprises the Thorny Woodcock, (*M. Tribulus*) the Spider shells, and several sorts commonly termed Whelks. Some species resemble in some degree the genus *Buccinum* in their general form.. *M. Erinaceous*, rough ridged whelk.. *M. Reticulatus*.. *M. Corneus*.. *M. Gracilis*.. *M. Muricatus*.. *M. Purpureus*.. *M. Attenuatus*.

TROCHUS.—Top Shell.

Convoluted; form decidedly conical; pillar oblique; aperture angular.

The conical form of this genus is its leading feature. Most of its species have a very brilliant pearly lustre when the outside has been taken off by some corrosive acid. The *T. Pharaonis*, strawberry shell, and *T. Perspetivus*, staircase shell, are amongst the foreign species.

T. Magus.. T. Obliquatus.. T. Patholatus .. T. Terrestris, is a land shell, small and very remarkable, sometimes called *Helix Spinulosa. T. Striatus.. T. Ziczac.. T. Crassus.*

TURBO.—Turban Shell.

Convoluted; form conical; aperture circular and remarkably perfect.

This genus is distinguished from the *Trochus* by the shape of the aperture. Amongst the foreign species are the *Turbo Scalaris*, or True Wentle trap,* in which there is no colu-

* This is a corruption of the German Wendle Treppe, a winding staircase.

mella, and the *Turbo Clathrus,* or false Wentle trap, which is much more taper, and has a columella uniting the whorls in the usual manner. The former is so rare, that good specimens of it have been sold for £25.

T. Rudis.. T. Petræus.. T.Jugosus.. T. Crassior.. T. Littoreus, the common periwinkle; *T. Tenebrosus,* which is of a chocolate colour.

These have a striated surface, *T. Crinex,* or bug periwinkle, *T. Calathiscus.*

T. Auricularis, which is *umbilicated,* (i. e. with a hole at the base of the columella,) found in Southampton water. *T. Vinctus* and *T. Thermalis,* are also umbilicated.

T. Bidens, T. Laminatus, and *T. Labiatus,* are reversed shells, and have teeth at the aperture.

Minute shells—*T. Costatus.. T. Semicostatus... T. Punctur as... T. Elegantissimus... T. Arenarius.. T. Labiosus.. T. Ventrosus.. T. Interruptus..* some of which are found in great quantities on the shores of bays and arms of the sea. *T. Parvus*, found in Guernsey.

T. Fasciatus, a land shell, found in immense quantities in the West of England.

Above seventy species of *Trochus* exist in Britain, most of which are very minute.

HELIX.—Snail.

Convoluted; semi-transparent; thin and fragile; aperture nearly circular and very entire.

Perhaps the most extensively diffused of all genera. Found in all climates in fresh water and all land; amongst plants and on the driest deserts: a few species exist in the sea. Some of the land species lie dormant in winter, and are then covered with an operculum, which falls off in summer.

This genus is divided into several very distinct families, which are treated by those who make a more exclusive study of fresh-water shells as separate genera. The first of these is the *Helix;* the character of which is

Orbicular, thin; with a conical spire; rather obtuse; aperture nearly semicircular, the margin being interrupted by the whorl next the last.

H. Nemoralis or coppice snail, a glossy shell, handsomely striated, colours red, brown, and white. *H. Hortensis,* garden snail, nearly globular, smooth, yellow or brownish, with bands like the above, but less. (*P. II. Fig. 7.*) *H. Arbustorum, H. Cantiana,* Kent snail.. *H. Rufescens,* deeply umbilicated.. *H. Sericia,* of a yellowish horn colour, and hairy.. *H. Pisana.. H. Crenulata.. H. Spinulosa.. H. Pomatia,* eatable snail; abounds in Buckinghamshire, Surrey, Bedfordshire, and some other counties. Eaten in considerable quantities on the Continent during Lent; and once used as an article of food in our own country. Its size is larger than that of most English snails; the shell is nearly globular, with brown bands, and the columellar lip much turned over. *(P. II. Fig.* 8.) *H. Ericetorum,* heath snail.. *H. Aspersa,* or *Grisea,* the commonest of all snails, and the pest of gardens, with a wrinkled coat.. *H. Fusca.. H. Nitens,* of a greenish horn colour.. *H. Crystallina.*

Another division is called *Planorbis.* (*See P. II. Fig.* 9.)

Shell circular; flat; dish like; the whorls turning horizontally round each other, something like those of the Nautilus.

H. Planorbis; H. Complanata; H. Rhombea; H. Vortex; H. Cornea.

A third division is called *Limneus.* (*See P. II. Fig.* 10.)

Shell oblong, and often with a very acute spire; a single fold in the middle of the pillar; entire at the base.

H. Auricularia.. H. Peregra.. H. Limosa.. H. Glutinosa.. a very delicate shell, nearly globular.. *H. Stagnalis.*

NERITA.—Hoof Shell.

Convoluted; aperture semicircular; columellar lip strikingly truncate, in a transverse direction, and flat.

The most common of this genus are marked with black spots on a white ground. The best known foreign species have teeth curiously situated on the columellar lip.. ***N. Peloronta,*** bleeding tooth Nerite.. ***N. Bidens. N. Tesselata,*** &c.

N. Pallidula.. N. Carena, tabby cat shell.. ***N. Littoralis.***

HALIOTIS.—Ear Shell.

Dilated; ear shaped, mostly with a row of holes on one side; depressed spire on one side. Fish adheres to rocks by a broad foot.

H. Iris and ***H. Splendens,*** are very remarkable. These beautiful species of this genus are from New Zealand and Australia.

H. Tuberculata, common Ear shell, or Aumer, abounds in the island of Guernsey. (*P. III. Fig.* 1.)

PATELLA.—Limpet.

Dilated; conical; no regular spire. Fish adheres strongly to rocks by a broad fleshy foot.

P. Pellucida.. *P. Lævis*.. *P. Ungarica*.. *P. Vulgata*, common limpet.. *P. Intorta*, cone much inclined.. *P. Fissura*, with a small slit in the margin.. *P. Lacustris*, a fresh water shell.

DENTALIUM.—Tooth Shell.

In the form of a tube slightly curved and tapering.

Mostly found on sandy shores in the South of England and the Channel Islands.

D. Entalis, common tooth shell.. *D. Dentalis*, striated tooth shell. (*P. III. Fig.* 3 & 4.)

SERPULA.—Worm Shell.

Tubular; irregularly contorted; mostly adhering to other substances, with frequent partitions.

S. Triquatra, triangular worm shell.. *S. Intricata*.. *S. Vermicularis*, round worm shell.. (*P. III. Fig.* 5.) *S. Tubularia*.. *S. Semilunum*, never adhering to other substances.

TEREDO.—Ship Worm.

Tubular; lodged in woody substances; with hemispherical valves at each end.

Pierces the hardest oak, probably by means of a solvent liquid, and thereby very destructive to shipping. See the remark under the genus Pholas.

Teredo Navalis.—Common ship worm, from three to twelve inches long. (*P. III. Fig.* 6.)

II. BIVALVES.

MYA.—Trough Shell or Gaper.

Valves alike ; gaping at one end ; hinge with one broad tooth, broader at one end than the other, placed beneath the beak ; form mostly oval, but some species nearly round, and others angular, with ears.

They generally burrow in sand, and are provided with a thick brown coating, or *epidermis*. When this is removed, the shell often exhibits rich prismatic hues.

M. Truncata, abrupt gaper, looks as if it had been cut off at one end. The fish is furnished with a proboscis, which it can protrude several inches : this species is eaten in some countries. *M. Arenaria*..*M. Declivis*..*M.*

Prætensus..M. Distorta..M. Bidentata, **with two teeth at the hinge..*M. Purpurea..M. Prismatica.***

The following are distinguished by the teeth fitting into the opposite valve :—*M. Margaritifera,* a river shell, which produces pearls; covered with a black wrinkled skin, which fringes the margin; thick and ponderous..*M. Prata,* also a river shell..*M. Suborbicularis..V. Inæquivalvus.*

SOLEN.—RAZOR SHELL.

Valves alike; gaping at both ends; hinge with one small taper tooth, sometimes double, not often inserted in the opposite valve; mostly brittle, and covered with an epidermis.

IN many species the breadth of the shell is more than six times its length. They are found on most sandy shores, where they bury themselves with great rapidity.

The following are very wide and entirely open at both ends :—*S. Siliqua*, pod razor shell; nearly cylindrical; square at one end and rounded at the other.. (*P. III. Fig.* 11.) *S. Vagina*, sheath shell, square at both ends, and much flatter.. *S. Ensis*, sword shell, more curved and more slender.. *S. Pellucidus.*

The following are oblong :—*S. Fragilis.. S. Coarctatus.. S. Minutus.. S. Vespertinus.. S. Squamosus*, found in Dorsetshire.

TELLINA.—Tellen.

Valves alike; form generally broader at one end than the other; hinge with three teeth, which distinguishes it from some of the oblong species of Solen; in the fore part of one valve a convex fold, and in that of the other a concave one; with the anterior slope more or less compressed.

T. Radiata .. T. Fragilis.. T. Oblonga .. T. Levigata.. T. Punicea.. T. Inæquivalvus.. T.

Depressa.. *T. Tenuis*.. *T. Striata*.. *T. Planata*. The following species have nearly round shells:—*T. Remies*.. *T. Reticulata*.. *T. Crassa*, Island of Guernsey . *T. Lactea*.. *T. Rotundata* .. *T. Zonata*.

These are found in fresh water, *T. Lacustris*.. *T. Cornea*.

CARDIUM.—Cockle or Heart Shell.

Valves alike ; generally very convex ; shape generally round, longitudinally ribbed, with a crenated margin, the edges of the shells fitting close together ; hinge with four teeth, two near the valve and one on each side, at a little distance, all locked into the opposite valve.

This shell takes its name from the Greek word for a heart, from the form it bears when looked at on the edges of the valves with the hinge upwards. The fish mostly buries in the sand.

C. Edule, common cockle, eaten by poor people.. *C. Fasciatum*.. *C. Elongatum*.. *C. Echinatum*, prickly cockle.. *C. Aculeatum*.. *C. Exiguum*.. *C. Rubrum*.. *C. Lævigatum*, smooth cockle.

MACTRA.—Kneading Trough.

Valves alike; principal tooth of the hinge, just under the beak, complicated, and having a small hole on each side, which may be considered characteristic of the shell. One tooth on each side at some distance, and inserted into each other, the teeth always remarkably thin. Form, oblong or approaching a triangle.

The Colour of these shells is mostly lilac, or a dull white tinged with blue and yellow. They are thin, light, and often semi-transparent.

M. Stultorum.. *M. Triangularis*.. *M. Radiata*.. *M. Solida*.. *M. Truncata*.. *M. Tenuis*.. *M. Fragilis*.. *M. Hians*.. *M. Glauca*.. *M. Listeri*.. *M. Planata*.

DONAX.—Wedge Shell.

Valves alike; hinge with two central teeth, and one at some distance, on one side; mostly approaching a triangle and always closely resembling a wedge; often gaping. Margin often Crenulate, or ending in small teeth, fitting between those of the opposite valve.

D. Trunculus.. *D. Denticulata*, very rarely found on our coasts.. *D. Castanea*, of a chestnut colour.. *D. Plebeia.*. *D. Complanata.*. *D. Irus.*

VENUS.—Venus.

Valves alike; inequilateral; front margin flattened; forms varying from nearly circular, to nearly oval; hinge almost universally with three teeth very near each other, the middle one longitudinal, the other diverging; beak turned away from the ligament. (See Plate I. Figs. 3 & 4.)

The *V. Mercenaria*, a thick obliquely heart-shaped shell, thick, and of a grey brownish, or sometimes rich purple colour, with a white inside, is used by the North American Indians for making their wampum belts, which are given by one to another in token of friendship; the shells are cut into strips and strung together. They are also used as money, and by the women as ornaments.

The following are nearly heart-shaped:—*V. Fasciata*, thick-ribbed Venus, a triangular shell, marked with very distinct concentric ridges.. *V. Cassina*, broad-ribbed Venus.. *V. Cingenda*, girdled Venus.. *V. Excavata*.. *T. Spinifera*, thorny Venus, found in the West of England.. *V. Verrucosa*, trusty Venus.. *V. Minima*, red-streaked Venus.. *V. Gallina*, hen Venus .. *V. Ovata* .. *V. Triangularis* .. *V. Chione*, the beautiful, well-known, smooth brown Venus.. *V. Deflorata*.. *V. Exoleta*.. *V. Undata*.. *V. Spuria*.. *V. Decussata*.. *V. Perforans*, piercing Venus, bores into limestone; found in Devonshire .. *V. Virginea* .. *V. Aurea*.

The following is nearly circular :—*V. Tigrina*, tiger Venus.

ARCA.—Ark.

Valves alike; inequilateral; forms very different in the various species, often oblong, sometimes circular; hinge with a great number of sharp teeth, fitting between each other in the opposite valves, in some species placed in a straight line, and in others in a curved one.

Most of the species lie buried in the sand, a few adhere to rocks by means of a *byssus* or beard.

These have the teeth of the hinge in a straight line, and are oblong in form :—*A. Noæ*, Noah's Ark, a singular looking shell, of a darkish brown colour.. (*P. IV. Fig.* 9.) *A. Imbricata*.. *A. Lactea*.

The following have the teeth in a curved line, and are of a circular form :—*A. Glycymeris*, orbicular ark, found chiefly in the Island of Guernsey.. (*P. IV. Fig.* 2.) *A. Pilosa.*

OSTREA.—Oyster, Scallop, or Pecten.

Valves generally unlike ; with small ears ; hinge without teeth, but having an ovate cavity, in which an elastic cartilage is fixed, and in most species with lateral transverse grooves

This genus is divided into two sub-genera ; the Pecten and the Oyster.

The Pecten or Scallop, is of a circular form, with very distinct ears, and having very regular diverging furrows from the beak to the margin; several of these are equivalve. Their colours are often very brilliant. The fish have, in common with several other testacea, the power of leaping, by suddenly opening and closing their shells, and are provided with a very strong muscle for that purpose, often to be seen in the shells. At times they float on the water, with one shell erected as a sail.

All the species of OYSTER are of very irregular shape, covered with scaly laminæ, with the upper valve small and flat, the other convex; inside pearly white. They scarcely ever move from the spot of rock to which they first adhere.

The British species of the division PECTEN are *O. Maxima*, greater scallop, often eaten; found in great quantities on the coast of Sussex and many other parts. This shell was formerly worn in the hats of pilgrims. *O. Jacobæa*.. *O. Fasciata*, all with equal ears. With unequal ears, *O. Cinnabarica*, red Scallop.. *O. Sinuosa*.. *O. Opercularis*.. *O. Lineata* .. *O. Obsoleta*.. *O. Lævis*.

The following species of OYSTER is well known, and distinguished by its coarse rough valves.—*O. Edulis*, common eatable oyster.

SPONDYLUS.--THORNY OYSTER; OR, ARTICHOKE.

Inequivalve; one valve much flatter than the other; hinge with two recurved teeth.

THE distinguishing mark of this genus is that all the species are covered with spines or ramifications. There are no British species. They generally come from the Indian Ocean. The best known is *S. Gædaropus*, or Thorny red Artichoke.

ANOMIA.--ANCIENT LAMP.

Valves unlike, one flattened and the other considerably convex towards the beak, which turns over the hinge. One of the valves in almost all the species has a hole near the hinge; hinge with a linear projection

on the flat valve, united to a strong ligament on the other valve. The interior often has a silvery appearance. Generally thin and semi-transparent.

The use of the hole is for the fish to protrude part of its body, by which it adheres to various substances, mostly shells of larger animals. The genus is divided into two families, one of which is commonly known by the name Anomia, and bears a very general resemblance to the oyster, and, like it, seldom moves from the spot to which it first adheres. The other family is termed Terebratula, and is distinguished by a very graceful form; no species of this family exists in Britain.

A. Ephippium, wrinkled Anomia, often found adhering to oysters.. (*P. IV. Fig.* 4.) *A. Cepa*, onion Anomia.. *A. Aculeata*.. *A. Undulata*, striated Anomia.

MYTILUS.—Muscle.

Surface rough ; hinge generally toothless, marked with a long furrow, which in some species is waved ; form commonly a long oval ; mostly fixed to rocks and stones by a byssus, or beard of fine filaments, but some species perforate rocks and large massive shells.

M. Edulis, common eatable muscle.. ***M. Pellucidus*** .. ***M. Discors*** .. ***M. Hirundo,*** swallow muscle (*P. III. Fig 7.*) so named from a fancied resemblance to a swallow flying; found chiefly in the west of England.

The following burrows in rocks :—***M. Ambiguus*** .. ***M. Rugosus*** .. ***M. Præcisus*** .. ***M. Lithophagus,*** seldom found in Britain.

PINNA.—Fin or Wing Shell.

Valves alike ; very fragile ; gaping at one end ; furnished with a byssus ; shape approaching a triangle ; a cut towards the beak ; hinge toothless, and the valves united by a long external ligament.

The byssus of this creature is used as a sort of silk, for the sake of which it is caught by the inhabitants of the islands of the Mediterranean sea, where there are some very large species, often two or three feet long.

P. Pectinata, spiny Pinna.. *P. Carnea*, flesh-coloured Pinna. (*P. IV. Fig.* 6.)

III. MULTIVALVES.

PHOLAS.—Stone Borer.

Two primary valves, with several smaller ones situated about the hinge; hinge united by a cartilage, and having a long slender tooth turned back in each valve; open at one end, generally at both.

Some of the shells of this genus are of a brown colour; but the commonest species are white, with the surface beautifully reticulated, looking as if it were covered with fine lace. It is not known by what means the fish makes its habitation, but it is generally found in a hole by itself, bored in limestone, chalk, or wood.

As it grows, it enlarges the cavity inside, but does not alter the opening. It has been conjectured that the process is purely mechanical, effected by the rotary motion of a sort of proboscis; but it seems more likely that it is effected chemically, by a solvent liquid which the animal is provided with. This is perhaps, more probable from the circumstance that a phosphorescent fluid oozes out of its shell, and the phosphorescent fluid of other animals, as the *Acephala*, is known to be corrosive. The *Pholas* is oftenest found at the bottom of chalk cliffs.

P. Dactylus, prickly piercer.. (*P. IV. Fig.* 8.) *P. Candida*, white piercer, which is the commonest of the genus in the south of England.. *P. Crispata*.. *P. Parva*.. *P. Papyracea*, a very thin shell, with one end truncated.

LEPAS.—Barnacle.

More or less of a conical form ; valves erect and unequal, varying in number, but generally six ; affixed to rocks or some other substance.

This genus is divided into two very distinct families, one known as the proper Lepas, the other Belanus.

The Lepas is found united to rocks or to drift wood by a long fleshy *peduncle*, often of a flesh or orange colour, and very flexible. The form of the shell is compressed. They occur in great numbers on the coast of Sussex. The shell of the Balanus is affixed directly to the substance on which it dwells, and some of the species look almost like limpets. The fish of the Lepas and Balanus are very similar, and both are distinguished by a very curious bunch of tentacula or feelers, resembling a curl of hair.

The species of Lepas known on our coasts are *L. Anatifera*, duck Barnacle.. (*P. IV. Fig.* 11.) *L. Scalpellum.. L. Anserifera*, all closely resembling each other.. *L. Sulcata.*

The species of the BALANUS, are *L. Balanus*, acorn shell, the common barnacle.. *L. Balanoides*, smooth barnacle.. *L. Conoides.. L. Elongata.. L. Rugosa*, wrinkled barnacle.. *L. Punctatus.. L. Radiatus*, rayed barnacle.. *L. Striatus.. L. Spongeosa*, spongy barnacle, with a curious appendage at the base, like a small saucer.

CHITON.—COAT OF MAIL.

Several valves, mostly eight, arranged on the back of the animal longitudinally, the margin of one valve resting on the back of the next, connected by an elastic membrane.

THIS genus is so peculiar that it can never be confounded with any other. The animal can roll itself into a ball, like a wood-louse, which, indeed, it considerably resembles. It sometimes remains at the bottom of the sea rolled up, and at other times adheres to rocks.

C. Fascicularis, sometimes found adhering to oysters on the west coast of England.. *C. Punctatus.. C. Albus.. C. Lævis.* None of these are very common.

INDEX

OF

The Common Names of Shells.

The following Table is intended to assist the early progress of the Student of Conchology, by enabling him to find the scientific place of those shells which are most generally known, so as to have acquired a vulgar name. It should be observed that these names are in almost all instances very loosely applied, by those who deal in shells, and other persons who are ignorant of Conchology, to dissimilar species and even to distinct genera; reference to this Index may, therefore, not always prove satisfactory. When the names are more properly applied, many of them are used to designate whole genera; we have distinguished such by printing them in capitals.

Abbot Shell.. *Conus Abbas*
Acorn Shell.. See Barnacle
ANTIQUE LAMP.... ANOMIA
ARK.... ARCA
Ark (Noah's).... A. *Noæ*
ARTICHOKE.... SPONDYLUS
Artichoke (Orange).. . *S. Aurantius*
Artichoke (Thorny Red).... *S. Gædaropus*
Ass's Ear.... *Haliotis Asinina*
Aumer.... *Haliotis Tuberculata*
Awl Shell.... *Bulla Terebellum*

BARNACLE.... LEPAS
Barnacle (common) or Acorn Shell.... *L. Balanus*

Barnacle (Bell-shaped).... *L. Tintinbulum*
Barnacle (Club).... *L. Elongata*
Barnacle (Duck).... *L. Anatifera*
Barnacle (Wrinkled)... *L. Rugosa*
Bean Shell.... *Mytilus Faba*
Bishop Shell.... *Conus Episcopus*
Blackamoor's Tooth.... *Cypræa Europea*
Bleeding Tooth.... *Nerita Peloronta*
Boat Nautilus; or, Boat Shell.... *Argonauta Gondola*
Boat Volute.... *Voluta Navicula*
BORER.... PHOLAS
BUBBLE.... BULLA
Bucket Shell.... *Argonauta Haustrum*

Cat's Foot.... *Ostrea pes felis*
Chinese Bonnet.... *Patella Sinensis*
Chinese Obelisk.... *Murex Obeliscus*
CHITON.... CHITON
CLAM.... CHAMA
Clam (Gigantic).... *C. Gigas*
Clam (Heart).... *C. Cor*

Clam (Spotted, or Bear's Paw).... *C. Hippopus*

CLAW SHELL.... STROMBUS

COCKLE.... CARDIUM

Cockle (Common).... ***Cardium Edule***

Cockle (Prickly).... *C. Echinatum*

Cock's Comb.... ***Ostrea Crista Galli***

CONE.... CONUS

COWRY.... CYPRÆA

Cowry (Mole).... *C. Talpa*

Cowry (Money, or Trussed Fowl)... *C. Moneta*

Cowry (Mouse).... *C. Mus*

Cowry (Nutmeg).... *C. Arabica*

Cowry (Saffron-throated, or Brown-mouthed). *C. Vanelli*

Cowry (Striped).... *C. Zonata*

Cowry (Tortoise Shell).... ***C. Testudinaria***

Cowry (Vetch).... ***C. Cicercula***

Crozier.... *Nautilus Lituus*, or sometimes *Nautilus Spirula*

Cup and Saucer.... *Patella Equestris*

Devil's Claw.... ***Strombus Chiragra***

Diana's Ear.... *Strombus Auris Dianæ*
DIPPER....BULLA

EAR SHELL....HALIOTIS
Ear, several species of VOLUTA and of STROMBUS, are thus called.

FIN SHELL....PINNA
Fool's Cap.... *Patella Ungarica*

GAPER....MYA
Geometrical Stair Case.... *Trochus Perspectivus*
Glory of the Sea.... *Conus Gloria Maris*

Hammer Shell ... *Ostrea Malleus*
Harps; many species of BUCCINUM are termed Harps: the most generally known by the name is *B. Harpa.*
Heart Shell, several species of CARDIUM are so termed
Hedge-Hog Shell.... *Spondylis Histrix*

Helmets; many species of BUCCINUM are so called

HOOF SHELL.... NERITA
Horse Tooth.... *Nerita Plicata*

Judas's Ear.... *Voluta Auris Judæ*

KNEADING TROUGH.... MACTRA
KNIFE HANDLE.... SOLEN

Lamp Shell.... *Anomia Terebratula*
LIMPET.... PATELLA

Magpie Shell.... *Turbo Pica*
Melon Shell.... *Voluta Olla* and *V. Melo*
Midas' Ear.... *Haliotis Midæ*
Midas' Ear Volute.... *Voluta Auris-Midæ*
Mitre Shell.... *Voluta Episcopalis*
Money Shell.... *Cypræa Moneta*
Mulberry Shell.... *Mytilus Morio*
MUSCLE. .. MYTILUS
Music Shell.... *Voluta Musica*

NACRE.... PINNA

Needle, several species of Buccinum and Turbo, of a slender form, are so called.

NERITE.... NERITA

Olive.... *Voluta Oliva.* Several other species of VOLUTA of nearly a cylindrical form are called *Olives.*

Onion Shell.... *Anomia Cepa*

OYSTER.... OSTREA

Oyster (Common).... *Ostrea Edulis*

PAPER NAUTILUS, OR SAILOR.... ARGONAUTA

Parrot's Beak.... *Anomia Psittacea*

PEARLY SAILOR.... NAUTILUS

Pelican's Foot Shell.... *Strombus pes Pelicani*

Periwinkle.... *Turbo Littoreus*

Pewett's Egg.... *Bulla Ampulla*

PIERCER.... PHOLAS

Piercer (Prickly).... *Pholas Dactylis*

Piercer (Paper).... *P. Papyracea*

Poached Egg.... *Bulla Ovum*

Ram's Horn.... *Nautilus Spirula*
RAZOR SHELL.... SOLEN
ROCK SHELL.... MUREX

Satchel Shell.... *Pinna Saccata*
Scallop, one of the sub-genera of OSTREA
Scallop (Great).... *Ostrea Maxima*
Scoop; several species of BUCCINUM, having the aperture very wide, are so called.
SCREW.... TURBO
SEA WING.... PINNA
Sea Nut.... *Bulla Naucum*
SHIP WORM .. TEREDO
SNAIL.... HELIX
Snipe; several species of MUREX, are so called.
Spider Claw Shell ... *Strombus Lambis*
Spider Shell ... *Murex Rota*
Staircase Shell.... *Trochus Perspectivus*
Strawberry Heart ... *Cardium Unedo*
Strawberry Shell ... *Trochus Pharaonis*

Strawberry (White).... *Cardium Fragum*
Sun Shell (Rising).... *Solen Oriens*
Sun Shell (Setting).... *Solen Occidens*
Swallow Shell ... *Mytilus Hirundo*

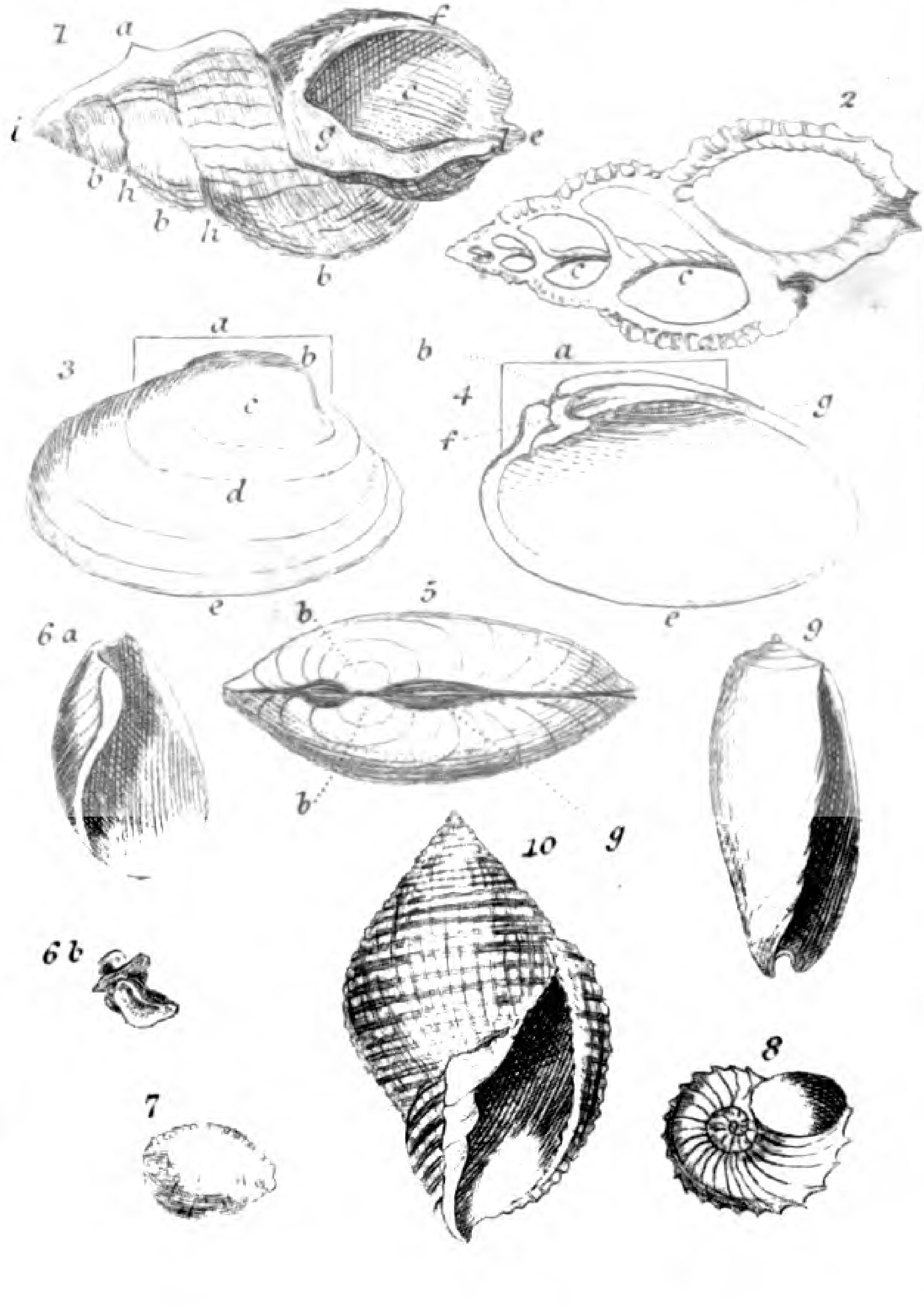
Telescope Shell.... *Trochus Telescopium*
TELLEN.... TELLINA
THORNY OYSTER.... SPONDYLUS. See ARTICHOKE
Thorny Snipe.... *Murex Scolopax*
Thorny Woodcock.... *Murex Tribulus*
TOOTH SHELL.... DENTALIUM
TOP SHELL.... TROCHUS
Tower; several species of MUREX are so designated.
Tower of Babel.... *Murex Babylonius*
Triton.... *Murex Tritonis*
TRUMPET SHELL.... MUREX
Tulip Shell.... *Murex Tulipa*
Tun; many species of BUCCINUM are thus called.
Tun (Ribbed).... *Buccinum Nodosum*

TURBAN SHELL....*Turbo*

VENUS....Venus
Venus' Heart....*Cardium Cardissa*
Venus (Hen)....*V. Gallina*
Venus (Polished)....*V. Erycina*
Venus (Smooth Brown)....*V. Chione*
Venus (Tiger)....*V. Tigrina*
VOLUTE....VOLUTA

WREATH; VOLUTA AND TURBO
Weavers' Shuttle....*Bulla Volva*
WEDGE SHELL....DONAX
Wentle Trap....*Turbo Scalaris*
WHELK; BUCCINUM and some species of MUREX
WING (SEA)....PINNA
WING SHELL....STROMBUS
WORM SHELL....SERPULA

I



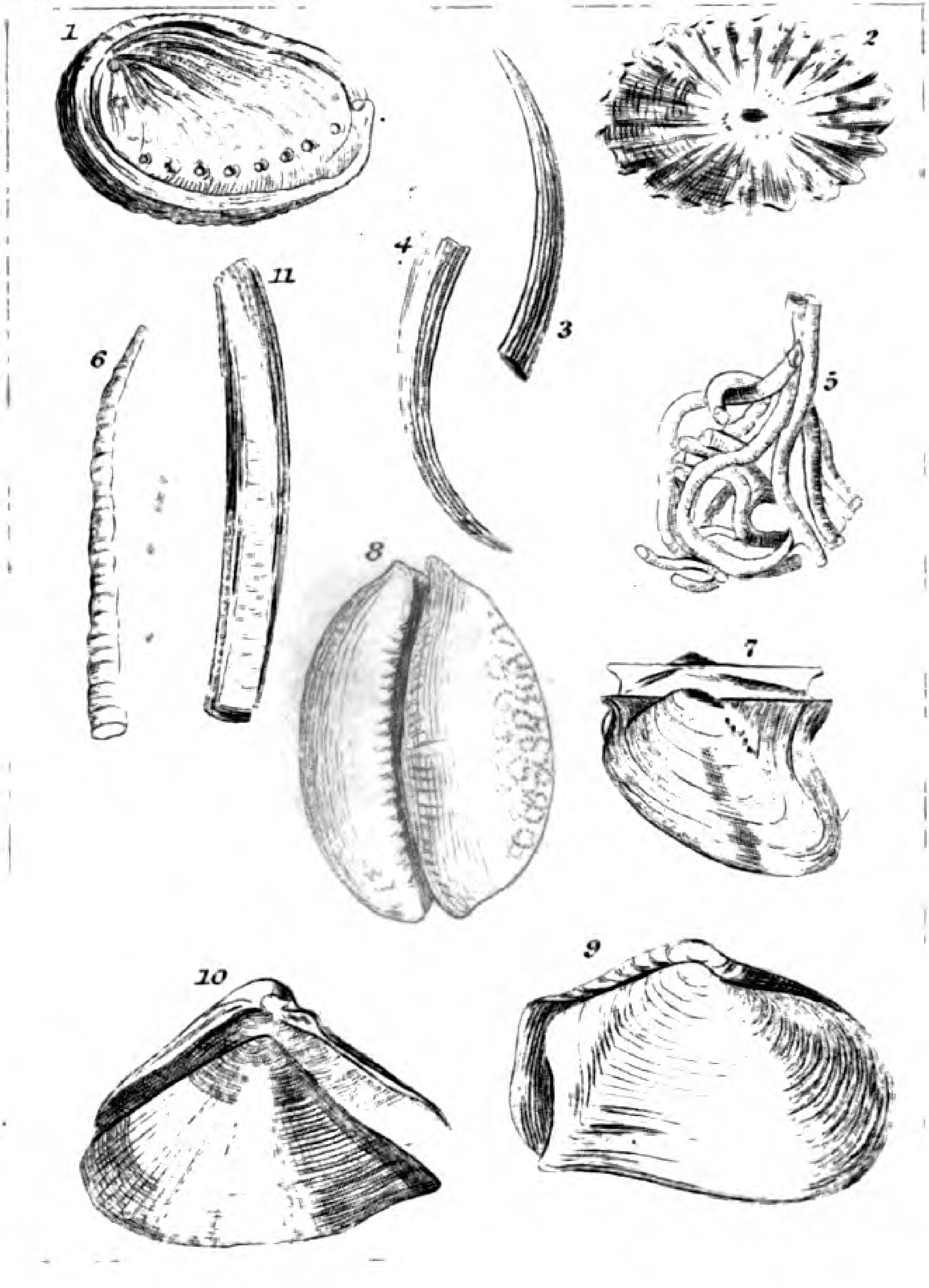
EXPLANATION OF PLATE I.

	ENGLISH NAMES.
1. *Buccinum Undatum* (see P. 16.)	Common Whelk.
2. *Buccinum Undatum* showing the Columella	
3 & 4. *Valves of the Venus Chione* (see p. 6.)	Smooth Brown Venus.
5. *Venus Chione,* showing the hinge and ligament	
6 *a*. *Bulla Lignaria*	Wood Dipper
6 *b*. *Gizzard of the Bulla Lignaria*	
7. *Cypræa Europæa*	Nun Cowry
8. *Nautilus Lacustris*	Fresh Water Nautilus
9. *Voluta Oliva*	Olive Volute
10. *Voluta Cancellata*	Latticed Volute

EXPLANATION OF PLATE II.

	ENGLISH NAMES.
1. *Buccinum Harpa*	The Harp Shell
2. *Buccinum flammeum*	Triangular Helmet
3. *Strombus pes pelicani*	Pelican's Foot
4. *Trochus ziziphinus*	Livid Top Shell
5. *Turbo Scalaris*	Wentle Trap
6. *Murex Ramosus*	Branched Murex
7. *Helix Hortensis*	Garden Snail
8. *Helix Pomatia*	Eatable Snail
9. *Helix planorbis, or Complanata*	Flat Snail
10. *Helix fragilis*	Brittle Snail.

III



EXPLANATION OF PLATE III.

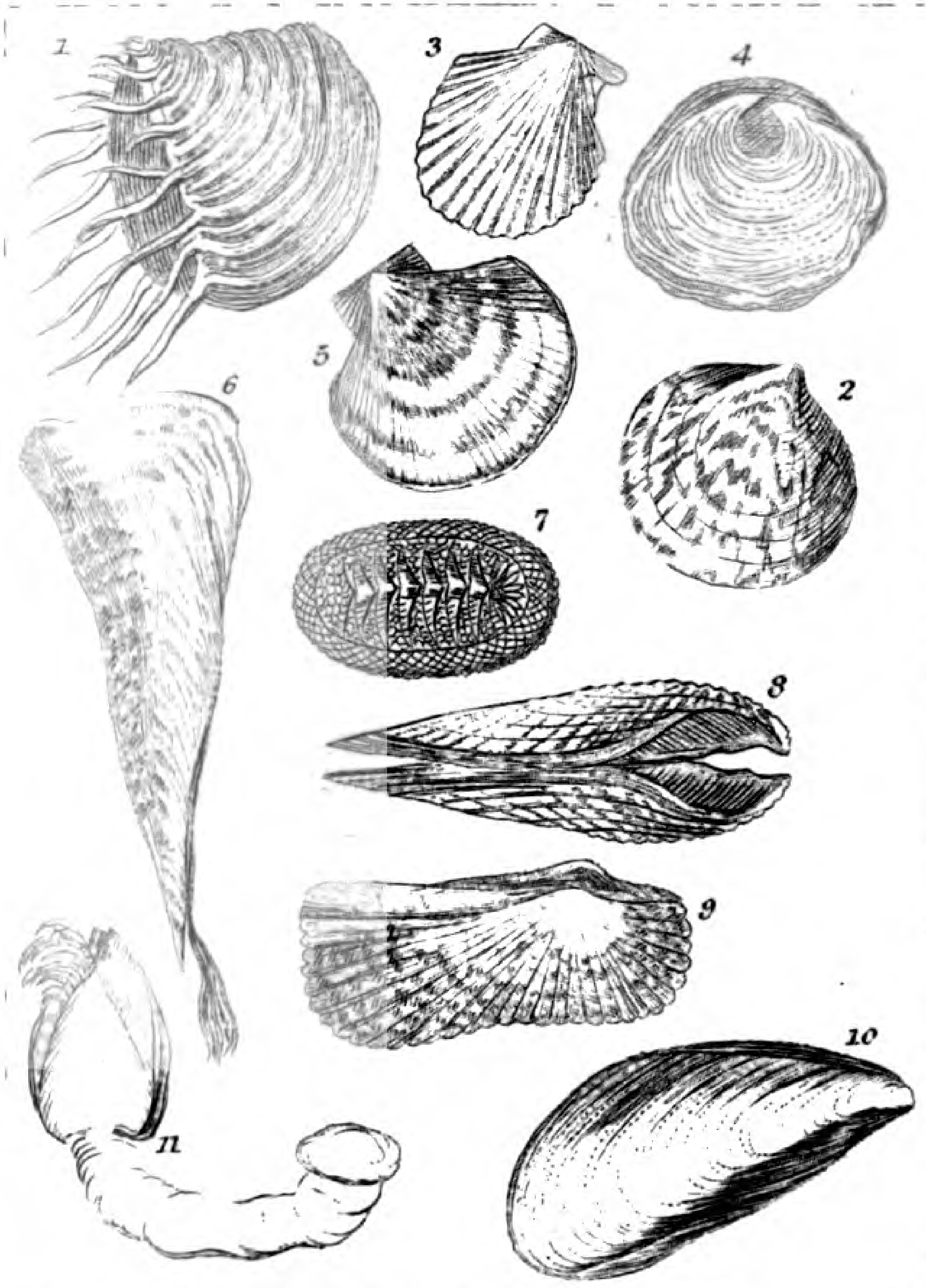
		ENGLISH NAMES.
1.	*Haliotis Tuberculata*	Aumer, or Common Ear Shell
2.	*Patella Nodosa*	Rough Limpet
3 & 4.	*Dentalium Dentalis*	Tooth Shell
5.	*Serpula Vermicularis*	Worm Shell
6.	*Teredo Navalis*	Ship Borer
7.	*Mytilus Hirundo*	Swallow Muscle
8.	*Cypræa Arabica*	Nutmeg Cowry
9.	*Mya Truncata*	Truncated Gaper
10.	*Donax Scortum*	Beaked Donax
11.	*Solen Siliqua*	Pod-like Sheath Shell

EXPLANATION OF PLATE IV.

	ENGLISH NAMES.
1. *Venus Dione*	Spined Venus
2. *Arca Glycymeris*	Circular Ark
3. *Ostrea Varia*	Variegated Scallop
4. *Anomia Ephippium*	Circular Antique Lamp
5. *Ostrea Ziczac*	Zigzag Scallop
6. *Pinna Pectinata*	Spiny Pinna
7. *Chiton Squamosus*	Scaly Chiton
8. *Pholas Dactylus*	Prickly Piercer
9. *Arca Noæ*	Noah's Ark
10. *Mytilus Edulis*	Common Muscle
11. *Lepas Anatifera*	Duck Barnacle

J. MASTERS, ALDERSGATE STREET.

IV



IV

THE LITTLE
MARINE BOTANIST

PRINTED IN COLORS BY GREGORY & COLLINS
16 ST. JAMES STREET CLERKENWELL

PREFACE.

The little attention, comparatively speaking, that has been paid to the character and habits of the different plants included under the term Algæ, and the generally imperfect nature of the attempts at systematic arrangement hitherto made, render it somewhat difficult to exhibit in a small compass any clear and comprehensive view of the plan best adapted for the classification of the various individuals according to their several distinctive genera. The most striking characteristics of the different families have, however, been pointed out in the following pages, as plainly and as concisely as appeared compatible with the nature of the subject.

The system principally followed has been that of Dr. Greville, so elaborately and yet so agreeably laid down in his "*Algæ Britannicæ*," from which work, and from the article on "*Fuci*" in the "Edinburgh Encyclopedia" by Mr. Neill, almost all the remarks contained in this little book have been drawn; and the laborious researches and great practical knowledge of their authors will, it is hoped, render this brief abstract of their more important details not wholly useless to the inexperienced collector of marine plants.

The genera described are confined to those which are found upon the shores of Great Britain and Ireland.

INTRODUCTION.

THE *Algæ*, or *Thalassiophytæ*, (marine plants) are well known in this country by the popular name of *sea-weeds*; but, properly speaking, the Algæ tribe comprehends sea-weeds, lavers, and fresh-water submersed species of similar habits.

Algæ, like land-plants, reach maturity in different spaces of time, and endure for different periods. Many of the smaller and more delicate are annual; others, of the herbaceous kind, seem to be biennial, or, at least, frequently perish at the end of the second season; and many continue for several years, particularly those of woody texture.

Some are so small as to be invisible to the naked eye, except by the appearance which they give to other species on which they happen to be parasitic in immense numbers; others, again, grow to a prodigious length, as *Macrocystis Pyrifera*, which is said to be from 500 to 1500 feet in length.

The rapid growth of some of the large coriaceous kinds throughout the winter is wonderful, for the vegetation of sea-plants is not suspended during the winter like that of land plants. In the bays of this country *Chorda Filum* frequently reaches thirty or forty feet; and in some places, as in Scalpa Flow in Orkney, this is considered as the growth of the summer and autumn months, from May to October.

Some species are coriaceous, often branched, and shrub-like; others are membranaceous, and traversed by a longitudinal nerve or mid-rib; others are filiform—generally not jointed; —they produce receptacles, tubercles or capsules, and most of them are furnished with air-vesicles. All the parts of sea-plants are of much more uniform texture than those of land-plants in general, most of them seeming to be capable of changing into others—the *peduncle* becoming a *branch*, the *air-vesicle* a *frond*, and so on. Some suppose that they are composed entirely of *cellular tissue*, which is an assemblage of vesicles from the one-thousandth to the one-thirtieth of an inch in diameter, generally colourless and semi-transparent, and whose rapid developement is one of the most surprising phenomena in nature.

GENERAL STRUCTURE, &c.

ROOT. All those Algæ destined to resist the force and agitation of stormy seas have roots peculiarly adapted to take the firmest hold of the rocks, which they grapple by means of tough and thick fibres. Other species of shorter duration, or presenting less surface to be acted on by the waves, are generally fixed by a simple shield-like base or *disc*. It is not believed that submersed Algæ derive much of their nourishment from the processes by which they are attached to rocks or other substances, although these processes in many instances resemble roots, and usually receive that name. They adhere to rocks of mica-slate, green-stone, basalt, sand-stone, and lime-stone; and many of the smaller kinds grow on the stems of the larger plants. Although the root-like processes would seem to be not *merely* intended for fixing the plants, but to a certain degree useful as organs of nutrition, from the fact of some species seeming peculiar to chalk, some to sandstone, &c., yet at least one species, *Sargassum Bacciferum,* has never been found with any root or base, but it evidently lives and increases while floating about.

FROND. This is generally analogous to the leaf of a land-plant, but often includes the whole of a sea-weed except the root. The frond varies greatly in structure and form in different genera and species, as may be seen by a reference to the following list, which is, however, inadequate to afford much notion of the appearance of the various plants which can only be obtained by practical observation. The colour likewise is very various, and is generally fugitive in the annuals; but when there is reason to believe it has been changed by exposure to air or rains, the original colour may often be detected by holding the specimen up against a strong light.

FRUCTIFICATION. This is not yet perfectly understood, from the difficulty of procuring specimens in all stages of their growth. It appears to consist of tubercles contained in distinct receptacles, or imbedded in the frond, or on its surface, and containing dark coloured seeds or *sporules*. Sometimes the fructification forms *sori*, or spots on the frond. The seeds must be very minute, appearing to abound imperceptibly in the sea, as the impalpable seeds of *fungi*, *musci*, and *lichens*, do in the air. In judging whether sea-weeds are annual or perennial, it may be useful to know that the former generally have the fructification at the *tips* of the *fronds*, while it exists on the *branches* of the latter. The smaller and more delicate sea-weeds produce their fruit in the beginning of autumn, while the larger and coarser species prefer, for this purpose, the stormy months of winter.

AIR VESICLES. No part of the structure of sea-weeds has more generally attracted notice than the inflated portions of the stem or frond resembling bladders, seen in many species, and particularly conspicuous in the well-known *Fucus Vesiculosus* and *Fucus Nodosus*. They are now generally denominated *air-vesicles*, or simply *vesicles*. It is supposed that none are entirely, and at all times, destitute of them. They were for a long time considered as destined merely to give buoyancy to the plant, but it is now believed that they serve a more important purpose in the economy of sea-weeds—acting as respiratory organs to contain and decompose the atmospheric air, on which marine plants are supposed to exert the same action as those on land, absorbing oxygen during the night, and giving it out during the day. However, air-vesicles are by no means otherwise useless, for they support large floating Algæ in the water, especially *M. Pyrifera*, whose immense length could never be sustained, the stem being not thicker than the finger, and the upper branches as slender as common pack-thread, were not a vesicle, filled with air, placed at the base of each long and narrow leaf.

Among the Romans Algæ were proverbially useless, and anything utterly worthless was compared to them; but in modern times they have become valuable, and serviceable in many respects. To the agriculturist they furnish a most important manure, and to the glass-blower and soap-boiler yield *kelp*, which is a very impure carbonate of soda,* and consists of the ashes of burnt sea-weeds, particularly those of the *Fuci Vesiculosus*, *Nodosus*, and *Serratus*. The manufacture of kelp has become a valuable source of revenue to the proprietors of the rocky shores of Europe, especially of Britain, and, above all, in the

* Although soda is a vegetable product, yet, as it is procured from plants growing near the sea, it is most probably formed by the decomposition of the salt or muriate of soda, which, by some chemical process carried on in the plant, is converted into carbonate of soda.

northern and western isles of Scotland. Of such importance has this manufacture appeared, that in some places attempts have been made, and not without success, to *cultivate* the fuci. In the Orkney Isles alone 20,000 hands are furnished with employment in the kelp season. Either from the ashes of the plants, or from kelp, the chemist also obtains the very curious elementary substance named *Iodine* (from the violet coloured gas which it yields on exposure to increased temperature), so useful in medical cases, particularly in the cure of *goître*. Some of the smaller Algæ yield various condiments, or afford fresh salads, while others are employed medicinally. From a few of them substances useful in the arts are procured: one species, but not a British one, *Fucus Tenax*, is invaluable as a glue and varnish to the Chinese, who employ it as we do glue and gum arabic, and chiefly in the manufacture of lanterns to strengthen or varnish the paper, and sometimes to thicken or give a gloss to gauze or silk. The quantity annually imported at Canton, from two provinces, is 27,000 lbs. The great collections of floating sea-weeds are not without their use in the economy of nature, for they afford both food and shelter to myriads of fishes and mollusca, and probably tend, by giving forth oxygen, to maintain the wholesome purity of the sea. To the mariner the young and most succulent shoots of *Fucus Natans* offer an acceptable salad, or they are prepared as a pickle like samphire. With the more delicate and elegant species ornamental pictures are constructed. The number of known species has been supposed to be about 1600, but this has been said to be considerably exaggerated. Amongst those known, 148 species belong to France, where the Algæ have never been without admirers. The *Florideæ* are predominant over the *Ulvaceæ*, and these again over the *Dictyoteæ*.

Notwithstanding the many observations of late inquirers, in no department of Natural History does there remain greater room for discovery than in tracing the progress of living Algæ. The *habitat* of the plants presents many difficulties, for only in a few favourable situations, in calm weather and at ebb tide, can observations be made; and yet, to afford any satisfactory information, individual plants must be watched, visited at every season of the year, and the observations must be continued for a series of years. It is therefore extremely difficult to distinguish and arrange the various Algæ; and still more so from their organization being more simple than that of land plants, and consequently exhibiting fewer distinctive characters. Those best able to delineate their natures are often situated at a distance, and must describe from the examination of specimens not always judiciously selected by others; frequently from such as are torn from the rocks and thrown ashore in storms, when the root, or means of attachment, is generally wanting. The characters therefore of many Algæ are yet but imperfectly understood.

THE ALGÆ ARE DIVIDED INTO TWELVE ORDERS.

1. FUCOIDEÆ . .	containing	14 genera
2. LICHINEÆ . . .	,,	1 genus
3. LAMINARIEÆ .	,,	7 genera
4. SPOROCHNIDEÆ .	,,	3 genera
5. CHORDARIEÆ .	,,	1 genus
6. DICTYOTEÆ . .	,,	10 genera
7. FURCELLARIEÆ	,,	1 genus
8. SPONGIOCARPEÆ	,,	1 genus
9. FLORIDEÆ . .	,,	33 genera
10. GASTROCARPEÆ	,,	4 genera
11. ULVACEÆ . .	,,	8 genera
12. SIPHONEÆ . .	,,	4 genera

THE LITTLE MARINE BOTANIST.

ORDER I. FUCOIDEÆ.

FOURTEEN GENERA.

Sargassum, Turbinaria, Carpophyllum, Cystoseira, Halidrys, Carpodesmia, Seirococcus, Scytothalia, Coccophora, Fucus, Hymanthalia, Moniliformia, Splachnidium, Polyphacum, Scaberia.

PLANTS, all marine, of an olive-brown or olive-green colour, becoming black on exposure ; of a firm coriaceous or ligneous substance, and fibrous texture. Frond, with a hard scutate root, and furnished in many species with distinct leaves. Vesicles or air-vessels, generally present, and are either uniform dilatations of particular parts, or distinct bodies supported on little stalks. Fructification, tubercles contained in distinct receptacles, or imbedded in the frond.

SARGASSUM—floating on the ocean.

Gen. Char. Frond, leaved. Leaves, stalked, with a mid-rib. Air-vessels, simple, axillary, stalked. Growing to the length of from one to four feet.

This is a very extensive genus, and entirely exotic, being nearly confined to the tropics ; two species have been sometimes wafted on the Orkney shores. *S. Vulgare. S. Bacciferum.* These sea-weeds are met with by all navigators, and called *gulf-weed ;* in the Atlantic ocean they occur in such prodigious quantities as to appear like a boundless floating meadow, and actually to impede the progress of ships. They are eaten as salad in the East. The Red Sea is full of Sargassa.

CYSTOSEIRA—chain of air-vessels.

GEN. CHAR. Frond, varying from one to three feet long, furnished with branch-like leaves. Air-vessels, simple, arranged consecutively within the substance of the leaves. Perennial. Found on the south-western coasts of England.

C. Ericoides; this plant appears very beautiful when growing beneath the water from the glaucous, prismatic tints which it reflects. *C. Granulata*; rare. *C. Barbata*; exotic. *C. Fœniculacea*. *C. Fibrosa*; distinguished by its large vesicles and bushy frond.

HALIDRYS—tree in the sea.

GEN. CHAR. Frond, compressed, linear, pinnated with distichous branches. Air-vessels, stalked. Perennial. Common on almost every part of the British coast.

Only one species. *H. Siliquosa*; known in Norway as *knop-tang*. From one to four feet long.

FUCUS—paint, dye, or sea-weed.

This name was applied by Linnæus to every plant not included in his "*Ulva*" and "*Conferva*," and is supposed to be derived from the property possessed by some small red fuci of yielding a sort of rouge.

GEN. CHAR. Frond, plane, compressed or cylindrical, linear, dichotomous, varying in size from three inches to six feet. Air-vessels, when present, within the frond, simple and large. Perennial.

F. Vesiculosus; very common every where, grows very thickly. Known in England as *sea-ware*, or *sea-wrack;* in Scotland as *kelp-ware*, and *black-tang*. It is there most abundant and valuable, and is cultivated for many purposes, especially for the manufacture of kelp or pot-ash, for the use of soap and glass makers; the ashes contain half their weight of alkaline salt. *F. Ceranoides*. *F. Serratus;* a handsome species; abounds at

Sidmouth. The Norwegians feed cattle with it. *F. Nodosus;* conspicuous by its large yellow receptacles; is known in some parts by the name of *sea-whistle,* and is valuable in making kelp. *F. Mackaii;* Scotland and Ireland. *F. Canaliculatus;* very common, grows on rocks within reach of the tide. *F. Tuberculatus;* rare. None of these species adhere to paper in drying.

HYMANTHALIA—sea-thongs.

GEN. CHAR. Frond, orbicular. No vesicles. Common on most parts of the British coast.

Only one species, *H. Lorea.* The appearance is peculiar, the long and narrow receptacles rising from the centre of the frond to the height of several feet, and greatly resembling a set of leathern thongs.

ORDER II. LICHINEÆ.

ONE GENUS.

Lichina.

Plants, marine, of a blackish green colour, changing on exposure to deep black. Of a cartilaginous substance, and fibrous structure.

LICHINA—resembling a Lichen.

GEN. CHAR. Frond, flat or cylindrical, minute, branched in a dichotomous, or sub-palmate manner; densely tufted, growing to the height of about half-an-inch. Fructification, terminal or nearly so, composed of capsules. Perennial. Very abundant on the rocks in the south-west of England, near the sea shore.

This is a very curious genus, bordering closely on the Lichens in habit. Contains only two species.— *L. Pygmea*, on every part of the British coast; *L. Confinis*, more scarce.

ORDER III. LAMINARIEÆ.

SEVEN GENERA.

Durvillæa, Lessonia, Macrocystis, Laminaria, Agarum, Alaria, Costaria.

Plants, all marine, of an olive-brown or olive-green colour; varying from coriaceous to membranaceous. Structure, densely fibro-so-cellular, without any appearance of reticulation. Frond, with a lobed or fibrous root, more or less stipitate, and forming a plane, entire or cleft, expansion. Vesicles, none, except in the genus *Macrocystis.* Fructification, dense spreading spots or sori on the surface of some part of the frond. Varying from two inches to several feet in height.

The largest known Algæ belong to this family, and they are fixed to the rocks by a more powerful apparatus than the simple scutate base of the *Fucoideæ.* By means of thick clasping fibres they take so firm a hold as to resist the force of the waves, and even specimens of a very moderate size cannot be wrenched from their situation by the utmost efforts of the botanist.

ALARIA—winged.

GEN. CHAR. The stem is pinnated with fertile leaflets between the root and the frond, hence the name of this genus. The surface scattered over with minute pores. Generally in deep water. Annual. The frond is long and narrow; the stem continued as a mid-rib, and grows from the length of three to that of twenty feet. Leaflets from two to seven inches.

A. Esculenta. Abundant on the coast of Newfoundland, where it resembles the leaves of the plaintain. Parts of the plant are eaten in Scotland and Ireland. It also bears the names of ***murlins*** and ***honey-ware***.

LAMINARIA—a thin plate or substance.

GEN. CHAR. Frond, expanded without a

mid-rib. Fructification, obscure. Most species perennial. Growing in deep water and very common. Does not generally adhere to paper in drying.

L. Digitata. The flat frond is cut into segments, and rudely resembles a many-fingered hand. Stem, one to six feet in height. In England, where it is used extensively as manure, it is called *sea girdles.* Eaten in Scotland under the name of *tangle, red-ware,* or *sea-wand;* there also knife handles, scarcely to be distinguished from hart's-horn, are made from the stem. *L. Bulbosa;* frond, reniform, distinguished by a large bulb, which, forming at the base of the stem, finally incloses the root; and putting forth powerful radicles from every part, becomes a more efficient support for the enormous frond. This plant grows to an immense size, one being a sufficient load for a man's shoulders. It is in England called *sea-furbelows,* and *furbelowed hangers. L. Latifolia; L. Saccharina,* *sea-belt* in England, derives its specific name from the sweetish impression left upon the palate by the salt upon its surface. *L. Phyllitis;* frond, lanceolate, pale green, transparent, and beautiful. *L. Debilis;* fronds, tufted, very small. Some gigantic plants belong to this genus; *L. Buccinalis,* or *trumpet-weed* of the Cape of Good Hope, has a long hollow stem, which the country people convert into a kind of horn or trumpet. *L. Pototorum,* of New Holland, is of such a size and firmness that the natives manufacture vessels from the frond, for the purpose of carrying water.

ORDER IV. SPOROCHNIDEÆ.

THREE GENERA.

Desmarestia, Dichloria, Sporochnus.

Plants, all marine, of an olivaceous or yellowish green colour, not changing in drying. Of a cartilagino-membranaceous substance, becoming flaccid on exposure. Frond, with a scutate root, and flat compressed or cylindrical branches; and bearing in most species, at some period of their growth, little pencil-like deciduous tufts of fine green filaments. Fructification not certainly known.

DESMARESTIA—

Dedicated to Prof. Desmarest.

GEN. CHAR. Frond, plane or compressed, distichously branched; the branches set with marginal spines. Common on the British shores. From one to six feet long.

D. Ligulata. Annual; a beautiful plant. *D. Aculeata.* Perennial. It is hardly possible to conceive a more beautiful object than this plant, waving its young and delicately feathered branches in the water. When thus gathered however it possesses, in common with the following genus, the singular property of changing to a verdigris green, and decomposing most other Algæ placed near it.

DICHLORIA—two, (and the colour) green.

This generic name alludes to the singular change of hue common to the various species.

GEN. CHAR. Frond, pinnated, with opposite branches; from two to three feet long, and beautifully feathery. Fructification unknown. Colour while growing olivaceous, changing to verdigris green on removal from the water, and resuming the pristine hue on being dried. Does not adhere to paper.

Only one species, *D. Viridis.*

SPOROCHNUS.

GEN. CHAR. Frond, filiform. Fructification contained in scattered warts, or distinct in stalked receptacles. Annual. Adheres to paper in drying. Not uncommon on the southern and western shores.

S. Pedunculatus—S. Villosus. It is said that this species when freshly spread upon paper renders it transparent, as if touched with oil, which appearance however subsides. *S. Rhizodes*, attached to other Algæ.

ORDER V. CHORDARIEÆ.

ONE GENUS.

Chordaria.

Plants, all marine, of an olive-green colour, becoming darker on exposure to the air. Of a cartilaginous and lubricous substance. Root, scutate. Frond, continuous, cylindrical, filiform, composed of a solid cellular centre, and a dense exterior mass of concentrical filaments. Fructification imperfectly known.

CHORDARIA—a cord or string.

GEN. CHAR. Frond, six inches to six feet in length, not thicker than very fine twine, furnished with a stem which divides at a certain point abruptly into branches, more or less numerous, commencing near the root.

The only British species is *C. Flagelliformis*, known in some parts of the country as *whip-cord fucus*. The singular structure of this plant removes it from all other orders. It is composed, outwardly, of a mass of concentrical club-shaped filaments.

ORDER VI. DICTYOTEÆ.

TEN GENERA.

Chorda, Asperococcus, Stilophora, Punctaria, Striaria, Dictyosiphon, Dictyota, Cutleria, Padina, Halyseris.

Plants, all marine, of an olive-green colour, not changing on exposure. Of a membranaceous flexible substance, and reticulated structure. Root, either naked and scutate, or composed of a mass of woolly filaments. Frond, cylindrical or flat, thin, entire or divided, often flabelliform. Fructification, seeds enveloped in a pellucid case, covering the surface or scattered, forming minute spots or transverse lines.

CHORDA—cord or string.

GEN. CHAR. Fronds, filiform; several from the same base and hollow. Annual.

C. Filum is very common on the British and Irish shores. Fronds, from one to twenty feet long, and about half-an-inch in diameter; cylindrical, the whole frond twisted spirally from the base to the apex. It is used as food for cattle in Norway. *C. Lomentaria*, from three to sixteen inches long. The appearance of this species is very similar to that of the intestines of an animal tied at certain intervals.

ASPEROCOCCUS—(from its) rough surface.

GEN. CHAR. Frond, tubular and cylindrical. Fructification, distinct spots composed of imbedded seeds, mixed with erect club-shaped filaments. Annual.

A. Echinatus, on rocks and stones in the sea. From two inches to two feet in length. Common on British coasts. *A. Bullosus*, on rocks and stems of Algæ. Fronds from one to three inches in length. A rare species; not easily discernible under the water from the light colour of its thin, transparent, tubular fronds, which are filled with water.

PUNCTARIA—dot or minute spot.

The generic name is derived from the dotted appearance given by the fructification to the frond.

GEN. CHAR. Frond, simple and flat, composed of an interlacing of longitudinal transverse filaments, covered by a membrane; grows from two to eight inches high. Fructification, scattered over the whole frond in distinct spots. Annual. On rocks and other Algæ. Adheres to paper. Not uncommon on the coasts.

P. Latifolia. P. Plantaginea. P. Tenuissima. Very delicate, and reddish green colour.

STRIARIA.

GEN. CHAR. Frond, filiform, tubular, branched. Fructification forms transverse lines.

S. Attenuata, in the sea, on various Algæ. Annual. Isle of Bute. From three to twelve inches high, and very tender.

DICTYOSIPHON—net-work and tube.

GEN. CHAR. Frond, filiform, tubular, and reticulated.

D. Fæniculaceus is parasitic upon *Chorda Filum*, &c., found on the northern shores. Frond, capillary, universally branched.

DICTYOTA—net-work.

GEN. CHAR. Frond, flat, highly reticulated; from three to twelve inches long; dichotomous, or irregularly cleft. Root, a mass of woolly filaments. Fructification, prominent seeds on both sides of the frond. Annual. Adheres to paper in drying.

D. Dichotoma. Parasitic upon various Algæ, common on most parts of the British coast. *D. Atomaria*, on rocks; a beautiful plant.

CUTLERIA—dedicated to Miss Cutler.

GEN. CHAR. Frond, irregularly cleft. Fructification, minute tufts of capsules, supported on long slender stalks.

C. Multifida. Annual. Very rare. Found at Yarmouth. Adheres. The capsule of this plant is a beautiful object under the microscope.

PADINA.

GEN. CHAR. Frond, flabelliform, mostly undivided; marked with concentric lines. Attached to rocks in the sea. Annual. Adheres imperfectly.

P. Pavonia, a singular and beautiful plant; the margin of the frond is revolute and fringed with filaments, which sometimes decompose, as by a prism, the rays of light. It is also elegantly marked with concentrical zones one to two lines apart, and is generally covered with a white pulverulent substance. *P. Parvula*, deeply lobed.

HALYSERIS—sea-endive.

GEN. CHAR. Frond, flat, linear, with a mid-rib.

H. Polypodioides, on rocks, and larger Algæ. Biennial. The frond is marked with lines resembling those on a map. The odour of the plant, when freshly gathered, is extremely powerful and disagreeable.

ORDER VII. FURCELLARIEÆ.

ONE GENUS.

Furcellaria.

Plants, marine, of a dull, dark purplish or brownish red colour, changing to black on exposure to the air. Substance cartilaginous. Structure, cellular, with a dense coloured stratum of horizontal filaments forming the circumference. Root, creeping. Frond, cylindrical, filiform, dichotomous. Fructification, terminal, composed of pod-like indehiscent receptacles.

FURCELLARIA—from the form of the receptacles.

GEN. CHAR. Fronds, tufted, very numerous, filiform, dichotomous, three to nine inches high. Root, creeping, composed of entangled pale pink fibres.

F. Fastigiata, on rocks in the sea. Extremely common. Does not adhere to paper.

ORDER VIII. SPONGIOCARPEÆ.

ONE GENUS.

POLYIDES—many forms.

This name is scarcely applicable to this constant plant, which is a very distinct genus from its spongy wart-like fructification.

Plants, marine, of a dull, dark reddish colour, changing to nearly black on exposure to the air; cartilaginous substance, and cellular structure. Root, scutate. Frond, filiform, cylindrical, and dichotomous. Fructification, uniform, consisting of naked spongy warts.

P. Rotundus, found on many parts of the British coast, on rocks in the sea. Perennial. Fronds, tufted and numerous, from three to nine inches high.

ORDER IX. FLORIDEÆ.

THIRTY-THREE GENERA.

Claudea, Amansia, Delesseria, Nitophyllum, Hymenena, Rhodomenia, Botryocarpa, Thamnophora, Plocamium, Microcladia, Odonthalia, Dictyomenia, Rhodomela, Alsidium, Bonnemaisonia, Laurencia, Gastridium, Corallopsis, Acanthophora, Gracilaria, Chondrus, Phyllophora, Sphærococcus, Bowiesia, Gelidium, Gigartina, Grateloupia, Hypnea, Chætosphora, Philota, Dasia, Champia, Digenia.

Plants, all marine, of a purplish, reddish, or fine rose colour, seldom changing much by exposure to the air; of a coriaceous, cartilaginous, or membranaceous substance, and cellular texture, often reticulated. Frond, flat, compressed or cylindrical, with or without a mid-rib, sometimes furnished with distinct leaves or foliaceous expansions. Fructification, often of two kinds; the first spherical or hemispherical capsules, sessile or stalked; the second composed of granules scattered or collected into little spots (*sori*) or lines, and situated either in the general substance of the frond, or in little leaflets, or distinct pod-like foliaceous processes.*

DELESSERIA—dedicated to Baron B. Delessert.

GEN. CHAR. Frond, rose-red, flat, with a percurrent mid-rib, generally two to twelve inches long. Adheres if much pressed. Common on the British and Irish coasts.

D. Sanguinea. Stem branched with leaves. This is an exceedingly beautiful and delicate species. *D. Sinuosa*, particularly fine in Ire-

* The fructification will be understood to be of both these natures henceforth in varieties of the same species when spoken of as "of two kinds."

land. *D. Alata. D. Hypoglossum;* small and elegant, common on the British coast. *D. Ruscifolia;* more scarce.

NITOPHYLLUM—a shining leaf.

GEN. CHAR. Frond, reticulated, wholly without veins and mid-rib, rose-coloured. Fructification, forming distinct scattered spots on the frond. Annual.

The plants forming this genus are remarkable by their extreme delicacy and tenuity, their beautifully reticulated structure, and their transparency. Most, when dried, appear varnished. Fronds from two to nine inches in length, variously cleft in the several species. Often adhering to other Algæ. Not common. *N. Ocellatum. N. Punctatum. N. Hilliæ. N. Bonnemaisoni. N. Gmelini.* Very fine in Ireland. *N. Laceratum;* the whole frond has the power of attaching itself by its edges, and creeping, as it were, upon the rocks and plants in its way. Adhesive.

RHODOMENIA—red membrane.

GEN. CHAR. Frond, plane, membranaceous, fine pink or red; quite veinless; sessile, or with a short stem, which expands immediately into the frond. Fructification, contained in capsules, or spread over the frond. Annual, or biennial. Generally on rocks, or larger Algæ. Fronds, varying from one to twelve inches. Adhering imperfectly.

R. Bifida. R. Laciniata. R. Polycarpa. R. Palmetta. R. Cristata. R. Ciliata. R. Jubata. R. Palmata; extremely common. More generally an article of food, both for men and cattle, than *Iridea Edulis.* Cried about Edinburgh under the name of *dulse;* called by Highlanders, *duillisg,* (*leaf of the water*)*;* by the Irish, *dillesk.* The Scotch and Irish wash the plant in fresh water, dry it in the sun, and, rolling it up, chew it like tobacco; but it is usually eaten fresh from the sea. The Icelanders, after drying it, pack it down in casks for occasional consumption ; and it is then ready to be eaten, either raw with fish and butter, or boiled with milk, to which is sometimes added a little rye-flour. In Norway it is called *sou-söll*, or *sheep's-weed ;* sheep being exceedingly fond of it, and frequenting the sea-shore at ebb-tide in order to obtain it. It is used medicinally, in fevers, in the Isle of Skye ; and is a favourite ingredient in ragouts, in the Islands of the Archipelago, to which it imparts a red colour, besides rendering them of a thicker and richer consistence. The dried frond, like many other marine Algæ, when infused in water, exhales an odour resembling that of violets, and is said to communicate that flavour to vegetables with which it is mixed. *R. Sobolifera. R. Teedii,* is a very charming plant, often beautifully variegated with green, pink, and pale purple.

PLOCAMIUM—head of hair.

GEN. CHAR. Frond, filiform, compressed, much branched; branches, distichous; a very beautiful red, between scarlet and crimson. Fructification, of two kinds. Perennial.

The only known species, *P. Coccineum*, is one of the most charming and symmetrical Algæ in the world; extremely common everywhere, and an universal favourite. Although liable to vary very considerably in size, and in the proportion of its parts, a single glance at the beautifully regular and peculiar division of the ultimate branches is at all times sufficient to distinguish it. Some specimens are not above an inch in length, with the frond almost as fine as a hair; while others, from New Holland, are a line in width, and above a foot long, but the admirable character above mentioned is universally preserved. When dexterously expanded on very smooth white paper, or on the glossy interior of large flat shells, the effect is very beautiful.

MICROCLADIA—finely branched.

GEN. CHAR. Frond, filiform, compressed, irregularly branched; branches, distichous. Fructification, of two kinds.

M. Glandulosa, a beautiful, but extremely rare plant; two or three inches long; a pink-red colour. Parasitic. Annual. Adheres imperfectly.

ODONTHALIA—a tooth (and) *the sea.*

GEN. CHAR. Frond, plane; dark vinous red; with an imperfect mid-rib, and dentate margin. Fructification, of two kinds.

O. Dentata. Very beautiful; grows on rocks in the sea. Confined, in Britain, to the northern shores. Frond, three to ten inches long. Perennial. Adheres imperfectly. The urceolate capsules on the frond (which is one species of fructification) appear very curious when viewed with the microscope.

RHODOMELA—changing from red to black.

Gen. Char. Frond, cylindrical or compressed, filiform, much branched. Fructification, of two kinds. On rocks and other Algæ.

This genus changes colour on exposure—hence its name. *R. Lycopodioides*; a northern species. Fronds, tufted: from two to twenty inches. Perennial. Presents a very different appearance during the winter, to its beautiful feathery summer state. *R. Subfusca*; changes still more entirely during the winter. *R. Pinastroides*; not uncommon in Sussex. Covered, during the winter months, with shortly stalked yellow bodies; probably of an animal nature. *R. Scorpioides.*

BONNEMAISONIA—in honour of M. Bonnemaison.

Gen. Char. Frond, compressed or plane, filiform, much branched; from six to nine inches long.

B. Asparagoides; on rocks and stones in the sea. Very rare. An extremely elegant and beautiful plant. Colour, a pale transparent crimson. Annual.

LAURENCIA—in honour of M. De Lalaurencie.

GEN. CHAR. Frond, filiform; yellowish, or purplish red. Varying from one to fourteen inches. Fructification, of two kinds. Annual. On rocks in the sea, or larger Algæ. Adhesive.

L. Pinnatifida; extremely common. The varieties of this species often assume very different forms. Sometimes it tastes hot and biting, and is eaten in Scotland as *pepper-dulse*. *L. Obtusa, L. Dasyphylla, L. Tenuissima,* is rare; confined in this island to the south-western shores.

GASTRIDIUM—from the plants being turgid with fluid.

GEN. CHAR. Frond, cylindrical, filiform, (often contracted as if jointed) of a pinky red colour. Fructification, either contained in capsules, or imbedded. In the sea, on rocks, and other Algæ. Annual. Fronds, varying from three to eighteen inches in height. Adhesive.

G. Clavellosum. G. Ovale. G. Kaliforme. G. Parvulum. G. Articulatum. These are not unfrequent on British coasts.

GRACILARIA—slender.

Gen. Char. Frond, filiform, cylindrical, or compressed; of a dull red colour. Fructification, imbedded, or in capsules. Fronds, varying in the different species from two inches to two feet.

G. Purpurascens. Annual. Frequently found on rocks and other Algæ, around which the branches twist themselves by capillary tendrils, in which they occasionally terminate. *G. Confervoides.* Perennial. A white wart-like excrescence is sometimes found on this species. *G. Erecta.* Two inches high. Always found growing on the nearly level bottoms of shallow pools, left by the recess of the tide, and generally half immersed in sand. *G. Compressa.* A newly-discovered species; is a fine, and not uncommon plant. Annual. Has proved excellent both as a pickle and preserve. *G. Lichenoides* is highly valued for food in Ceylon, and other parts of the East, and bears a great resemblance to *G. Compressa,* to which it seems but little superior.

CHONDRUS—cartilage.

GEN. CHAR. Stem, cartilaginous, dilating upwards into a flat, nerveless, dichotomously divided frond; of a purplish, or livid red colour; varying from three to twelve inches, and tufted. Fructification, subspherical capsules in the surface of the frond.

C. Mamillosus is common on the British and Irish coasts. The frond often presents a very peculiar appearance, from the number of capsules covering it. *C. Crispus.* Very common on every part of the British coast, where rocks are present. This is called the Proteus of Marine Algæ, the varieties being innumerable; and passing so insensibly one into the other, that it is almost impossible to define them. When fully ripe the capsules fall away, leaving the frond full of holes. It is used in Ireland as size for house-painters; and under the name of *Carrageen Moss* is often boiled in milk, when it makes a very nice blanc-mange.

PHYLLOPHORA--leaf-bearing.

GEN. CHAR. Frond, of a purple or red colour, plane, proliferous from the disk, and furnished with a more or less imperfect mid-rib. Fructification, of two kinds. Perennial.

P. Rubens; on rocks and stones in the sea. Very common on English coasts. Fronds, tufted; three to nine inches long; it is sometimes linear, sometimes wedge-shaped. Non-adhesive. It is impossible to confound this species with any other British plant, the proliferous manner of growth being universally present, except in very young plants.

SPHŒROCOCCUS.

GEN. CHAR. Frond, compressed, two-edged, linear, distichously branched. Fructification, distinct capsules.

S. Coronopifolius. Biennial. Isle of Wight and Cornwall, &c. &c. Frond, from six to eighteen inches long. Colour, a fine scarlet. When perfect is one of the most beautiful Algæ, but is generally, more or less, mutilated before reaching the hands of the botanist. Adheres imperfectly. *S. Crinitus.*

GELIDIUM—from the frond being easily reduced to a jelly.

GEN. CHAR. Frond, compressed, linear, more or less pinnated. Fructification, of two kinds. Colour, fine red, becoming white in decay. On rocks in the sea. Perennial.

The inhabitants of many countries, bordering the Indian Ocean, make use of Algæ belonging to this genus to render more palatable their hot and biting condiments; and from some undetermined species the celebrated edible swallows' nests of China are constructed. Three species of swallows form edible nests, two of which building at a distance from the sea-coast, use the sea-weed only as a cement for other matters; the nests of the third are consequently most esteemed, and are sold for nearly their weight in gold.

G. Cartilagineum; found in Fresh-water Bay in the Isle of Wight, but it is extremely doubtful whether it vegetates upon our coasts. Fronds, from eight to twenty inches high. The mode of growth, and the colour of this species are so beautiful, that it is often brought, under various ornamental forms, from the Cape of Good Hope, where it occurs in greater abundance than in any other part of the world. *G. Corneum;* on most of the rocky shores of Great Britain and Ireland. The varieties of this plant are almost endless, and some of them so singular, that without practical knowledge they might be taken for very distinct species.

GIGARTINA—grape-stone.

GEN. CHAR. Frond, filiform, cylindrical, irregularly branched, tufted; from one to ten inches high. Fructification, sessile capsules. Colour, a dark purple.

The generic name is derived from the supposed resemblance of the semi-transparent capsules to a grape. *G. Pistillata.* Perennial. One of the rarest British species. *G. Acicularis.* Annual. Very rare. *G. Griffithsiæ. G. Plicata.* Very common; so entangled, tough, and wiry, that there is little chance of its being mistaken for any other species.

GRATELOUPIA—in honour of Dr. Grateloup.

GEN CHAR. Frond, plane, sometimes pinnated with branches, or fringed with foliaceous processes. Fructification, minute, aggregated tubercles.

G. Filicina. On rocks, and different sub-marine substances. Slightly adhesive. Fronds, somewhat tufted, from two to six inches high. Colour, purplish red, turning greenish. There are some exotic species.

CHŒTOSPORA—from the seeds being protected by filaments.

GEN. CHAR. Frond, filiform, branched. Fructification, very imperfectly understood. A number of little ramuli swell into a lanceolate form, and are composed of crowded filaments. Colour, a lively rose-pink. Adheres closely.

C. Wiggii. From its delicate nature this elegant sea-weed is extremely liable to injury, and most of the specimens that the botanist is fortunate enough to find are generally mutilated.

PHILOTA—from its numerous regular feathery branches.

GEN. CHAR. Frond, flat, of a red colour. Fructification, capsules surrounded by an involucre.

This is one of the most beautiful marine Algæ. *P. Plumosa.* Perennial. Not uncommon. Fronds, somewhat tufted; three to twelve inches long; irregularly branched. Finest in the Orkneys. Adhesive.

ORDER X. GASTROCARPEÆ.

FOUR GENERA.

Iridea, Halymenia, Dumontia, Catanella.

Plants, all marine, with a scutate root; of a pink, red, or purplish red colour; most of them not changing much on exposure; of a carnose, gelatino-cartilaginous, or gelatinoso-membranaceous substance; the structure, externally, consisting of a cellular coat or membrane. Frond, cylindrical, compressed, or flat; continuous; destitute of mid-rib or veins. Fructification, seeds embedded in the internal substance of the frond.

IRIDEA—from its prismatic tints while growing.

GEN CHAR. Frond, flat and expanded; of a purplish red. Adhesive.

I. Edulis. On rocks in the sea. Biennial. Not uncommon, particularly in the north. Frond, from six to eighteen inches long. A perfect specimen can seldom be procured, for, if not injured by the force of the waves, this plant is generally mutilated by crabs and other marine animals, to whom it is a grateful food. It is sometimes eaten under the name of *dulse* by fishermen, and when pinched between hot irons, is said to resemble roasted oysters. It is also fried in Scotland. When bruised in water it gives out a fine purple colour; and, with the assistance of alum, a fine lake has been obtained from an infusion of this species. *I. Reniformis*, is a small, beautiful, and extremely rare species, of a permanent blood-red hue.

HALYMENIA—sea-membrane.

GEN. CHAR. Frond, nearly flat, or cylindrical; of a pinky red colour, more or less dichotomons. On rocks and stones in the sea. Annual. Adhesive.

H. Ligulata, from two to twelve inches long. *H. Furcellata*, from one to four inches.

DUMONTIA—dedicated to M. Dumont.

GEN. CHAR. Frond, cylindrical, simple, or branched.

D. Filiformis. On rocks and stones. Very common. Colour varying from pale yellowish dull red to purple. Frond, from six to eighteen inches long; the fructification gives it a mottled appearance. On immersion in fresh water it gives out a pink dye very freely, and is likewise apt to stain the paper when pressed. Adhesive.

CATANELLA—a little chain.

GEN. CHAR. Fronds, filiform, creeping, throwing up numerous branches; contracted, as if jointed in a moniliform manner. Fructification, unknown.

The generic name alludes to the necklace-like form of the frond.

C. Opuntia. Perennial. Common, particularly in the north. Colour, a dark purple. It grows on sea-side rocks within high water mark, in crevices and spots least exposed to the sun, where it covers large spaces, extending like a mat. Adheres imperfectly.

ORDER XI. ULVACEÆ.

EIGHT GENERA.

Anadyomene, Porphyra, Ulva, Tetraspora, Bangia, Enteromorpha, Valonia, Alysium.

Plants, found in the sea, in fresh water, or on damp ground, &c. Of a herbaceous green, or fine purple colour; of a thin, tender, membranaceous substance, and reticulated structure, rarely gelatinous. Frond, with a very minutely scutate root; and expanded, or tubular and continuous. Fructification, embedded in the delicate membrane of the frond.

PORPHYRA—purple.

All the species of this genus form beautiful specimens for the herbarium; and, when carefully dried, the surface is delightfully smooth and glossy.

GEN. CHAR. Frond, plane, exceedingly thin, and of a purple colour. On rocks or stones in or near the sea. Annual. Abundant on most parts of the British coast. Fronds, from three to eight inches long.

P. Laciniata. Well known in England as *laver;* in Scotland as *stoke;* and is, with some people, a favourite dish for the table, prepared in various ways. *P. Vulgaris;* a very beautiful species; so also is *P. Linearis,* which renders the rocks on which it grows (viz., beneath Peakhead near Sidmouth) purple with its delicate fronds.

ULVA—from the Celtic word Ul-water.

This name appears to have been formerly applied to all aquatic vegetables. The Ulvæ are of very general distribution; species occur in salt and fresh water, and on the surface of damp ground, the shaded roofs of old thatch-covered buildings, and even on walls and stones. Some do not exceed a line in length, others are not less than one or two feet.

SPECIES CONFINED TO THE SEA.

GEN. CHAR. Frond, green. Attached to rocks, stones, shells, corallines, and marine plants. Annual.

U. Latissima, called also *laver* and *stoke*, is very common, and eaten at fashionable tables, though inferior in flavour to *Porphyra Laciniata*. The Scottish Islanders ascribe to it an anodyne virtue, and bind the leaves about the front and temples to promote sleep, and to assuage the head-ache in fevers. *U. Lactuca*, or *lettuce laver*, smaller, and more beautiful for the herbarium; adhering so closely as to resemble a drawing, and the surface shining as if varnished. *U. Linza*.

SPECIES FOUND IN FRESH WATER, ON DAMP GROUND, &c. &c.

Ulva Bullosa, *Ulva Crispa*, *Ulva Furfuracea*, *Ulva Calophylla*.

BANGIA—in honour of Hoffmann Bang.

GEN. CHAR. Frond, flat and capillary, of a green-reddish, or purple colour.

B. Fusco-Purpurea. On rocks and planks of wood in the sea. Covers rocks to a great extent with its crowded and glossy filaments. Annual.

ENTEROMORPHA—form, and an intestine.

GEN. CHAR. Frond, tubular and hollow; green colour; from two inches to two feet long. Extremely common. Annual. Adheres imperfectly.

E. Intestinalis. Fronds, long and rather narrow; waved, wrinkled, crisped, and curled. *E. Compressa.* Eaten in the Sandwich Islands. *E. Clathrata.* *E. Linkiana.*

ORDER XII. SIPHONEÆ.

FOUR GENERA.

Codium, Bryopsis, Vaucheria, Botrydium.

Plants, found in the sea, in fresh water, or on damp ground, &c.; of a herbaceous green colour. Frond, either membranaceous and filiform, or presenting a lax, spongy body of various forms; crustaceous, globular, cylindrical, or flat. Fructification, vesicles produced on the outer surface of the tubes composing the frond.

CODIUM—velvet covering.

GEN. CHAR. Frond, spongy; dark green; composed of an interwoven mass of continuous filaments. On rocks. Perennial.

C. Tomentosum has a soft woolly appearance. Fronds, four to twelve inches long. Denominated *sponges* by early writers. *C. Bursa;* very rare, but abundant on the Sussex coast. Apparently no root. Frond, a hollow spongy ball, one to eight inches in diameter. Both these species imbibe water like a sponge.

BRYOPSIS—like feathery moss.

GEN. CHAR. Frond, filiform; branched and glistening. Fructification, unknown. Adhesive.

This is one of the most beautiful genera of the marine Flora, and so perfectly natural that it is most difficult to define the species. When dried upon paper, it has a shining glistening appearance, as if varnished. *B. Rosæ*, the most charming of the whole; a native of the Malouine or Falkland Islands; is twelve inches in length, and has been compared to an Italian poplar in miniature. *B. Plumosa* is an elegant plant, greatly resembling a feather. Frond, from one to three inches in length. On rocks and stones in the sea. Annual. Coast of Devonshire, Brighton, &c.

Colour, a bright grass-green. That of *B. Hypnoides* is paler ; frond, from two to four inches long, very slender, and branched in a lax, bushy manner.

VAUCHERIA—in honour of M. Vaucher.

GEN. CHAR. Fronds, aggregated, tubular, continuous, capillary, coloured by an internal green pulverulent mass. Fructification, vesicles attached to the frond.

This is not a marine genus; the plants grow on the surface of damp ground, the edge of water-falls, the gentle trickling of springs; or float in masses on the water of ponds and ditches. One of the species, *V. Clavata*, is connected with a curious theory recently prevalent in Germany, that some vegetable bodies possess successively an animal and a vegetable nature, and that they pass from one state to the other without disorganization. M. Unger watched this plant until the vesicles (which become new plants) were separated from the frond and floated on the water, but instead of remaining quiescent, as a vegetable organ might be expected to become, it swam about in all respects like an animal endowed with voluntary locomotion. After having been exceedingly active for about an hour, the globule slightly changed its form and colour, put forth first a radicle, then a stem, fixed itself to the nearest substance, and in about eleven days bore fructification in its turn. These singular observations were many times repeated by M. Unger, and always with the same result. This does not appear to be an English species. ***V. Dichotoma. V. Dillwynii. V. Terrestris. V. Sessilis. V. Ornithocephala. V. Geminata. V. Cæspitosa. V. Racemosa.***

BOTRYDIUM—

Very little is known of the real nature of this curious plant, which is not bigger than a large pin's head, being little more than a green globule with a radicating tuft of fibres. Fructification, unknown. It is found on damp clayey ground, dried-up ditches and ponds, shady paths in gardens, &c. Annual. *B. Granulatum.*

Method of preparing Sea-weeds for Preservation.

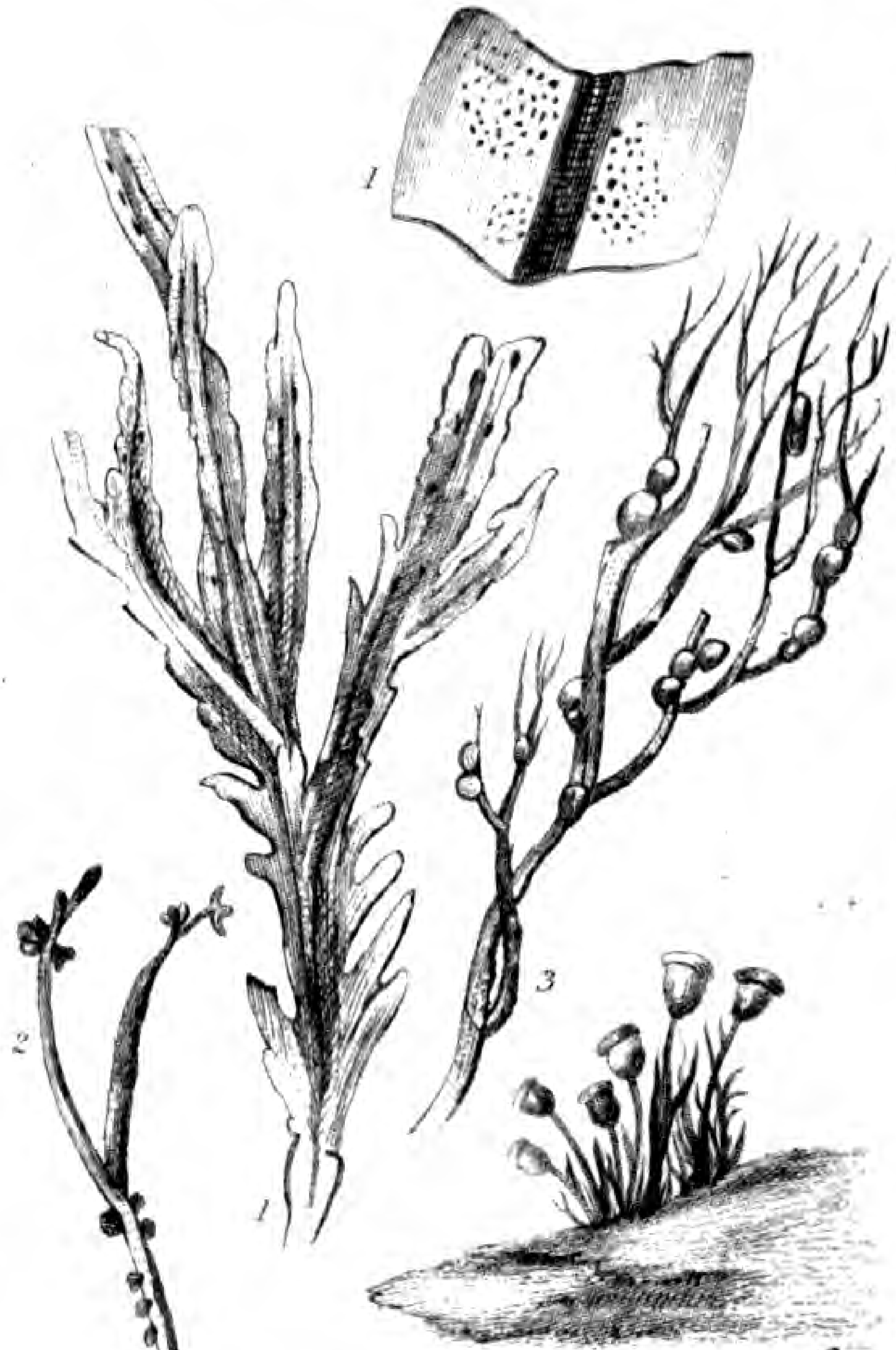
Many of the Algæ, and particularly the Florideæ, make a beautiful appearance when preserved in a herbarium, or hortus-siccus. All of them require to be soaked for some time in fresh water; and they are the better for being repeatedly rinsed in renewed basins of water, to cleanse away and extract, as much as possible, the sea-salt which adheres to them, or with which they are impregnated.

The larger sort need no other preparation, but are to be dried between folds of blotting paper, and pressed in the manner of herbaceous plants. The finer leaved Algæ must be treated in a different way; after being washed in repeated waters, till no impurities of any kind remain, they are to be separately floated out in a large shallow dish containing water, so that their most minute and delicate branches may be fully expanded. For disentangling the nice ramifications a common pin, or a nice pointed pen may be employed. A piece of stiff, but fine and smooth writing paper, is to be gently introduced under the specimens, and the minute branchlets being again spread out where they may have been disordered, the paper is to be cautiously and slowly inclined, and at last drawn out so as to contain on its surface the plant in its fully expanded state. After this, most of the delicate species, if carefully dried and pressed, adhere to the paper by their own gluten, and require no further care.* The non-adhesive kinds may be fixed by means of a cement made from *F. Ciliatus* and *C. Crispus* of our shores. These are boiled in water over a quick fire, and soon become melted; on cooling they form a gluten, not to be relied on as a strong cement, but which is well adapted for a herbarium, as it neither imparts a stain like glue, nor a glare like gum. If the paper be slightly rubbed over with the mucilage, and a delicate membranaceous plant afterwards placed on it, it will become sufficiently fixed merely by moderate pressure. Some collectors, finding that any kind of paper is apt to curl up, expand the delicate species over a plate of glass, and, after allowing the water to drip off, transfer the specimen carefully to the paper. To inland collectors, who occasionally make an excursion to the shore,

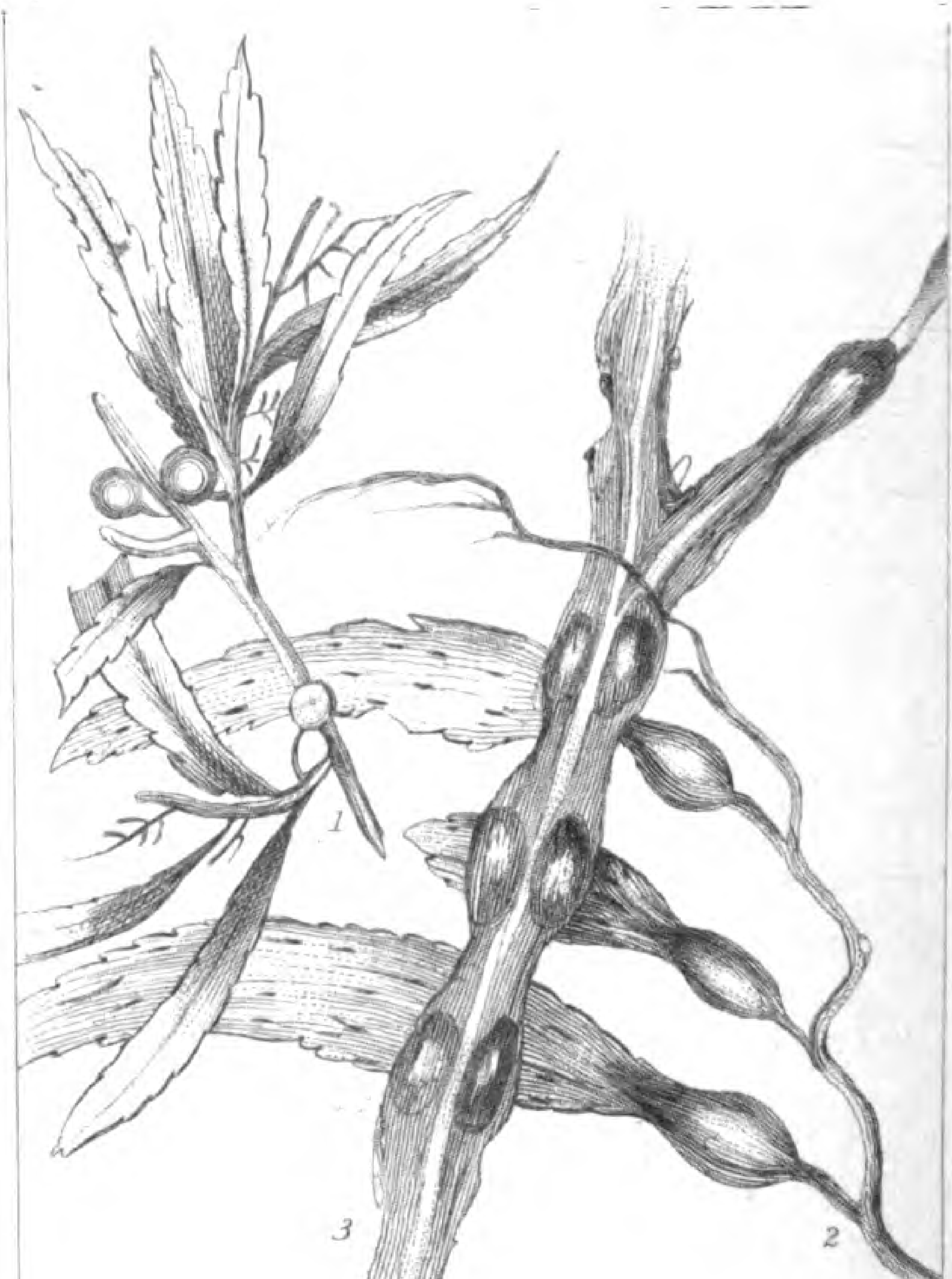
---

* These plants are indicated in the descriptions as "adhesive."

it may be useful to know, that all the preparation that is necessary at the sea-side is to dry the specimens moderately in the free air, and tie them loosely up in strong brown paper. In this way they may be carried to a great distance, and kept for some days. On being immersed in fresh water, they generally expand as fully as before ; but it must be confessed that the colour of some kinds is extremely apt to change. In the *vasculum*, or botanic box, which serves so well for preserving herbaceous land plants, specimens of marine plants very rapidly undergo the putrefactive fermentation.


1
1
2
3
4

I



EXPLANATION OF THE PLATES.

PLATE I.

THREE KINDS OF AIR VESSELS.

1. *Axillary*—Sargassum Vulgare.

2. *With an Expansion of the Petiole*—Macrocystis Pyrifera.

3. *With a dilatation of some part of the Frond*—Fucus Vesiculosus.

PLATE II.

FOUR KINDS OF FRUCTIFICATION.

1. *Distinct Spots* or *Sori*—Halyseris Polypodioides with magnified portion of the Frond.

2. *Terminal Receptacles*—Furcellaria Fastigiata.

3. *Naked Spongy Warts*—Polyides Rotundus.

4. *Capsules on the Frond, magnified*—Odonthalia Dentata.

Plate III.

THREE KINDS OF ROOTS.

1. *Scutate*—Hymanthalia Lorea.
2. *Clasping*—Alaria esculenta.
3. *Fibrous*—Rhodomenia Ciliata.

Plate IV.

1. Plocamium Coccineum.
2. Desmarestia Aculeata.
3. Chondrus Crispus.
4. Porphyra Linearis.

III

GLOSSARY.

Algæ, the 57th Linnæan natural order of plants, containing flags, sea-weeds, and other marine plants, whose root, leaf, and stem, are one.

Aggregated, collected, compound.

Annual, only lasting one year.

Axillary, produced where the leaf or its footstalk joins the stem.

Biennial, continuing for two years.

Cartilaginous, consisting of gristly substance.

Capsules, seed vessels; often partly hollow; frequently placed singly; smooth on the surface; sometimes spherical, but often of a lanceolate shape. It may be observed that, in some cases, the terms tubercle and capsule become nearly synonymous.

Capillary, like hair.

Carnose, fleshy.

Cellular, composed of cavities or cells.

Conferva, one of the three orders into which Linnæus divided those plants included under the term Algæ. By the Confervæ are generally meant all jointed or articulated Algæ; the greater number are fresh-water species, and abound in ditches and running streams.

Gelatinous, of the nature of jelly.

Glaucous, of a light green colour.

Globular, spherical, round like a ball.

Herbaceous, partaking of the nature of herbs.

Indehiscent, the pericarp or seed vessel is so called when it does not open naturally, but is either split open by the process of germination, or rots away by external action, in opposition to dehiscent, which means to split open naturally, dividing into valves.

Lanceolate, (see Frond.)

Leaf, (see Frond.)

Linear, (see Frond.)

Ligneous, like wood.

Lubricous, slippery—unsteady.

Mid-rib, generally speaking a continuation of the stem down the middle of the leaf, but said to consist in Algæ of elongated cellular tissue.

Membranaceous, composed of a fibrous web.

Moniliform, having a single flower of the form of a lily.

Orbicular, circular, spherical.

Perennial, a plant whose roots vegetate many years.

Plane, flat, not globular.

Pinnated, a stem is pinnated when the fronds or leaflets spring out laterally.

Pulverulent, in a state of powder or dust; feebly ucering.

Proliferous, fruitful, fertile.

Ramuli, little branches.

Coriaceous, like leather.

Crustaceous, shelly.

Cylindrical, long and round, in the form of a tube.

Dentate, (see frond.)

Deciduous, plants whose leaves fall annually.

Dichotomous, growing in pairs.

Distichous, a stem is distichous when the branches, and a branch when the leaves, are placed on both sides alternately and close together—the third under the first, the fourth under the second, and so on.

Exotic, not native.

Filaments, slender threads, fibres.

Flabelliform, fan-like.

Filiform, thread-like.

Fibre, a vegetable thread.

Foliaceous, leafy.

Frond, (see Introduction). A frond or leaf is linear, when entire, with the margins parallel; setaceous, when long, narrow, stiff, and sharp; dentated, when the margin presents small, radiating, acute teeth, that neither incline to its base nor apex; and serrated, when these teeth are inclined. An oblong leaf becomes lanceolate when it gradually tapers into a point at the apex. A divided leaf may be cleft, or if the divisions are deeper it is lobed, but when they are deep and unequal it is laciniated. When orbicular, and having two heart-shaped lobes at the base of the stem, it is reniform; and cuneiform when narrow at the base, and somewhat squared off at the top.

Fructification, the name of all those parts of a plant which produce the seed.

GELATINOUS, of the nature of jelly.

GLAUCOUS, of a light green colour.

GLOBULAR, spherical, round like a ball.

HERBACEOUS, partaking of the nature of herbs.

INDEHISCENT, the pericarp or seed vessel is so called when it does not open naturally, but is either split open by the process of germination, or rots away by external action, in opposition to dehiscent, which means to split open naturally, dividing into valves.

LANCEOLATE, (see Frond.)

LEAF, (see Frond.)

LINEAR, (see Frond.)

LIGNEOUS, like wood.

LUBRICOUS, slippery—unsteady.

MID-RIB, generally speaking a continuation of the stem down the middle of the leaf, but said to consist in Algæ of elongated cellular tissue.

MEMBRANACEOUS, composed of a fibrous web.

MONILIFORM, having a single flower of the form of a lily.

ORBICULAR, circular, spherical.

PERENNIAL, a plant whose roots vegetate many years.

PLANE, flat, not globular.

PINNATED, a stem is pinnated when the fronds or leaflets spring out laterally.

PULVERULENT, in a state of powder or dust; feebly cohering.

PROLIFEROUS, fruitful, fertile.

RAMULI, little branches.

Reticulated, in a net-like form.

Revolute, rolled back.

Radicle, is the rudiment of the root, which it becomes by germination.

Receptacle, a process often resembling a pod, and generally containing many tubercles, which again contain the seeds, as in F. Vesiculosus.

Sessile, having a slit.

Scutate, like a shield.

Sub-palmate, in some degree resembling a hand spread out.

Stipitate, having a stem or trunk.

Sori, spots.

Stratum, a row or layer.

Turgid, swelled, bloated.

Tubercles are nearly solid, generally roundish, often composed of minute fibres, among which the seeds lie; they frequently resemble pimples or warts, and are often clustered together, sometimes half immersed in the frond, sometimes on short peduncles.

Ulva, one of Linnæus's three divisions of the Algæ.

Urceolate, pitcher-shaped.

Vesicles, generally speaking the air bladders; well-known in F. Vesiculosus and Nodosus and others, but these vesiculæ have no connexion with the fructification.

J MASTERS, ALDERSGATE STREET.


1
2
3
4
5
6

THE LITTLE

ENTOMOLOGIST.

PRINTED IN COLORS BY GREGORY & COLLINS
16 ST. JAMES STREET CLERKENWELL

PREFACE.

THIS little book is intended to give a brief view of the nature of Entomological study, its present state, and the system which has been adopted in these days as the one best calculated, if pursued, to facilitate an acquaintance with the several species and varieties of the insect tribe. This attainment is highly important in promoting the study of their nature, economy, and the influence which, as beings created to bear their part in a world of which no living inhabitant was formed in vain, they are found to exercise in the scale of nature.

In a work professing to give any idea of the system of Entomology, the introduction of technical terms was necessarily involved, but the glossary subjoined will, it is hoped, render this no difficulty; and should the details be thought dry, it must be remembered that in so small a book it is impossible even to *allude* to many of the thousand interesting characteristics peculiar to, and beautifully exemplified by this generally despised and injured portion of the animal race.

The following remarks and information are gratefully acknowledged as taken from M. Latreille, the author of the insect department in Baron Cuvier's "Animal Kingdom," and from Messrs. Kirby and Spence's invaluable "Introduction to the Study of Entomology."

INTRODUCTION.

HISTORY OF ENTOMOLOGY.

ARISTOTLE was the first who bestowed any pains on the study of insects, and although he is now known to have erred on many points respecting them, yet the discoveries of comparatively modern philosophers have only confirmed his general principles, and the knowledge of Entomology we now possess, is built on the foundation of his laborious investigations. Aristotle distinguished insects by the absence or presence of *wings*, and by the nature of these organs. From his time to that of Pliny, little was added to the Entomological knowledge which the former had bequeathed. His notice of insects appears to be little more than a compilation from Aristotle.

Ulysses Aldrovandus, an Italian in the seventeenth century, attempted a systematical arrangement of insects. He arranged them according to the medium they inhabit.

After this, the celebrated Swammerdam classed insects according to the metamorphoses which they undergo. Ray and Willoughby, two English naturalists, following out his plan, pre-erected that superstructure which prepared the way for the present improved state of the science. At this era there were many eminent Entomologists, and the Royal Society contributed greatly to facilitate the progress of the study. In 1707 Linnæus was born. He imbibed a taste for Entomology almost as early as for Botany, " attempting when a boy to introduce wasps and bees into his father's garden, to the great annoyance of the old gentleman."* Linnæus' system was

* STÆVER's Life of Linnæus.

founded on the absence or presence of the organs of flight, and has been called the Alary system, from *Ala*, a wing: it is in some degree a republication of that pursued by Aristotle. Linnæus gave definitions of those genera which had been hitherto distinguished only by a *name;* and the plan he contrived for specifying definitively any species or insect has conferred a lasting benefit on Natural History.

De Geer's system, which was published about the same time, is founded both on the organs of flight and those of manducation. M. de Reaumur too published a work of a similar name, and he appears to be considered by Entomologists as almost beyond praise. Reaumur confined himself to no system; but the elegance of his language, the felicity of his illustrations, his patience in planning and pursuing his various experiments, and his thorough investigation of the subject, have rendered him an almost perfect model to future students of nature. M. Bonnet also, his regular Entomological correspondent, was an admirable observer of the economy and manners of insects. The Linnæan Society was now established in England, in whose transactions much valuable information may be discovered by the Entomologist.

Fabricius, a pupil of Linnæus, being unsatisfied with the system of the latter, assumed the *instruments* of *manducation* for the basis of a new system, which, from the *maxillæ* being principally employed to characterise the *classes*, or rather *orders*, may be called the maxillary system. His incredible labours in defining new genera and species, with which view he travelled into various parts of Europe, and seven times into Britain, have been of infinite service, and have placed the science much nearer to that of Botany than it had ever before attained.

The system of Fabricius did not however meet with general adoption, but M. Latreille now appeared in France, whose indefatigable labours and singular talents have thrown more light over Entomological science than those of all his predecessors. In 1796 he published his "*Précis de Caractères Génériques des Insectes*," in which important work he disregarded all *artificial* systems of Entomology, and attempted to construct one upon a *natural* basis; and to this end, uniting the consideration of the instruments of manducation with that of the organs of flight and motion, and of other external characters, or the system of Linnæus with that of Fabricius, he became the founder of the modern or *eclectic* system.

In Baron Cuvier's inestimable "Animal Kingdom," M. Latreille has been the author of the insect department. M. Clairville and M. Lamarck are also well-known names in the later history of Entomology. Mr. M'Leay has invented the Quinary System, in which insects are arranged in circular groups of fives. Last, but not least, the names of the Rev. William Kirby and William Spence, Esq. are deserving of the highest esteem and admiration, for the records they have left of their invaluable labours in their "Introduction to the Study of Entomology," a series of letters as interesting as they are instructive to the mind and heart. The progress of the science since the era of Fabricius has been very rapid, and the pens and pencils of able and eminent men, in every corner of Europe, have been employed to illustrate it. The internal anatomy of insects, too, formerly so unattractive, on account of the extreme nicety required in dissecting them, has now numerous votaries, while the pictorial department has been brought to great perfection.

THE

Little Entomologist.

Entomology or the study of Insects derives its name from *Entoma*, a Greek word synonymous with the Latin *Insecta* and English *Insect*. By this term all the more minute portion of the animal creation are usually implied, but when we consider how many of the foreign birds and reptiles are exceeded in size by varieties of the insect race, it becomes necessary to define more accurately the distinguishing characteristics of the latter.

I. Insects are Invertebrate or without a vertebral column, have cold white blood, or sanics, and although they respire air do not receive it by the mouth, but through little orifices in the *sides* of the body called *spiracula* or *spiracles*. They are also destitute of lungs, but furnished with a system of air-vessels ramified universally, and penetrating to every part and organ of their frame.

II. Insects are generally *insected*, being divided as it were into three principal pieces, head, trunk, and abdomen, and this character of insection or division into segments is more or less present in almost every insect.

III. Insects pass through four states, or stages of existence: the *egg*, the *larva*, the *pupa*, and the *imago*. All insects are produced by eggs, though in some cases these are hatched within the body of the mother, and hence called *ovo-viviparous*, to distinguish them from the true viviparous animals, the class Mammalia. By far the larger portion of insects is oviparous in the ordinary acceptation of the term. The ovo-viviparous tribes at present known are scorpions, the flesh-fly, and several other flies; a minute gnat, some species of coccus, some bugs, and most aphides.

IV. Various are the ways by which parent-insects provide for the safety of their *eggs*. Some exclude them in masses of jelly upon the surface of water or leaves of willows; some in a sort of capsule containing the eggs as in a box, which bursts open as soon as the young are hatched. Others weave pouches or bags in which they enclose the eggs, and either carry about with them or fasten in some secure place.

V. On leaving the egg, insects appear in the *larva* state. They are then soft, without wings, and in shape usually like worms, and some are called *caterpillars*, and others *grubs* or *maggots*. They now eat voraciously, cast their skins several times, and live, according to their species, days, months, or even years.

VI. Previously to entering the *pupa* or third state, the larvæ generally enclose themselves in cases of wood or earth, or weave for themselves habitations called cocoons, wherein this metamorphosis takes place. They then present a swathed appearance, although the rudiments of the future insect may generally be distinctly traced, and most are incapable of locomotion, and do not feed at all during this time, *most*—because very many, as locusts, cock-roaches, bugs, spiders, &c., although casting their skins and undergoing changes in their conformation sufficiently marked to indicate their passing through the pupa metamorphosis, are yet capable of walking and eating as usual. Pupæ are defined as *Chrysalides*, *Nymphs*, *Semi-Nymphs*, or *Cased-Nymphs*, according to their nature.

VII. After remaining thus for a longer or shorter period, some a few days, others even one or more years, the insect, having become perfect in all its parts, breaks through its prison and appears in its last or *imago* state, so called from its being now a perfect image of its species, and this state is implied when speaking indefinitely of any insect.

VIII. Insects appear to be generally arranged in two classes, *Insecta* and *Arachnida*, which may briefly be defined as follows.

INSECTA.

Body divided into Head—Trunk—Abdomen.

Head. Principal seat of the organs of sensation.

Organs of sight. Immoveable eyes, simple or compound, varying in number, so situated and formed as to enable the insect to discern surrounding objects as clearly as if the eyes were capable of motion; have neither iris nor pupil, and are destitute of eye-lids to cover them during sleep or repose. *Usually* two in number and compound.

Organs of hearing. Uncertain. The *antennæ* of insects in number and situation correspond with the *ears* of Vertebrate animals, but whether they convey the vibrations of sound has not been ascertained; although it is proved that they receive pulses of some kind from the atmosphere, so that if insects do not *hear* with them in one sense, they may, by communicating information, supply the place of ears, which would render them perfectly analogous to those organs.

Organ of taste. Ligula or palate within the mouth, accompanied with the *organs of manducation,* a pair of mandibles and maxillæ, and an upper and lower lip or their representatives.

Organs of touch. Principally two jointed *antennæ* or their representatives, and four jointed feelers, or *Palpi,* two maxillary, and two labial. In some insects the palpi assume a different form that they may serve for suction, but none are totally obliterated or without some representative.

Organ of smelling. Uncertain, but supposed to reside in the vicinity of the mouth, in that part terminating the face above the upper lip, which is in a degree analogous to the nose.

Trunk. Principal seat of the organs of motion.

Organs of walking, running, or jumping. Six or eight jointed thoracic legs in pairs.

Organs of flight. Four wings or their representatives, mostly with branching nervures containing air-vessels ; found in the majority of the class.

Organs (external) of respiration. A double set of lateral spiracles, some for expiration.

Abdomen. *Organs of Motion.* In the *Myriapods* many pairs of acquired legs ; in the *Thysanura* elastic ventral or caudal appendages.

Organs of respiration. A double series of lateral spiracles in the majority, in some only a single series, and in the others only a single pair.

By their internal anatomy, insects are still more accurately distinguished, but it will be unnecessary here to enter more fully into the subject.

Development. In their passage to their adult state, after they have left the egg, *insects* undergo several simultaneous changes of their integument, or successive moults; and the majority assume three distinct forms, with distinct organs, which appear as rudiments in their second state, and are completely developed in their last.

They never breed but once during life.

ARACHNIDA

Are principally distinguished from Insecta by their external anatomy. It will be needful only to mention those points in which they differ.

Body. Head and trunk usually not separated by a suture.

Eyes. Two to eight, not lateral.

Mandibles. Cheliform unguiculate.

Palpi. Pediform or cheliform.

Trunk. Legs eight, or their representatives, tibiæ mostly consisting of two joints.

Abdomen. With from two to eight spiracles.

Breeding more than once during life.

IX. No genuine *Insect* or *Arachnidan* has yet been found to inhabit the ocean.

X. The class *Insecta* has been divided by Entomologists into twelve orders as follows.

1. *Coleoptera*, consisting of *Beetles.*

2. *Strepsiptera*, consisting of the genera *Xenos* and *Stylops.*

3. *Dermaptera*, consisting of the *Earwigs.*

4. *Orthoptera*, consisting of *Cock-roaches, Locusts, Grasshoppers, Crickets, Spectres, Mantes, &c.*

5. *Hemiptera*, consisting of *Bugs, Cicudæ, Water-scorpions, Water-boatmen, Plant-lice, Cochineal Insects, &c.*

6. *Trichoptera*, consisting of the *flies* produced by the various species of *Case-worms.*

7. *Lepidoptera*, consisting of *Butterflies, Hawk-moths*, and *Moths.*

8. *Neuroptera*, consisting of *Dragon-flies, Ant-lions, Ephemeræ, &c.*

9. *Hymenoptera*, consisting of *Bees, Wasps*, and other insects armed with a *sting* or *ovipositor* and its *valves*.

10. *Diptera*, consisting of *Flies, Gnats*, and other *two-winged* insects.

11. *Aphanipt̀era*, consisting of the *Flea* tribe.

12. *Aptera*, consisting of *Mites, Lice, &c.*

XI. The class *Arachnida* has been also divided into four orders, as follows.

1. *Araneida*, or *Spiders*.
2. *Scorpionidea* or *Scorpions*.
3. *Galeodea*.
4. *Phrynidea*.

XII. The twelve orders of Insecta include all the genera or species of known *insects*, and are generally arranged as follows under two heads, *Mandibulata* or insects with *jaws*, and *Haustellata*, or those with *suckers*. Six orders under each.

(FIRST SUB-CLASS) MANDIBULATA.

Order 1st.—*Coleoptera*, from two Greek words signifying *a sheath*, and *a wing*.

Have four wings, the two superior of which resemble horizontal scales, joining in a straight line along the inner margin; the inferior wings are merely folded transversely, and covered with others which form cases or covers for them, usually denominated the *elytra*. Several species are apterous, but the elytra still exist. Of all insects these are the most numerous and the best known. Their head presents antennæ of various forms and almost always composed of eleven joints; two compound eyes, but none simple, and a mouth consisting of a labrum, two mandibles, usually of a scaly substance, two jaws, each furnished with one or two palpi, and of a labium formed of two pieces, the mentum and the ligula, accompanied by two palpi, commonly inserted into the latter.* The Coleoptera undergo a complete metamorphosis. The larva resembles a worm, having a scaly head, a mouth analogous to that of the perfect insect in the number of its parts, and usually six feet. The pupa is inactive, and takes no nourishment. The habitations, mode of life, and other habits of these insects, in both states, greatly vary. From the almost endless variety included in this order, we may select the four following genera.

LAMPYRIS.

All the different species of this genus appear to be more or less luminous. Amongst them is *Lampyris Splendidula* or the *glow-worm*. Lampyrides are nocturnal insects,

* In the principal nervure of the wings of Coleoptera as well as those of Lepidoptera, Hymenoptera, and Diptera, is found PHIALUM or the phial, which is a little bag to receive fluid at the will of the insect, by which the weight of the wing is increased.

and diffuse a phosphoric light from a pale-coloured patch terminating the under side of the abdomen, which light they can vary or withdraw at pleasure, and thus render themselves invisible to those birds who seek their prey by night. Indeed it is thought that they regularly extinguish it between eleven and twelve every evening. The female emits a much more brilliant light than the male, and differs greatly in appearance, resembling a caterpillar, rather than a winged beetle. These little insects are of a blackish colour, and are found every where about the country in June, July, and August, in hedges and meadows. They lay a great many lemon-coloured eggs, which they fix to the ground or the leaves of plants. Almost all the Lampyrides of hot climates are furnished with wings, and being very numerous, present a beautiful appearance in their evening flight. The latter are very common in Italy, and called *Lampyris Italica.*

ELATER.

Of this genus is *Elater noctilucus*, or the fire-fly of South America. It is rather more than an inch long. The light principally proceeds from the thorax; but when flying, it is discovered under the elytra, and the whole body is full of light. The fire-fly is useful in destroying the gnats which are so troublesome, and is employed by the Indians to light them when travelling by night, being fixed to their feet. The smallest print may be read by means of two or three fastened in a vase.

PTINUS.

Several species of this genus inhabit our houses, where they are very destructive whilst in the larva state, piercing wood, books and furniture, with little round holes. The tapping made by these insects with their mandibles against the wood they inhabit, resembles the tick of a watch, and is superstitiously called a *death-watch*. When touched, they counterfeit death, draw up their feet, and though supplied with wings, seldom use them as a means of escape.

SILPHA.

Of this genus is the ingenious *necrophorus* or *burying-beetle*, which excavates a hole under the body of a dead mole, mouse, or other small animal, and when it is buried, deposits its ova in the carcase, which serves the larva for food. Their sense of smell must be very acute, for very soon after a mole has been killed, the necrophori may be found surrounding it, although previously sought for in vain.

Order 2nd.—*Strepsiptera*, from two Greek words signifying a *turning* or *twisting*, and a *wing*.

Have large membranous wings, folding longitudinally in the form of a fan. The organs of the mouth more resemble the lancets of a sucker than jaws. These insects are parasites, residing in their larva state, between the abdominal scales of a species of Bee and Wasp ; consist of two genera.

Stylops.

Xenos.

Order 3rd.—*Dermaptera*, from two Greek words signifying a *skin* and a *wing*.

The wings folded under short crustaceous elytra, with a straight suture. These insects are furnished with pincers at the extremity of the body. They form one genus.

FORFICULA.

The best known species of this genus is the *Forficula auricularia* or common *earwig*. These insects are very common in cool and damp places, frequently collect in troops under stones and the bark of trees, are very injurious to cultivated fruit, devour even their dead companions, and defend themselves with their pincers. It has been thought that they insinuate themselves into the ear, and hence their vulgar name. They are about half an inch long, brown with a red head. The female keeps careful watch over her eggs, and for some time over her young ones.

Order 4th.—*Orthoptera*, from two Greek words signifying *straight*, and a *wing*.

Wings folded longitudinally most frequently in the form of a fan. They undergo a semi-metamorphosis. All the known Orthoptera are terrestrial. Some are carnivorous or omnivorous, but the greatest number feed on living plants. We may mention the four genera following.

BLATTA,

Or the cock-roach, is a well-known and most destructive insect, fond of residing in kitchens and bake-houses, not only attacking all kinds of provision, but cloth, linen, silk, and even shoes. In the French colonies the voracity of the Blattæ renders them a real pest to the inhabitants. They are however attacked and destroyed by a species of sand-wasp. The number of joints in the antennæ of these insects, sometimes amounts to 150.

MANTIS.

These insects are found only in southern and temperate climates, remain on plants or trees, frequently resembling their leaves and branches in the form and colour of their body. Some species are rapacious and others herbivorous. Those which are carnivorous are very furious even towards their own species, seize their prey with their fore legs, which are of a construction not unlike that of a sabre, and they can cut off the head of their antagonist, or cleave him in two with the utmost dexterity.

The upright or sitting posture which they assume when watching for their prey, has procured for some of these insects the name of the *praying Mantis, (Mantis religiosa.)*

Mantis fausta is also held in great veneration among the Hottentots.

GRYLLUS.

The species of this genus are well known by the shrill sound they emit; they conceal themselves in holes, and usually feed on insects. Several kinds are nocturnal. The female of the *Gryllus vulgaris* digs a smooth rounded subterranean cavern, about six inches deep, and greatly resembling a bottle, in which she deposits from two to four hundred eggs. The insects are an inch and a half long, and brownish. *Gryllus campestris*, or the *field-cricket*, is well known; it attacks *Gryllus domesticus*, or the *house-cricket*, which lives in the warmest parts of houses. *Gryllus umbraculatus* is a very singular insect, found in Spain and Barbary, the forehead of the male being furnished with a membranous prolongation, which falls like a veil. The cry of another species, in Sicily, is prolonged for half a minute, and may be heard at the distance of a mile.

LOCUSTA.

These insects are remarkable for their voracity. They are herbivorous, and many species are apterous. Some, called *Gryllus migratorius,* (migratory locust,) are two inches and a half in length; usually green, the wings prettily coloured with red and blue. They frequently migrate together in myriads, and are said to resemble a heavy cloud in their flight. Wherever they rest all vegetation quickly disappears; and should they die, the fetid odour exhaled by so vast a number of corrupting bodies, poisons all the atmosphere. They are common in Poland, and Barbary; Egypt and the south of Europe are frequently devastated by a larger species. In many parts of Africa locusts are preserved in brine, and eaten by the natives.

Order 5th.—*Neuroptera,* from two Greek words signifying a *nerve* and a *wing*.

Have four wings—membranous and naked. Many of these insects are carnivorous in their first and last state; some merely experience a semi-metamorphosis, the rest a complete one; but the larvæ have six hooked feet, which they usually employ in seeking their food. Of this order we may name the four following genera.

LIBELLULA,

Or Dragon-fly. The exterior of this beautiful insect is very familiar to all. It feeds on flies, which it pursues in the same way as a swallow. The largest variety is about two inches and a half in length. Its large wings resemble lustrous gauze.

EPHEMERA.

So called from its short life. These insects rather resemble large gnats, and may be often seen at sun-set, in summer and autumn, dancing in the air by the banks of rivers and lakes. In some places they are so numerous, that after their death, which usually takes place on the same day they leave the water—where for one or two years they have passed the intermediate stages of their existence—the ground is thickly strewed with their bodies. The female deposits her eggs in the water.

MYRMELEON.

This genus is found in the warm localities of southern countries. Myrmeleonides remain quiescent during the day, clinging to plants. Most of them fly well. The nymph is inactive. *Myrmeleon formicarium* is principally interesting in its larva state, when it feeds on ants so largely as to have obtained the name of *Formica-leo* (*Ant-lion*). As it moves slowly, and backwards, it would find much difficulty in securing its prey, but for the ingenious contrivance to which it has recourse. Excavating a funnel-shaped cavity in fine sand, in a sheltered situation, it retires to the further extremity, and waits until some unwary insect is entrapped, when, if unable to seize its victim with its mandibles, it showers over him such a torrent of sand, by means of its head, that escape is impossible.

TERMITÆ.

The *Termes*, or White Ants, are too well known in the countries between the tropics, to which they are peculiar. The injury they inflict whilst in the larva state is incalculable; attacking the wood-work of houses and furniture of all kinds, within which they excavate galleries to their dwellings, so that on being handled the articles crumble into dust. The nests of the Termes are generally exterior, built in pyramids or turrets, but no entrance is visible. On becoming perfect insects they fly from their retreat, but in a few hours lose their wings, fall to the ground, and become the prey of birds, &c. The Negroes consider the Termes a great delicacy.

Order 6th.—*Hymenoptera*, from two Greek words signifying a *membrane* and a *wing*.

Have four membranous and naked wings, and a mouth composed of mandibles, maxillæ, and two lips. The abdomen of the female is terminated by an ovipositor, or a sting. The Hymenoptera undergo a complete metamorphosis. Most of their larvæ resemble worms, are destitute of feet, and feed some on vegetable substances, which are conveyed by the mother into the admirable nests she has prepared for the reception of her young; and others on the bodies of insects and larvæ, in which the parent has laid her eggs. Almost all Hymenopterous insects, in their perfect state, live on flowers, and are usually most abundant in southern climates. Their period of life, from their birth to their ultimate metamorphosis, is limited to a year. Of this order we may mention the five genera following.

CYNIPS.

This genus is remarkable for the excrescences which they produce on different plants, for the purpose of depositing their eggs, being furnished with an instrument resembling a barbed arrow, with which they pierce the leaves and stems. The juices diffused by the wounded part soon form a sort of tumours, called galls. Within these the young insects often pass the two first stages of their life. The *gall-nut*, as it is termed, from Aleppo is highly valued on account of the black dye which it produces when mixed with sulphate of iron. Most persons have observed those fibrous balls so common on wild Rose-trees; these are effected by a species of this genus, *Cynips Rosæ.*

FORMICA,

Or the genus of Ants, are highly celebrated for the architectural skill manifested in the construction of their subterranean dwellings, and for their foresight; but it is considered, by M. Latreille, as a false notion that they store up provision for the winter, for at the end of the autumn all perish except the labourers, and these remain in a state of torpor, requiring no food. The exertions of ants are chiefly directed to the consolidation of their nests. They are so fond of a sweet liquid that may be drawn from the bodies of Aphides, that some species construct little earthen galleries from the nest to the very branches of the trees abounding with these insects.

The care bestowed by Ants upon the larvæ is remarkable; they feed them with their mouths, and in warm weather bring them out to receive the heat of the sun, conveying them home on the first approach of night or rain. They also watch for the moment when the nymphs have attained perfection within the cocoons enveloping some species, that they may open for the insects a passage to the world.

Ants leave the nest the moment their wings are developed. The labourers, which are distinguished not only by the want of wings, but also by the size of their heads, the strength of their mandibles, and their proportionally longer legs, have the sole charge of all the economy of the habitation, and the rearing of the young. They roam abroad in search of provisions, appear to intercommunicate the success of their labours by the senses of touch and smell, and to aid and assist each other. Fruit, insects or their larvæ, dead bodies of small quadrupeds, and birds constitute their food. The labourers prevent the individuals with newly-acquired wings from issuing forth until the proper moment has arrived, which is always determined by the heat of the atmosphere. They then open a passage for them and let them go. Some few among the labourers are furnished with a much larger head than the rest. These are said to be the defendants of the community, and apparently fulfil the functions of captains in their excursions, at which time they march along the sides of the main body.

The nature and form of the ant-hill vary according to the particular instinct of the species. They usually establish it in the ground. In its construction some only employ particles of earth and almost entirely conceal it, others seize on fragments of various bodies, and with them raise conical or dome-like hillocks over the spot in which they are domiciliated. Some establish their dwellings in the trunks of old trees, the interior of which they perforate in every direction in the manner of a labyrinth, in which the detached particles are also employed. Various and apparently irregular galleries lead to the particular residence of their young. The name of *eggs* is vulgarly applied to the larvæ and nymphs; those of the *Formica rufa* (*Red Ant*) are eaten by young pheasants. The labourers of the *For-*

mica roussatie or *Sanguinea*, (*Amazon Ant*,) by open violence procure auxiliaries of their own caste, but of different species. When the heat of the day begins to lessen and exactly at the same hour, at least for several days, the Amazons quit their nests, advance in a solid column, more or less numerous according to the extent of the population, and march upon the ant-hill they wish to attack. They soon penetrate into it, notwithstanding the opposition of the inhabitants, seize the larvæ and nymphs peculiar to the invaded community, and transport them in the same warlike order to their own domicile, where they are attended to in common with the posterity of their conquerors. Such is the composition of the *Mixed Ant-hills*.

VESPA.

There are several kinds of wasps. *Vespa muraria* is a solitary wasp, and makes a hole some inches deep in sand or the mortar of walls, within which she brings ten or twelve little green larvæ, like caterpillars, but without feet, arranging them in circular layers. She then deposits an egg—the larva of which when hatched, is fed by the little victims of its mother's parental anxiety—and closing the orifice, leaves it, hastening to provide another similar nest. *Vespa vulgaris* is known by its virulent sting when provoked. The wound usually following is, however, more the effect of the poison infused than of the mere puncture, for after stinging three or four times successively, the poison-bag is emptied, and the sting becomes harmless. By means of a sort of sucker terminating their feet, wasps are enabled to run up glass perpendicularly.

APIS.

Apis mellifica or the *hive-bee* is the most interesting species of this genus. Their communities usually consist of from 15 to 20,000 labourers, from 6 to 800 drones, and a single female, who is regarded as the principal Bee, and called a Queen.

The manner in which the labourers build their combs and cells is agreed by geometricians to be at once the most economical with regard to the expenditure of wax, and the most advantageous as respects the size of each cell. Bees always build from the roof downwards.

> "Who at the roof begins her golden work,
> And builds without foundation."

Some cells contain the brood, and others the honey and pollen of flowers.* The latter are mixed together by the bees to form bee-bread, with which they feed the larvæ, which are hatched in a few days, and complete their metamorphosis in less than a month. The bees swallow the juices of flowers, which,

* Which is collected and carried home in two little receptacles near the wings.

after undergoing a sort of change in the stomach, are regurgitated into the cells and become *honey*. *Wax* is secreted from honey or other sweet substances eaten by the bees, and transpires through the pores of the skin.

Dreadful combats sometimes take place amongst bees, and at the end of the autumn all the drones are put to death by the labourers. With the ancient Egyptians the *Bee* was the hieroglyphic emblem of royalty. The attachment always evinced towards the Queen-bee is almost proverbial. In some parts where bees are much cultivated, the hives are transported, when flowers are fading in their native regions, to those districts where they may revel in the blossoms of a later spring.

An elegant allusion is made to the "floating bee-house, or barge laden with bee-hives, which is seen in some parts of France and Piedmont," by Rogers, who uses it as a simile in "an Epistle to a Friend."

"So through the vales of Loire the bee-hives glide,
The light raft dropping with the silent tide;
So till the laughing scenes are lost in night,
The busy people wing their various flight,
Culling unnumbered sweets from nameless flowers,
That scent the vineyard in its purple hours."

BOMBUS.

Humble-bees are the only tribe besides the hive-bee that, in this part of the world, construct nests by the united labour of the society. The habitations composing them are of a rude construction, and the number of inhabitants small, sometimes not more than twenty. They are remarkable for their affection to their young. The nests of *Bombus muscorum* are very singular. They are generally found in meadows, pastures, and hedgerows, and do not exceed six or eight inches in diameter. The lower half occupies a cavity in the soil either accidentally found, or excavated with great labour by the bees. The upper part, or dome, of the nest is composed of a thick felted covering of moss, having the interior ceiling coated with a thin roof of wax to keep out the wet. The combs are not built with the same beautiful regularity exhibited by the hive-bee. The most curious circumstance in the construction of their nests, is the mode in which the bees transport the moss employed in forming the roof. When a quantity of this article is discovered in a convenient site, five or six insects place themselves upon it in a file, turning the hinder part of their bodies towards that quarter to which it is meant to be conveyed. The first takes a small portion, and with its jaws and fore-legs, as it were, felts it together, then pushes it under its body by means of the first pair of legs; the intermediate pair receives the moss, and delivers it to the last, which protrudes it as far as possible beyond the body. When by this process the insect has formed a small ball of well-carded moss, the next bee pushes it to the third, which consigns it in like manner to that behind it, and thus the balls are conveyed to the nest, and from thence elevated to the summit, much in the same way that a file of labourers transfer a parcel of cheeses from a vessel or cart to a warehouse, thus insuring a vast saving of time by this well-contrived division of labour.

(SECOND SUB-CLASS) HAUSTELLATA, (WITH SUCKERS.)

(Order 7th.) *Hemiptera*, from two Greek words signifying the *half* and a *wing*.

The mouth of hemipterous insects is only adapted for extracting fluids by suction. Have six legs and four wings, though some species are apterous. Of this order are these four genera.

CIMEX.

This genus includes all the *bug* tribe.

CICADA.

All this genus, called by us *grasshoppers*, live on trees and shrubs of which they suck the juices. The species *Tettix* was held in the highest esteem and almost love by the Grecians. They were supposed to live on dew, and lead lives the most innocent and happy. Even Plato's eloquence was not thought to suffer by a comparison with their note, and it was the highest commendation of a singer that he excelled this insect. The same word expressed the sound of the Tettix and of the harp. A Cicada sitting upon a harp was an emblem of the science of music, since it was said, that when two rival musicians, Eunomus and Ariston, were contending on that instrument, a Cicada flying to the former and sitting upon his harp, supplied the place of a broken string, and thus secured him the victory. The Chinese, who believe in the transmigration of souls, are said to affirm that the spirit of a poet passes into a grasshopper, because he sings till he starves. *Cicada Orne*, by wounding the bark of the tree from which it derives its specific name, produces the juice called *manna.*

APHIS.

The different species of this genus live on trees and plants. *Aphis rosæ* is familiar to all rose cultivators; and those Aphides which suck the juices of apple and other trees, are easily discernible by the white cottony down covering their bodies. They are exceedingly prolific.

COCCUS.

Of this genus are those insects so celebrated for the crimson dye they furnish—the Cochineal. The most esteemed is *Coccus cacti,* which is cultivated in Mexico, on a kind of Opuntia. From these insects we also obtain Carmine.

Order 8th.—*Trichoptera,* from two Greek words signifying *hair* and a *wing.*

Are destitute of mandibles, and the inferior wings are usually wider than the others, and plaited longitudinally. This order is formed of the genus

PHRYGANEA.

These insects greatly resemble little moths; fly chiefly at night, and are often attracted by light into houses. They diffuse a disagreeable odour; and deposit their eggs on plants near water. The larvæ, which are exceedingly like caterpillars, and live in the water, form for themselves ingenious little cylindrical habitations of shells, stones, leaves, seeds, sand, &c., arranged with the utmost nicety and connected by threads of silk, with which substance also the abode is lined. These habitations are seldom or never to be found alike; they may be often seen moving about in shallow clear water, and the inhabitant is called a *case* or *caddis-worm*.

Order 9th.—*Lepidoptera*, from two Greek words signifying a *scale* and a *wing*.

Have four wings, covered with small coloured scales resembling farinaceous dust, and a proboscis, called *lingua*, rolled spirally between two palpi, which is the instrument with which they extract the nectar from flowers, their only aliment. The females deposit their eggs on the vegetable substances which are to nourish their larvæ, and soon after die. The larvæ are known by the name of caterpillars ; some attack woollens, furs, leathers, &c. Usually change their skin four times. Some live in a silken tent spun by them in common, but most spin and enclose themselves in a cocoon. Are generally one year in passing through their several changes. Of this order are the two following genera.

PAPILIO.

The variety presented by the *butterfly* genus is almost innumerable, and the metamorphoses they undergo are familiar to most. They only fly by day, and are therefore called diurnal.

PHALÆNA.

The Phalænæ are called nocturnal insects: amongst them is *Bombyx mori*, or the *silkworm*. It feeds on the leaves of the mulberry tree, and spins an oval cocoon of a close tissue, containing about three hundred feet of very fine silk, usually of a yellow colour, but sometimes white. A variety is now preferred, which only yields the latter. The Bombyx which produces it is originally from the northern provinces of China. Silk was formerly sold for its weight in gold. The larva or caterpillar spins its cocoon amongst the branches of the tree on which it feeds. One species, *Bombyx processionnea*, lives in communities on the oak, in some parts of Asia. They spin in common, when young, a tent which shelters them, and from which they issue at night in procession. One goes first as guide, and is followed by two, then three, four, and so on; each succeeding line regularly increasing by an unit. When about to enter the pupa, or chrysalis state, they spin their cocoons as closely united as possible.

Order 10th.—*Diptera*, from two Greek words signifying *twice* or *double*, and a *wing*.

Have six feet, two membranous extended wings, and a mouth only adapted for extracting and transmitting fluids; the appendages of the sucker acting as lancets to open a passage to the juices on which the insects feed, and also to force them up into the mouth. Many of this order are noxious, sucking our blood and that of our domestic animals; whilst others are useful by consuming dead and putrefying bodies, and by accelerating the dissipation of stagnant and putrid water. They undergo a perfect metamorphosis, and some spin a cocoon—their term of life is very short. Of Diptera we may select these three genera.

CULEX,

Or Mosquitoes. These insects feed on the nectar of flowers, but unfortunately are not contented with so pure an aliment. They, at least the females, pursue human beings with an insatiable desire to suck their blood. The evening is the time when they generally begin their attack, and the sucker being formed like a sting, produces a wound wherein they instil a venomous fluid. In America the beds are furnished with gauze curtains on purpose to exclude these annoying insects.

ŒSTRUS.

The various species of this fly deposit their ova on different living animals, as the horse, ass, sheep, rein-deer, &c., whose bodies nourish the larva. These beasts seem to have an instinctive dread of this fly when hovering above them for the purpose of depositing its eggs.

MUSCA.

This genus includes all the varieties of common *flies*.

Order 11th.—*Aphaniptera,* from two Greek words signifying *in conspicuous,* (so named because something like *elytra, appear*), and a *wing.*

Have a cylindrical or conical proboscis, the base of which is covered by two scales. They form a single genus.

PULEX.

With *Pulex irritans* or the common *flea,* most persons are acquainted.

Pulex penetrans is called by the Americans *Chigoe.* It penetrates beneath the nails of the toes, and the numerous family to which it soon gives birth, cause a malignant ulcer. The Negroes cleverly extract the insect, however, if it be discovered in time.

Order 12th.—*Aptera,* from two Greek words signifying *without wings.*

Destitute of wings, and furnished with a sucker. Of this order are the genera—

PEDICULUS.

The body of the species of this genus is flattened and divided into eleven or twelve distinct segments, three of which belong to the trunk, each bearing one pair of legs. The antennæ are short, equal, and composed of five joints. The legs are short, and terminated by very stout nails, or two opposing hooks, which enable these insects to cling with great facility to the hairs of quadrupeds or to the feathers of birds, whose blood they suck, and on whose body they propagate and pass their lives. They attach their ova to these hairs or feathers. They multiply excessively, and one generation succeeds another with great rapidity. Three species live on man. Their ova are termed nits.

ACARUS.

The Acari, or mites as they are vulgarly termed, are oviparous, and excessively prolific. Most of these insects are very small, or nearly microscopical. They are observed every where. Som eare found under stones, leaves, the bark of trees, in the earth, in water; dried meat, old cheese, and putrescent animal matters. Others are parasitical, living on the skin or in the flesh of various animals, which they often, by their excessive multiplication, reduce to a state of great debility. The origin of certain diseases, such as the itch, has been attributed to particular kinds. Various species of Acari are also found on insects, and some of the Coleoptera that feed on foul substances are frequently covered with them. They have been even observed in the brain and eye of man. *Acarus telarius* is that little red insect which forms extremely fine webs in the leaves of several plants and trees, particularly the Elm, and is very injurious to them.

ARACHNIDA.

Order 1st.—*Araneidea.*

Of this genus are the *Spiders*, principally distinguished by their spinning propensities. It is well known that their webs are used for the purpose of entrapping their prey. The spinning apparatus is situated at the extremity of the abdomen. The spider generally waits in ambush, or even in the midst of the web, until some unhappy insect is caught in his snares, when, if it be large, he first suffers it to become entangled completely in the silk, and then rushing upon it, pierces it with his murderous dart, at the same time infusing a fatal poison into the wound, and sucks its juices. The eyes of Araneides shine like those of cats in the dark, from which it is supposed that they enjoy nocturnal and diurnal vision. The mother spins bags to contain her eggs, and one species of spider, the *Lycosa saccata*, manifests such attachment to them, that if deprived of her charge, life itself seems no longer worth preserving, for sooner than abandon it, she will remain and perish, as has been proved by a cruel experiment. After they are hatched, she still carries the young about with her, clinging to her back, legs, and sides.

Order 2nd.—*Scorpionidea.*

This order contains the varieties of *Scorpions.*

The Scorpion has an elongated body, suddenly terminated by a long slender tail formed of several joints, the last of which is formed by an exceedingly acute point or sting, which affords issue to a venomous fluid, contained in an internal reservoir. It inhabits the hot countries of both hemispheres, and resides under ground, concealing itself beneath stones and other bodies, most commonly in ruins, dark and cool places, and even in houses. It runs with considerable swiftness, curving its tail over its back, and in that attitude frequently approaches persons, presenting a most formidable appearance; it can turn its tail in every direction, and uses it for the purposes of attack and defence. It seizes its prey with its forceps, and throwing its sting forward, pierces and then devours it. Scorpions sometimes grow to a foot in length. The sting of *Scorpio occitanus* is very dangerous. It is found in the south of Europe and Barbary, and is very common in Spain.

Order 3rd.—*Galeodea.*

Order 4th.—*Phrynidea.*

NUMBER AND DISTINGUISHING CHARACTERISTICS OF INSECTS.

The number of species of Insects and Arachnidans distributed throughout the world cannot of course be accurately stated, since doubtless there are many thousands yet undiscovered, but it may be regarded as dependent in great measure on that of *plants.*

The number of plants known in Britain is about 1500, while of insects it is 10,000, averaging more than six insects to one plant. This proportion may be generally regarded as correct, and thus the species of phanerogamous *plants* existing throughout the globe being conjectured to amount to 100,000, those of *insects* may be supposed to average from 400,000 to 600,000, above *three-fourths* being, in all probability, yet undiscovered.

Some genera contain many more species than others, as the Coleoptera and Lepidoptera orders than the Orthoptera and Neuroptera. Some insects also are much more prolific than others; thus the Diptera order, though not containing above half so many *species* as the Coleoptera, exceeds it greatly in the number of *individuals*, filling the air in every place and almost at every season with its dancing myriads. It is difficult to meet with a single individual of some species, whilst thousands of others swarm in our paths; thus, how abundant are wasps, bees and ants! and whole countries are laid waste by the *aphides* and the locusts. An all-wise Providence has proportioned the numbers of each group and species to the work assigned them; and it is in this view that the numerical distribution of insects appears most interesting and important.

The relative proportions of the different orders to each other may be thus stated—

The *Coleoptera* as forming at least one-half of our whole insect population.

The *Orthoptera* and *Dermaptera* as about one-one-hundred-and-sixtieth.

The *Hemiptera* as one-fifteenth.

The *Lepidoptera* as more than one-fourth.

The *Neuroptera* with the *Trichoptera* as one-twenty-ninth.

The *Hymenoptera* as about one-fourth.

The *Diptera* as not one-seventh.

The *Aptera* and *Arachnida* as perhaps amounting to one-nineteenth.

Insects may be divided into those that feed upon *animal* matter, or carnivorous, and those that feed upon *vegetable*, or phytiphagous. The numbers belonging to these two classes may be considered as equiponderant.

They are further distinguished as taking their food in a *living* or a *dead* state, or as thalerophagous and saprophagous. The saprophagous among the British *carnivorous* insects, compared with those that are thalerophagous, are about as one-sixth, whilst among the *phytiphagous* they are as one-ninth. They are still more accurately defined as taking this food by suction or mastication.

Above one-half of our British insects when in their perfect state feed on the nectar of flowers, but it must be remembered that the *Hymenoptera*, although mandibulate, or furnished with jaws, do not suck, but *lap* their food with the tongue.

GEOGRAPHICAL DISTRIBUTION, ETC.

The geographical distribution of insects does not depend solely on the *heat* or nature of the climate, for the same species are seldom found within the same parallels of latitude in different countries, but yet, under certain limitations, it must be admitted that temperature has much to do with their station. The increase of caloric is always attended with a proportional increase in the number and kinds of the groups and species of these beings. If we begin within the polar regions of ice and snow, the list is very meagre. As we descend towards the line, their numbers keep gradually increasing until they absolutely swarm within the tropics; and again, insects that inhabit the *plains* of *northern* regions have been found on the *mountains* of more *southern* ones.

M. Latreille has observed that where the empire of *Flora* ceases, there also terminates that of Zoology. Phytiphagous animals can only exist where there are *plants*; and those that are *carnivorous* and feed upon the *former*, must of necessity cease where they do.

Where vegetation is richest and most abundant, there the animal productions, especially the insect, must be equally abundant.

Some species range over a very small part of the world, the distribution of others is more extensive; but with the exception of the flea and the louse, it is doubtful whether any have an *universal* range. Their different spheres appear to be wisely ordained for the fulfilment of their several functions: thus the lady-bird (Coccinella) keeps within due limits the *aphides* of every climate from pole to pole; and those insects which prey on dead carcases, are found wherever the action of the solar beam causes these to become putrid.

But most species appear to have some *capital* station, where they are predominant, and whence they extend their range more or less. The genus Culex, or the gnats, as also the Mosquito, seem to have both an *arctic* and a *tropical* metropolis, being found to prevail most in the coldest and hottest climates; and the Laplander and the tropical American are equally their prey, whilst the inhabitants of the temperate zone suffer comparatively but little from them.

In general, tropical insects exceed those of colder climates in size, although this is by no means an undeviating rule. An interesting fact connected with the topographical distribution of insects is their *representation* of each other :—thus, in countries where any species is deficient, it is often supplied by another in some degree similar. Some insects represent each other only in their *form*, others only in their *function*, and others in *both*. The general function of insects is to remove *nuisances* and to check *redundancies*, the saprophagi do the one, and the thalerophagi the other.

In going from the poles to the line, in proportion as the heat increases, the quantum of work for both kinds multiplies, and new forms are either added to the old ones, so as to increase their momentum, or new ones more powerfully talented, replace the old ones and act in their stead; thus we see an interesting change take place in proportion as we approach the maximum of heat and of insect population. As examples of these numerical additions and changes of nature, or *replacements*, may be cited the *Manticora*, which at the Cape *aids* the *Universal Cicindelæ*. The honey and wax of Europe, Asia, and Africa is prepared by *bees* congenerous with our common hive-bee (Apis) while in America this genus is not found as a native, but is replaced by a still different and undescribed type.

EXPLANATION OF THE PLATES.

FRONTISPIECE.

Fig. 1. Cactus cacti.—Fig. 2. Aphis rosæ.—Fig. 3. Larva of Myrmeleo formicarus.—Fig. 4. Papilio machaon.—Fig. 5. Caterpillar of ditto.—Fig. 6. Gryllus migratorius.

PLATE II.

Fig. 1. Head of Apis mellifica, magnified; A. eyes; B, stemmata; CC, antennæ; d, clypeus; e, labrum; ff, mandibles; dd, maxillæ; b, proboscis or tongue; cc, labial palpi.—Fig. 2. Head and mouth of a beetle; a, labrum or upper lip; b, mandibles; c, external maxillary palpi; d, labial palpi; e, antennæ.—Fig. 3. Elytra or wing-cases of beetle.—Fig. 4. Egg of Apis mellifica. —Fig. 5. Larva of ditto.—Fig. 6. Chrysalis, or pupa of ditto.

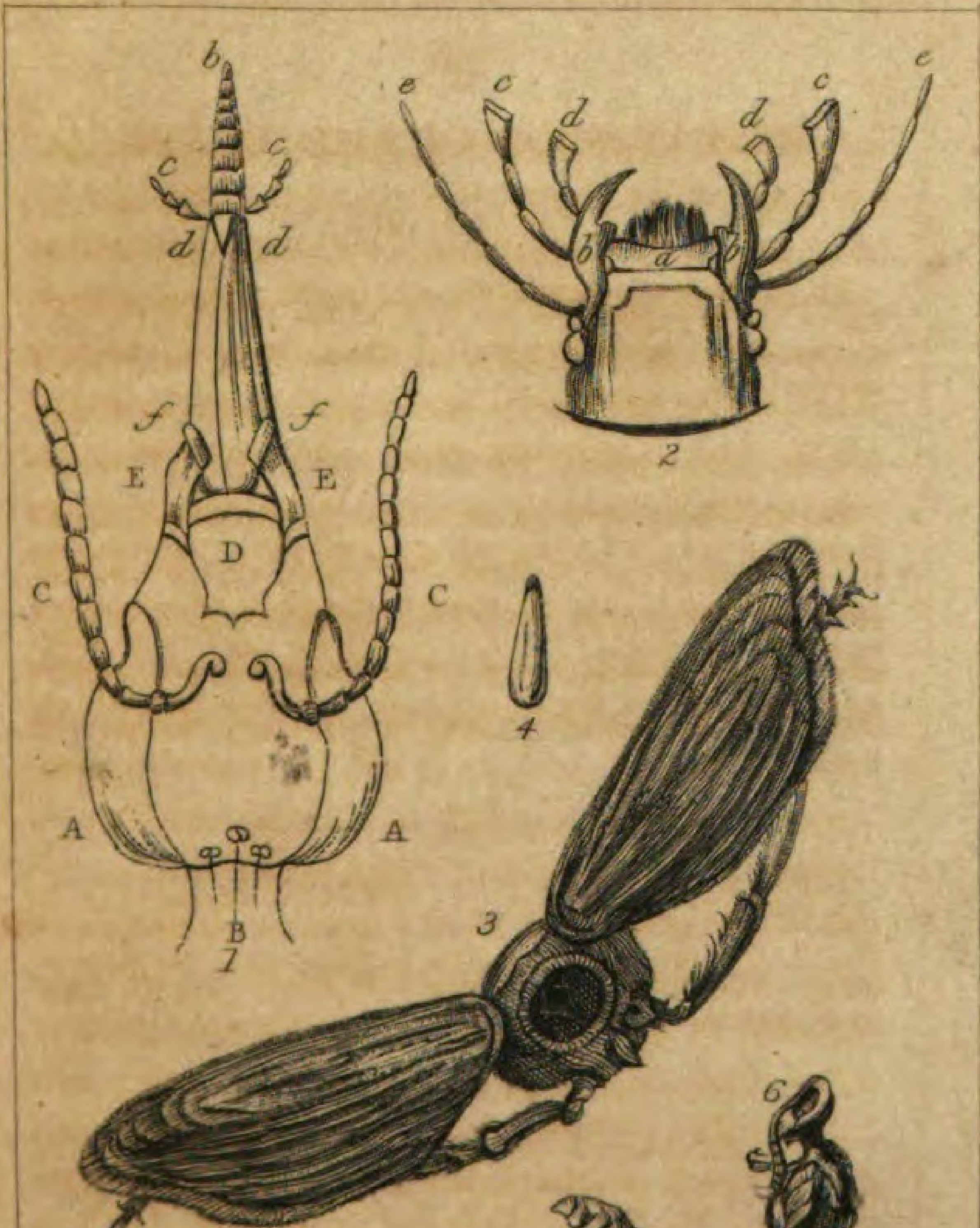
PLATE III.

Fig. 1. Habitation of Case, or Caddis-worm.—Fig. 2. Caterpillar or larva of Bomby mori, or silk-worm.—Fig. 3. Cocoon of ditto.—Fig. 4 Chrysalis, or pupa of ditto.—Fig. 5. Moth, or imago of ditto.—Fig. 6. Lampyris Italica.

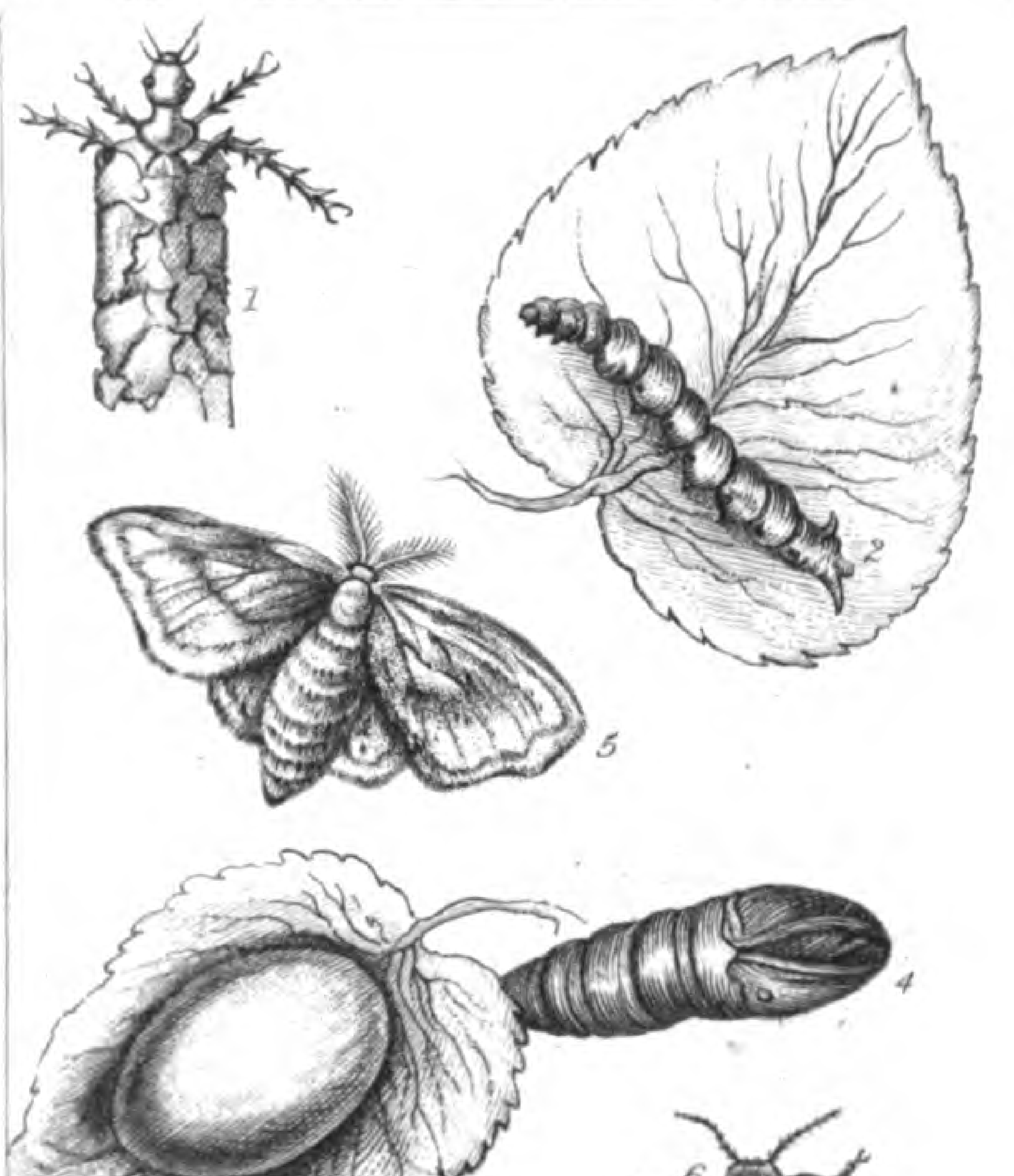
PLATE IV.

Fig. 1. Ephemera.—Fig. 2. Scorpion.—Fig. 3. Formica rufa (red ant).—Fig. 4. Gall nut, or nest of the Gall fly on the Aleppo oak.—Fig. 5. Eggs left on the water by Ephemera.—Fig. 6. Fire fly.

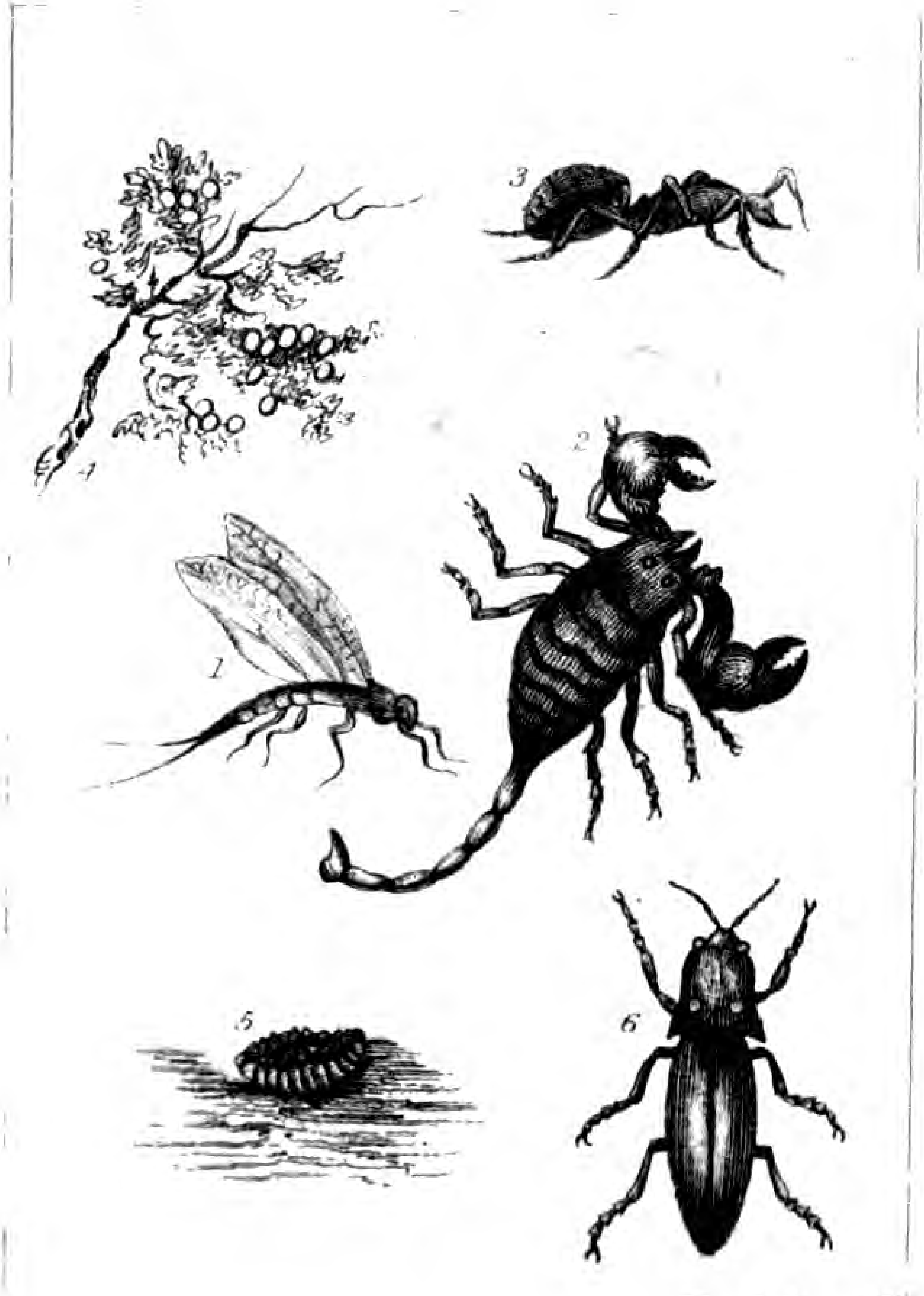
II



III



IV



GLOSSARY OF TERMS,

ETC.

Abdomen, (*the Abdomen*), is the third or posterior section of the body, which follows the *Truncus*; it includes the *Terjum*, *Venter*, *Petiolus*, *Cauda*, and *Anus*.

Alitruncus, (*the Alitrunk*), the posterior segment of the trunk, to which the abdomen is affixed, and which bears the legs and wings.

Antennæ, (*the Antennæ*), two moveable and jointed sensiferous organs, situated in the space between or before the eyes, but in no instance behind them.

Anus, the termination of the abdomen, consisting of the two last segments.

APTEROUS, destitute of wings.

CAPUT, (*the Head*), is the anterior section of the body, consisting of a kind of box without suture or segment, which receives the organs of sensation and manducation. It includes the ***Os, Facies, Sub-Facies,*** and ***Collum.***

CAPSULE, hollow case.

CAUDA, (***the Tail***).

CAUDAL, relating to the tail.

CARNIVOROUS, feeding on flesh.

CENTIPEDE, having more than fifty legs, but less than two hundred.—Ex., *Scolopendra.*

CHELIFORM, furnished with a *chela,* or thumb.

COCOON, the oval habitation woven by some larvæ before undergoing their second metamorphosis.

COLLUM, (*the Neck*).

COMPOUND, (*Compositi*), eyes consisting of an aggregate of hexagonal lenses.—Ex., ***all the winged orders.***

CRUSTACEOUS, (*Crustacea*), a rigid, calcareous substance.—Ex., ***the shell of a lobster or crab.***

DIURNAL, insects that walk or fly by day.

ELYTRA, wing-cases.

EYES, (*Oculi*), are either simple or compound, generally the latter.

FACIES, (*the Face*), upper surface of the head.

FARINACEOUS, mealy, like flour.

HERBIVOROUS, feeding on plants.

IMAGO, the last and perfect state of an insect.

INOSCULATE, the insertion of one part into the cavity of another, as a *joint*.

INTEGUMENT, a covering.

LABRUM, (*the upper Lip*), an usually movable organ, situate between the mandibulæ, which covers the mouth from *above*.

LABIUM, (*the under Lip*), a moveable organ situate between the maxillæ, which covers the mouth from *beneath*.

LABIAL, relating to the under lip.

LARVA, the first state of an insect on leaving the egg.

LATERAL, placed at the side.

LIGULA, (*the Palate*).

LINGUA, (*the Tongue*), varying considerably in different orders and tribes.

MANDIBULATA, insects furnished with jaws.

MANDUCATION, the act of chewing.

MANDIBULÆ or MANDIBLES, (*the Upper Jaws*), two transverse lateral organs, in most insects used for manducation, closing the mouth above, under the *Labrum*.

MANITRUNCUS, (*the Manitrunk*), the anterior segment of the trunk, in which the head inosculates, or on which it turns.

MAXILLÆ, (*the Under Jaws*), two organs moving sub-horizontally, fixed on each side of the base of the ***Labium***, and often parallel with it.

MAXILLARY, relating to the jaws.

MEMBRANOUS, (***Membranacea***), a fine, thin, transparent substance—a ***Membrane***.—EX., *wings of Hymenoptera and Diptera*.

MENTUM, (*the Chin*), it is usually seated between the base of the ***Maxillæ***.

MOULTS, changes of integument or covering.

MYRIAPODS, having 200 legs or more.—Ex. *Iulus*.

NERVURES, (***Nerves***).

NOCTURNAL, insects that walk or fly by night.

OCULI, (*Eyes*).

OMNIVOROUS, without choice in feeding.

OS, (*the Mouth*).

OVA, (***Eggs***).

OVIPAROUS, produced by eggs.

PALPI, (*Feelers*), of two kinds. *Palpi Labiales*, (the Labial feelers), two jointed sensiferous organs, the use of which is not clearly ascertained, which emerge one on each side from the *Labium*. *Palpi Maxillares*, (the

Maxillary feelers), *ditto*, emerging from the *Maxillæ*.

PARASITES, existing on the bodies of other living animals.

PEDIFORM, resembling the *legs* either in structure or use.

PETIOLUS, or FOOTSTALK, a slender part by which the abdomen of many Hymenoptera is united to the trunk.

PHANEROGAMOUS PLANTS, those of which the seed producing organs are apparent.

PHYTIPHAGOUS, feeding on living or dead vegetable matter.

PUPA, the second state of insects after leaving the egg.

RAPACIOUS, seizing by violence—(carnivorous).

SAPROPHAGOUS, taking food, whether animal or vegetable, in a dead state.

SEGMENT, (*Segmentum*), the great inosculating joints of the body.

SIMPLE, (*Simplices*), eyes which do not consist of an aggregate of hexagonal lenses. --Ex. *Araneidæ, Scorpio, Phalangium*.

SPIRACULA or SPIRACLES, breathing-pores.

SUB-FACIES, (*Sub-face*), lower surface of the head.

SUTURE, (*Sutura*), the line of separation of any two parts of a crust, which are connected only by membrane or ligament, but do not inosculate. A false suture is the *appearance* only of a division.

TERJUM, upper surface of the abdomen.

THALEROPHAGOUS, feeding on animal or vegetable matter in a living state.

THORAX, the whole upper side of the truncus.

THORACIC, relating to the thorax.

TIBIA, (*Shank*), fourth joint of the leg, very long.

TRUNCUS, (*the Trunk*), is the intermediate section of the body which lies between the head and the abdomen. It includes the *Manitruncus*, and the *Alitruncus*.

UNGUICULATE, terminating in a moveable claw.

VENTER, lower surface of the abdomen.

VENTRAL, relating to the venter.

J. MASTERS, ALDERSGATE STREET.