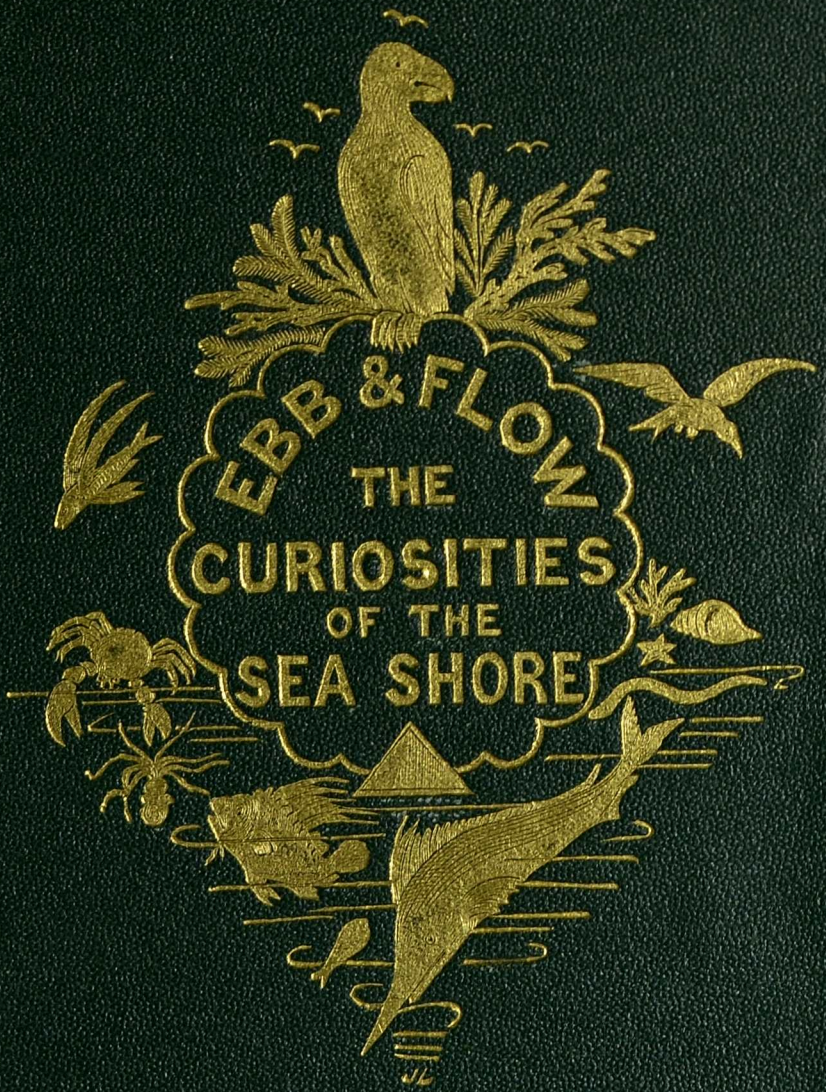
EBB & FLOW
THE
CURIOSITIES
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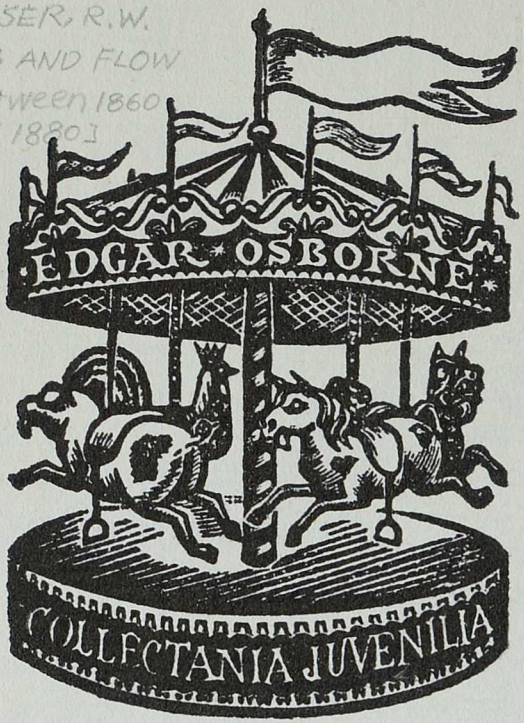
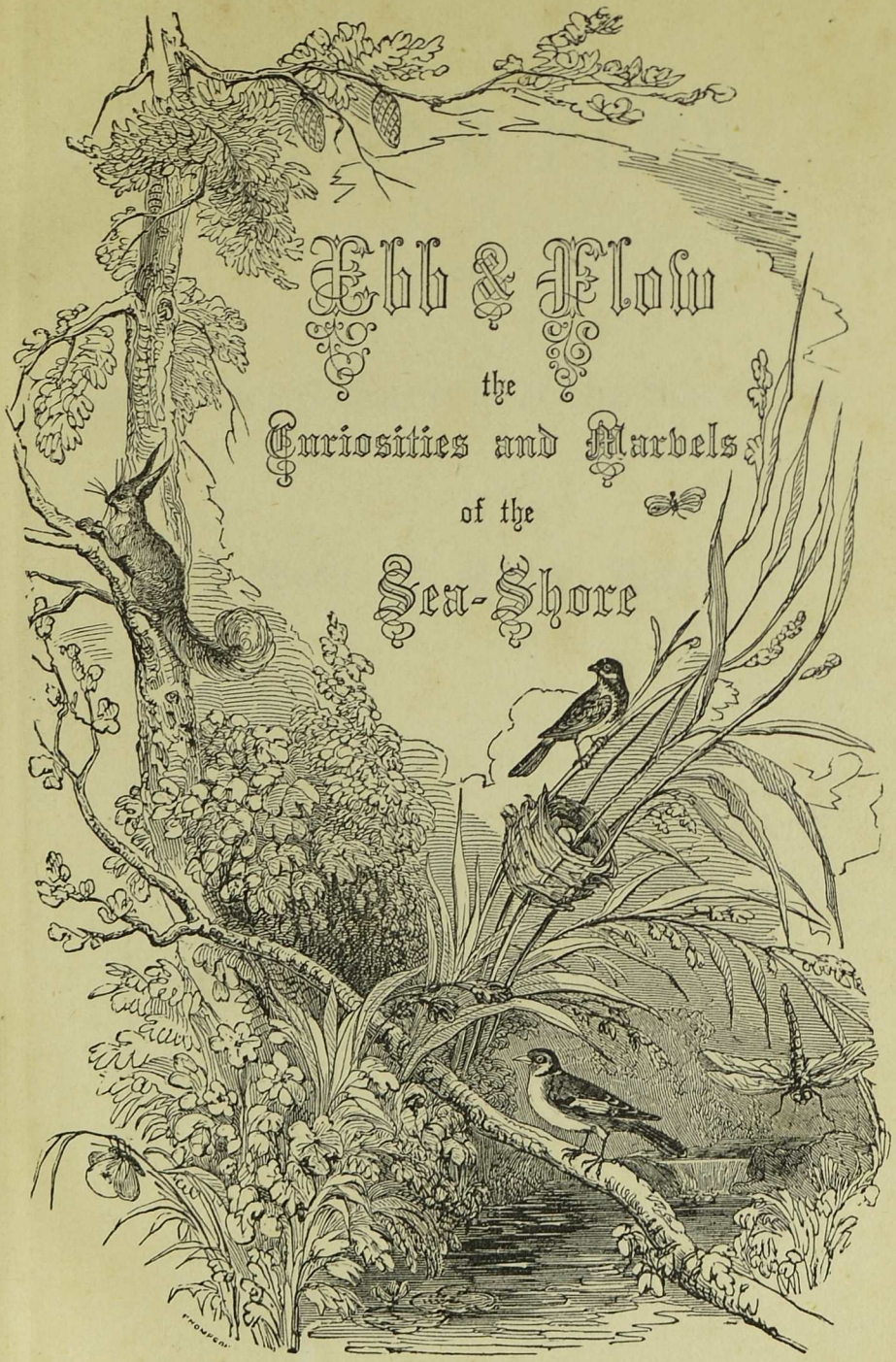


E. L. B. Stone Feb 1880

RAINBOW—ROSAMOND'S BOWER.


Ebb & Flow
the
Curiosities and Marvels
of the
Sea-Shore

EBB AND FLOW

THE

Curiosities & Marvels of the Sea-Shore

A Book for Young People

EDITED BY

The Author of 'Elements of Physical Science, &c.

New Edition.

EDINBURGH:
E. & S. LIVINGSTONE.

PREFACE.

Few objects possess greater interest than those which pertain to the Sea-shore. The coast itself, whether rocky or level—the ocean with its tides, its storms, and its calms—the plants, the fishes, the birds which inhabit or visit the shores—constitute an inexhaustible fund of instruction and delight. A great number and variety of such topics are presented in this volume, all of which merit the attention of intelligent minds.

The beauty and interest of the work are much enhanced by the Illustrations; and we trust the volume will prove an acceptable instructor at home, as well as an agreeable and appropriate companion by the Sea-shore.

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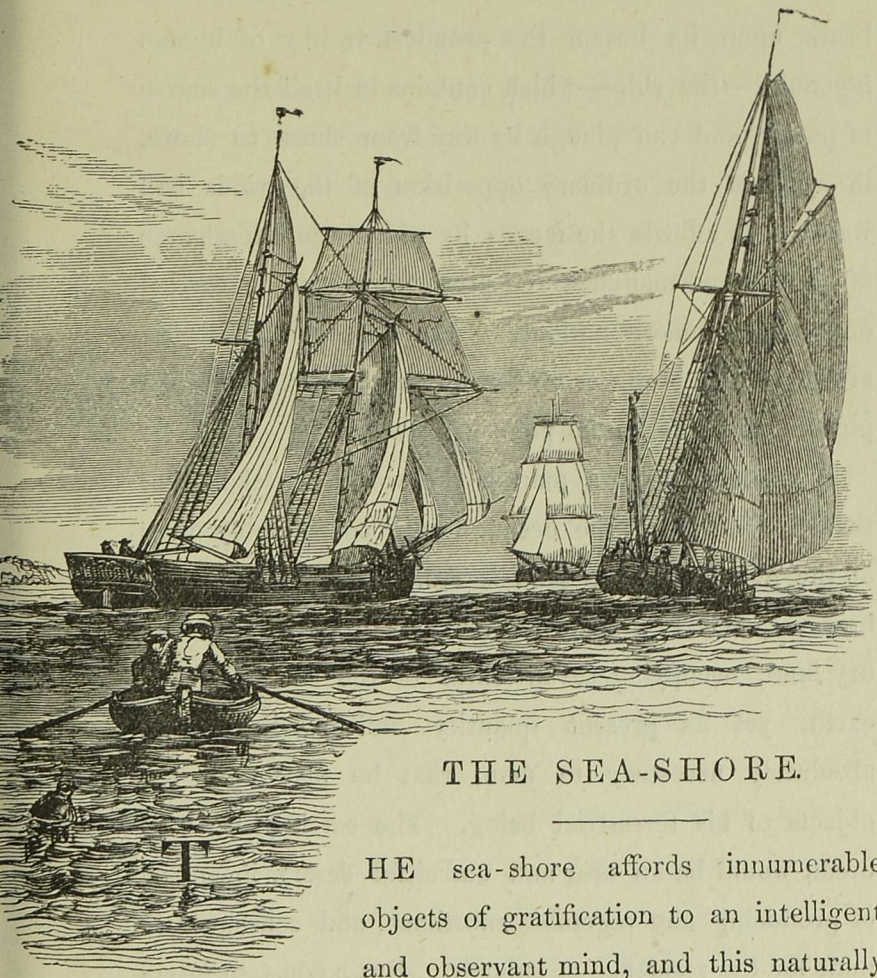


THE SEA-SHORE.

THE sea-shore affords innumerable objects of gratification to an intelligent and observant mind, and this naturally arises from the interest inseparable from the ocean and its phenomena and productions. The ocean divides large

portions of the inhabited parts of the earth from each other, but at the same time affords a ready and effectual means of communication between them. It bears upon its bosom the proudest trophy of human ingenuity—the ship—which contains in itself the source of power, and can plough its way from shore to shore, in spite of the ordinary opposition of the winds and waves. It affords the means by which the interchange of natural and manufactured productions can be carried on between remote nations, to the unspeakable benefit of the various branches of the human family, both in a physical and intellectual point of view.

If we look upon a map of the world, we shall find that the waters of the ocean occupy considerably more of the globe than the land is found to do. Although, however, the sea bears so large a proportion to the dry land, occupying seven-tenths of the surface of the earth, yet its present quantity and conditions are absolutely necessary to man, that he may fulfil the objects of his terrestrial being. The earth without an ocean would be an arid and unfruitful desert, incapable of producing any vegetable substance, and consequently unfit for the residence of animals. But a constant interchange is going on between the ocean, the atmosphere, and the dry land. By the action of solar heat upon the

surface of water, it is vaporised, and carried in an elastic form into the atmosphere. By a variety of causes, and especially by the agency of electricity, this aqueous vapour is condensed and returned to the earth, a part falling upon the sea itself, and a part upon the dry land. Having performed its purpose in watering the earth, and in giving fresh vigour to vegetable growth, it is, directly or indirectly, returned to the ocean, to pass again through the same series of changes and circumstances. But the ocean serves another important end, in the abstraction and decomposition of many of the noxious substances contained in the atmosphere; and there is little doubt that it is the means of checking some of those principles of disease which are known to be wafted from clime to clime on the wings of the wind.

Oceans are collections of water in valleys, and their basins must present the same inequalities as are observed upon the surface of the land. Mountains, hills, and valleys are to be found in the bed of the ocean as well as on dry land, and the causes which effected changes in the relative positions of the one must have had some and a similar influence upon the other. The depth of the sea, therefore, must vary considerably in different places. But there is much difficulty in ascertaining the depth at any place; for not only are substances moved more readily

in water than in the atmosphere, on account of their loss of weight in that medium, but they are also subject to rapid transportation by currents. On these accounts, there are many situations in which the heaviest sounding-lead can be of little or no value. Lord Mulgrave sounded in the Northern Ocean in a place where he gave out 4700 feet of line without finding a bottom; and Mr Scoresby could not find a bottom in one part of the Greenland Sea at the depth of 7200 feet. But the deepest soundings on record were made during the antarctic voyage, where at one place in the Atlantic, within the Southern tropic, 4600 fathoms or 27,600 feet of line was run out without reaching the bottom. The mean depth of the Atlantic has been calculated at 50,000 feet; and it is supposed that its deepest hollows do not exceed 80,000 feet, or about fifteen miles.

LEVEL OF THE SEA.

From the universal law by which water is known to be governed, it might be deduced that the surfaces of all connected bodies of water must be on the same level; and if there were no deranging causes, this would be the case, and the surface of the ocean would give the precise form of the earth. The great law of gravitation has its

action in this as well as in all other instances ; and water, wherever situated, not only seeks the lowest places it can reach, but also attempts to maintain the same level. But it is impossible that there can be a universal level at any moment, so long as the disturbing causes, intimately connected with the present physical condition of the earth, exist. The influence of the moon producing tides is one of these causes, and occasions a considerable difference in the height of the water in near as well as distant parts of the same ocean or sea. The level is also liable to alteration from the local influence of winds ; and it has been ascertained that in all gulfs and inland seas, the level is always higher than on the ocean. This is especially the case with those which are open only to the east, for they are more exposed to the great oscillation of the water from east to west, to which the ocean is periodically subject. By this movement the water is carried into these inlets, and the more confined their openings the higher will be the level. M. Humboldt made some experiments on the Isthmus of Panama, from which he deduces that the level of the Gulf of Mexico is from 20 to 23 feet higher than that of the Pacific. The influence of the tides is well known, and is observed more or less upon all bodies of water connected with the ocean. Winds also have an effect

in destroying the level, not only by the formation of waves, but also by driving in one direction a body of water in greater volume than usual. Upon sea-coasts this effect is frequently produced; and navigators are aware that in consequence of the easterly trade-winds urging the waters of the ocean towards the African coast, the level of the Red Sea is always about twenty feet above the level of the ocean. These are the causes which produce an elevation of the level in some places; and there is one agent, evaporation, which sometimes lowers it. The Mediterranean Sea, for instance, is a little below the general level; for the waters it receives from the numerous rivers whose basin it is, are not sufficient to compensate for the loss by evaporation, and a constant supply is consequently furnished through the Straits of Gibraltar.

THE COLOUR OF THE OCEAN.

The colour of the ocean is not fixed, but is influenced by the direction of the light, the chemical composition of the water, and the nature of the rocks over which it flows. The sea commonly appears to have a deep blue tinge, but as the depth decreases it becomes clearer and has a lighter shade. When a small quantity of sea-water is examined, it has no colour; and this is also

true of a small quantity of atmospheric air; both of these media are, in minute volumes, incapable of intercepting so large a quantity of any ray as to give colour to the volume. Yet they differ in their powers of interception; air reflects the most refrangible rays, the violet, indigo, and blue, which produce the azure hue that is known to distinguish it; but water, on account of its density as well as its depth, reflects some of the less refrangible rays, and hence its greenish blue colour. Under peculiar circumstances, the sea exhibits other shades, but these are to be attributed to local rather than general causes—the character of the bed over which the waters flow, and sometimes the animalculæ, insects, or plants, which float over or immediately beneath its surface. In the Gulf of Guinea the sea is white; around the Maldives it is black; in the upper part of the Mediterranean it has a purple tint; and the West Indies are washed by an ocean so transparent, that the bottom of the sea lies open to examination. There are also in all places changes of colour, produced by the shadows thrown upon the sea by the interception of the clouds, and these shades are so evanescent and varied when the sky is thickly covered with broken clouds, that we may almost fancy the eye is deceived.

PHOSPHORESCENCE OF THE SEA.

The sea has sometimes a luminous appearance, a phenomenon that has been observed by all sailors, who consider it the forerunner of windy weather. It is said to occur most frequently in the summer and autumn months, and varies so much in its character as to induce a doubt whether it can be always attributed to the same cause. Sometimes the luminous appearance is seen over the whole surface of the water, and the vessel seems as though floating upon an ocean of light; at other times the phosphorescence only encircles the ship. A portion of water taken from the sea does not necessarily retain its luminous appearance, but its brilliance will generally continue as long as the water is kept in a state of agitation. Some philosophers imagine the phosphorescence of the sea to arise from the diffusion of an immense number of animalculæ through the medium, and others attribute it to electricity. Dr Buchanan has given an account of a very remarkable appearance of the sea, observed by him during a voyage from Johanna to Bombay. About eight o'clock in the evening of the 31st of July 1785, the sea had a milk-white colour, and was illuminated by a multitude of luminous bodies greatly resembling the combination of stars known as the milky-way—the luminous

substances representing the brighter stars of a constellation. The whiteness, he says, was such as to prevent those on board from seeing either the break or swell of the sea; although, from the motion of the ship and the noise, they knew them to be violent, and the light was sufficiently intense to illuminate the ropes and rigging. This singular phenomenon continued until daylight appeared. Several buckets of water were drawn, and in them were found a great number of luminous bodies from a quarter of an inch to an inch and a half in length, and these were seen to move about as worms in the water. There might be, says Dr Buchanan, four hundred of these animals in a gallon of water. A similar appearance had been observed before in the same sea by several of the officers, and the gunner had seen it off Java Head in a voyage to China.

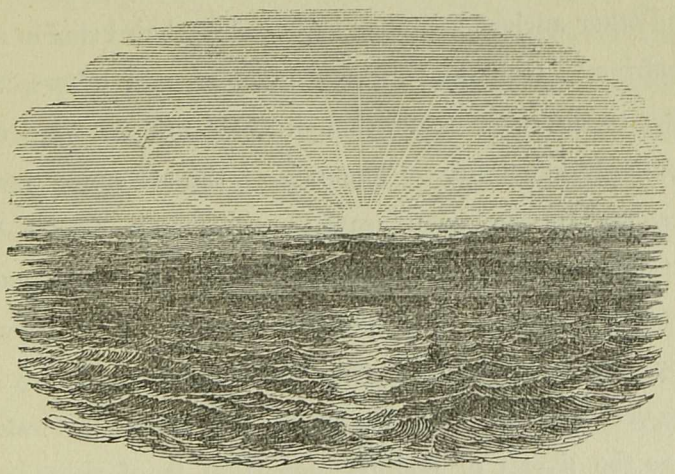
TEMPERATURE OF THE SEA.

The ocean has not always the same temperature in the same latitude. Within the tropics there is little or no difference between the temperature of the northern and southern hemispheres, but as we approach the poles the temperature is less, for any degree of latitude, in the northern than the southern. In eighty degrees north

latitude ice generally melts in the month of May, though it remains all the year round in sixty degrees south latitude. Ice also extends nearly eight degrees further from the south pole than it does from the north, for icebergs have been found as low as forty-eight degrees south latitude. This greater decrease of temperature in the southern hemisphere has been attributed to the almost entire absence of land in the antarctic circle, whereas the arctic sea is almost surrounded by land. Peron invented an instrument, which he called a thermo-barometer, for the measurement of the temperature of the ocean, and from a great number of experiments, deduced a series of singular results; but some of these have been controverted by Humboldt. Peron states that in the neighbourhood of islands or continents the temperature of the water is always higher than in the open sea, and that near a shore the cold increases with the depth. But Humboldt objects to this statement as a general law; for although the temperature of the tropical seas, and the Mediterranean, and Baffin's Bay, does diminish with the depth, yet in the Greenland Seas and in the Arctic Ocean the temperature increases with the depth. The experiments made in the south seas during Krusenstern's voyage of discovery tend to establish the law that the cold increases with the depth. Saussure

estimates the mean temperature of the sea at 53°; but it appears to range between 26° and 68° of Fahrenheit's thermometer.

In addition to such considerations as these, the currents and tides which prevail in the ocean, its living inhabitants and its vegetable productions, all add immensely to the interest with which it is impossible not to regard the world of waters. The sea at sunrise is



beyond doubt one of the most magnificent sights on which the eye can rest; and an intimate acquaintance with the phenomenon and productions of the ocean, cannot but add greatly to those emotions with which we regard this marvellous exhibition of the wisdom, the power, and the goodness of the great Creator.

TIDES AND CURRENTS OF THE SEA.

'The most constant and important motion of the sea,' says Mr Higgins, 'is that which it periodically suffers in consequence of the attractive force of the sun and moon. The tides, as these oscillatory movements are called, have long been supposed to have some connection with the position of the moon, for Pythias, Pliny, Ptolemy, and other ancient astronomers, confess their belief in this doctrine.' Galileo, Descartes, Kepler, and others, also refer to the same cause, though their notions were exceedingly indefinite. 'The orb of the attracting power possessed by the moon,' says the illustrious Kepler, 'is extended as far as the earth, and draws the water under the torrid zone, acting upon places where it is vertical, insensibly upon confined seas and bays, but sensibly on the ocean, whose beds are large, and where the waters have the liberty of reciprocation, that is, of rising and falling.' But it was left for Newton, the greatest of all philosophers, to determine the nature of the lunar attraction, and the laws by which that force is governed. Great as the volume of water upon the surface of the earth is, it has a constant oscillation, ebbing and flowing alternately. In six hours it rises from its lowest to its

highest level, and, after remaining stationary for a few minutes, descends in the same period of time to the level it had at low-water. The total period that intervenes between the times when the sea at any place has the same level is twelve hours and fifty minutes; but the time of high-water is fifty minutes later every day than it was the day previous; which answers to the motion of the moon rising later on every day than on the preceding, and performing her revolution in about thirty days. The cause stated generally, is the diminution of the gravity of the water; but the phenomena may be this particularly explained. That part of the earth nearest to the body of the moon must necessarily feel most of its attractive force, for the power of gravity increases as the square of the distance decreases. The waters at the side of the earth near the moon, will be more attracted than the central parts, and these more than the opposite side. It must also be taken into consideration that the force of attraction acts in right lines; and when it operates upon the edges of a body, it must depress rather than raise the fluid, for it draws it away as far as possible to the point nearest the attractive body. But at the same time, the water will rise on the side of the earth distant from the moon—the ocean, therefore, assumes a

spheroidal form in both hemispheres, and there will be high tide at places situated opposite to each other. But the moon is not the only body that exerts an attractive force upon the ocean: the sun is also active, and in fact all the planetary bodies, for every particle of matter has an influence upon every other particle. The sun being greatly superior in size to the moon, it might be supposed that it would have the greater effect upon the waters of our planet; but as its distance is incomparably greater than that of the moon, it has a much less effect. But still it is necessary to take its influence into consideration; and as the subject is one of the most interesting and important connected with the phenomena observed upon the ocean, it will be necessary to examine it with some degree of particularity.

It may not be very clear to a reader why the waters should rise on that side of the earth most distant from the moon, though he may perfectly understand why they are elevated on the side near to her. If it be borne in mind that the water is drawn towards the body by the difference of her attractive power at the surface and the centre, the whole matter will appear distinct. The ocean on that side the earth near to the moon is drawn towards it, because it is more attracted than the centre, and the ocean on the opposite side rises up, because the

centre is more attracted than it, and the water acts as though it receded from the earth's centre, being less operated upon by the attractive force.

Without entering with any minuteness into a consideration of all the important questions connected with the orign and inequalities of tides, there are two subjects worthy attention : the origin of high and low, neap and spring, tides.

The moon crosses the meridian of any place on the earth's surface once in twenty-four hours fifty minutes, in consequence of the diurnal revolution of the earth. There must, therefore, be a high tide at every place once in twenty-four hours fifty minutes, that is to say, when the moon crosses its meridian. But the time of high tide does not coincide with the time when the moon is on the meridian of the place ; and the cause of this is evident, for the water having received motion, continues to rise after the moon has passed from its meridian ; and although the moon's greatest power is afterwards exerted upon other spots, yet it continues to attract the waters at this place, though in a smaller degree. But we have already seen that a high tide also happens at that place most distant from the moon, and therefore there are two high tides during one revolution ; and it follows there must be two low tides which happen when the place is

removed ninety degrees from those relative aspects in which it suffered high tide.

In this explanation we have omitted to consider the influence of the sun ; but although this body is at so much greater distance from the earth than the moon as to have a much less effect upon the ocean, yet it cannot be altogether unnoticed in a theory of the tides, for it acts in the same manner though in a less degree. There are times when the sun and moon act together upon the ocean, and it is then that the waters rise the highest, and we have spring-tides ; there are other times when the moon acts in opposition to the sun, and there are then neap-tides. If the moon moved in the plane of the equator, the highest tides would always be under the equator, and in the polar seas there would be no tide. But as the moon moves in a path inclined several degrees to the plane of the equator, various parts of the earth's surface must come successively under its influence. At the time of new and full moon, the two luminaries co-operate in raising the waters of the ocean, and spring-tides are produced ; when the moon is in her quadratures the luminaries oppose each other, and neap-tides are the result. On account of the counteracting forces produced by the difference in the motions of the two attracting bodies, there must necessarily be a great irregularity in the tides ·

and to determine the period and character of these, requires the application of a precise analytical reasoning. But it may be mentioned, that to the existence of this opposition of forces we may trace the origin of the circumstance that the highest tides are always within the tropics, and the lowest within the polar circles.

There are other irregularities in the tides besides those we have already mentioned, and we may especially notice the disturbance and obstruction of the water resulting from the obstacles offered by banks and projecting masses of land. The tides in bays, gulfs, or harbours situated on the same shore may be very different, though if there were no such disturbing causes, they would be equal as to the circumstances of time and height. Local situation must, therefore, be considered in estimating the height and time of high tide. The tide of the German Ocean requires some hours to make its way up the narrow channel of the Thames to London Bridge. On some of the islands of the South Sea, the tide does not ordinarily rise more than two feet; at Annapolis, in the Bay of Fundy, it has an elevation of 120 feet; and at St Maloes, in Bretagne, and at Bristol, there is a difference of fifty feet between high and low water. These facts will be sufficient to prove the influence of locality upon the tides, and we might have

mentioned the effect of wind, increasing or restraining the rise according to circumstances.

We must now advance to a consideration of the third kind of motion to which the sea is subject—that produced by currents. These currents have been sometimes arranged in classes according to the circumstances which regulate their motion, some being constant, some periodical, and others temporary; but it will not be necessary that we should confine our remarks in this general sketch to the classification here marked out. In relation to their cause, we must speak much less decidedly than we did in the description we gave of the tides, but we may imagine several agents to assist in their production. The difference of temperature or saltness occasioning a difference of specific gravity—the action of the air in violent motion—the periodical melting of the polar ice, or unequal evaporation, may occasion a current, or two or more of these causes may act together to effect the same result. It is extremely difficult, in the present state of our knowledge, to assign either one of these causes as the positive origin of a current; the state of our information on this subject is rather negative than positive; it is often possible to say what is not a cause when the cause itself cannot be ascertained. We shall, however, only attempt to trace the direction of one of

the most important constant and periodical currents affecting the ocean.

The Florida, or Gulf Stream, is one of the most singular phenomena in hydrography: it is a perpetual current of water rising in the Gulf of Mexico, and flowing in a curved line into the Northern Atlantic. The direction of this current is, in a great measure, to be attributed to the obstacles thrown into the way of the various and universal movements to which the water is periodically subject. This will appear evident, if we trace the motion of the sea and the direction it takes. It is proved by the masses of ice and other substances floated from the polar regions towards the equator, that there is a general movement of the ocean in that direction; and it will be remembered, that it was this current that caused the failure of Captain Parry's last attempt to approach the North Pole, the current driving his vessel more rapidly towards the south than he could advance to the north. It is quite possible that the action we have already described in reference to the atmosphere may be going on in all collections of water; and there may be an upper and an under current, a stream of cold water rushing to the equator, and streams of heated water towards the poles. But the water of the arctic regions is urged to the tropics, not only by its lower temperature, but also by its being less attracted

by the heavenly bodies. Now, as this mass of water advances towards the equator, it comes under the influence of a greater centrifugal force; but being unable at once to acquire the increasing motion of the earth, it is left behind, if we may so speak, by the earth, which is turning from west to east, and it has consequently the appearance of a general movement from east to west. But this effect is aided by two causes, the motion of the wind and the tides. The trade-winds have, as we have already seen, a general westerly direction; and it has been observed by all navigators, that when the wind acts for any considerable time upon a body of water, it never fails to form a superficial current moving in the same direction. But the tides also, where uninfluenced by the land, have the same direction; so that there are three causes acting in concert, all assisting to produce a westerly current. But this effect is modified by the conformation of coasts, and by the other obstacles thrown into its path by the channels in which it flows. By this general westerly movement, the waters of the Atlantic are thrown from the coasts of Europe aud Africa towards the eastern coast of America. Without attempting to trace the course of the Gulf Stream here produced, or the geographical formation that alters its direction, it may be stated, that entering the Gulf of Mexico, it passes

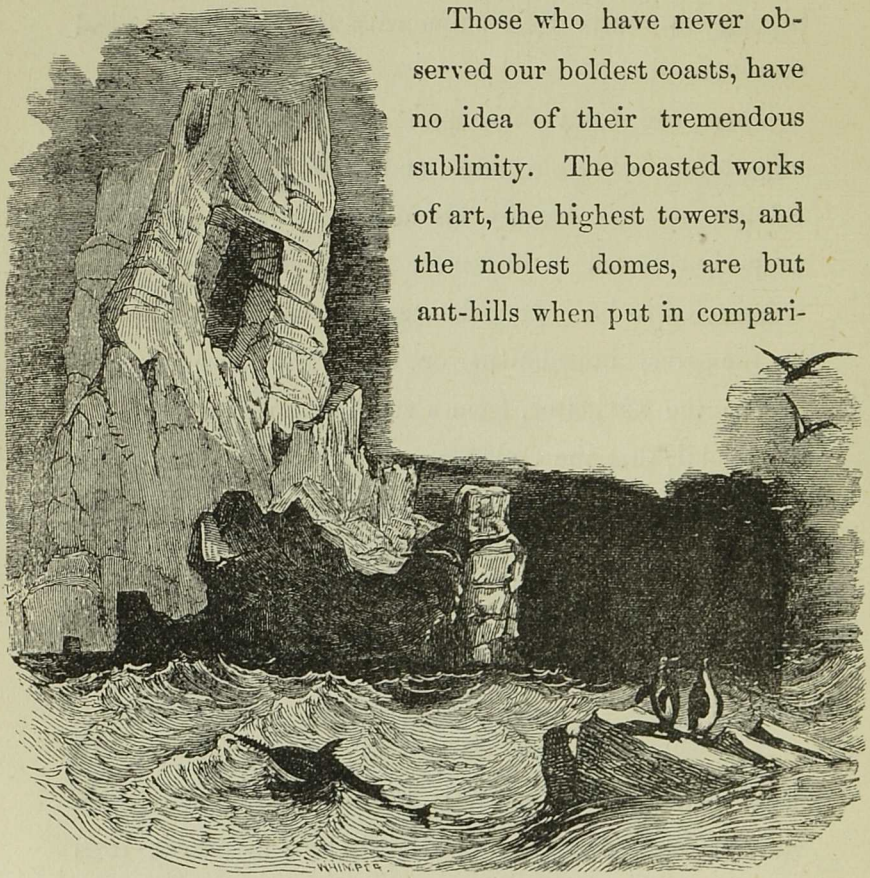
along the Mexican coast to the southern extremity of Florida, where it changes its path, flowing northward with great impetuosity through the Gulf of Florida, and after some variations of course is brought to the southern extremity of Newfoundland. It then turns to the eastward, and successively passes the Azores, the Straits of Gibraltar, Madeira, and the Canaries, completing its course by a union with the westerly tropical currents.

There are many other permanent currents of great importance to the navigator, and those that are periodical are not less worthy his attention; and might be properly referred to in a more practical work than this is intended to be. But the reader may obtain an idea of the great impediment or assistance these currents are to the navigator, from a statement made by Baron Humboldt, that the Gulf Stream in the twenty-sixth and twenty-seventh degrees of latitude, moves with a velocity of eighty miles in twenty-four hours.

VARIOUS ASPECTS OF THE SEA-SHORE.

The shores of the sea are of various aspects. In some instances the beach is low and flat, covered with smooth sand, or strewed with pebbles; in others, it is scattered over with stones on which the sea-weed grows,

or occupied by pieces of rock worn away by the action of the waves, and surrounded by pools of water, left by each recess of the tide; but in other instances, the shores are bounded by rocks which rise in vast perpendicular walls abruptly from the water, without having any beach at their basis, and which are unceasingly lashed by the billows.



Those who have never observed our boldest coasts, have no idea of their tremendous sublimity. The boasted works of art, the highest towers, and the noblest domes, are but ant-hills when put in compari-

son; the single cavity of a rock often exhibits a coping higher than the ceiling of a Gothic cathedral. The face of the shore offers to the view a wall of massive stone, ten times higher than our tallest steeples. What should we think of a precipice three quarters of a mile in height? and yet the rocks of St Kilda are still higher! What must be our awe to approach the edge of that impending height, and to look down on the unfathomable vacuity below; to ponder on the terrors of falling to the bottom, where the waves that swell like mountains are scarcely seen to curl on the surface, and the roar of an ocean a thousand leagues broad appears softer than the murmur of a brook! it is in these formidable mansions that myriads of sea-fowls are for ever seen sporting, flying in security down the depth, half a mile beneath the feet of the spectator. The crow and the chough avoid those frightful precipices; they choose smaller heights, where they are less exposed to the tempest; it is the cormorant, the gannet, the tarrock, and the terne, that venture to these dreadful retreats, and claim an undisturbed possession. To the spectator from above, those birds, though some of them are above the size of an eagle, seem scarcely as large as a swallow: and their loudest screaming is scarcely perceptible.

But the generality of our shores are not so formidable. Though they may rise two hundred fathoms above the surface, yet it often happens that the water forsakes the shore at the departure of the tide, and leaves a noble and delightful walk for curiosity on the beach. Not to mention the variety of shells with which the sand is strewed, the lofty rocks that hang over the spectator's head, and that seem but just kept from falling, produce in him no unpleasing gloom. If to this be added the fluttering, the screaming, and the pursuits of myriads of water-birds, all either intent on the duties of incubation, or roused at the presence of a stranger, nothing can compose a scene of more peculiar solemnity. To walk along the shore when the tide is departed, or to sit in the hollow of a rock when it is come in, attentive to the various sounds that gather on every side, above and below, may raise the mind to its highest and noblest exertions. The solemn roar of the waves swelling into and subsiding from the vast caverns beneath, the piercing note of the gull, the frequent chatter of the guillemot, the loud note of the auk, the scream of the heron, and the hoarse deep periodical croaking of the cormorant, all unite to furnish out the grandeur of the scene, and turn the mind to HIM who is the essence of all sublimity.

Yet it often happens that the contemplation of a sea-shore produces ideas of an humbler kind, yet still not unpleasing. The various arts of these birds to seize their prey, and sometimes to elude their pursuers, their society among each other, and their tenderness and care of their young, produce gentler sensations. It is ridiculous also now and then to see their various ways of imposing upon each other. It is common enough, for instance, with the arctic gull, to pursue the lesser gulls so long, that they drop their excrements through fear, which the hungry hunter quickly gobbles up before it ever reaches the water. In breeding, too, they have frequent contests; one bird who has no nest of her own, attempts to dispossess another, and puts herself in the place. This often happens among all the gull kind: and I have seen the poor bird, thus displaced by her more powerful invader, sit near the nest in pensive discontent, while the other seemed quite comfortable in her new habitation. Yet this place of pre-eminence is not easily obtained; for the instant the invader goes to snatch a momentary sustenance, the other enters upon her own, and always ventures another battle before she relinquishes the justness of her claim. The contemplation of a cliff thus covered with hatching birds, affords a very agreeable entertainment; and as they sit upon the ledges of the

rocks, one above another, with their white breasts forward, the whole group has not unaptly been compared to an apothecary's shop.

These birds, like all others of the rapacious kind, lay but few eggs; and hence, in many places, their number is daily seen to diminish. The lessening of so many rapacious birds, may, at first sight, appear a benefit to mankind; but when we consider how many of the natives of our islands are sustained by their flesh, either fresh or salted, we shall find no satisfaction in thinking that these poor people may in time lose their chief support. The gull, in general, as was said, builds on the ledges of rocks, and lays from one egg to three, in a nest formed of long grass and sea-weed. Most of the kind are fishy-tasted, with black stringy flesh; yet the young ones are better food: and of these, with several other birds of the penguin kind, the poor inhabitants of our northern islands make their wretched banquets. They have been long used to no other food; and even salted gull can be relished by those who know no better. Almost all delicacy is a relative thing; and the man who repines at the luxuries of a well-served table, starves not for want, but from comparison. The luxuries of the poor are indeed coarse to us, yet still they are luxuries to those ignorant of better; and it is probable enough

that a Kilda or a Feröe man may be found to exist, outdoing Apicius himself in consulting the pleasures of the table. Indeed, if it be true that such meat as is the most dangerously earned is the sweetest, no men can dine so luxuriously as these, as none venture so hardily in the pursuit of a dinner. In Jacobson's History of the Feröe Islands, we have an account of the method in which those birds are taken; and I will deliver it in his own simple manner.

'It cannot be expressed with what pains and danger they take these birds in those high steep cliffs, whereof many are two hundred fathoms high. But there are men apt by nature, and fit for the work, who take them usually in two manners; they either climb from below into those high promontories, that are as steep as a wall, or they let themselves down with a rope from above. When they climb from below, they have a pole five or six ells long with an iron hook at the end, which they that are below in the boat, or on the cliff, fasten unto the man's girdle, helping him up thus to the highest place where he can get footing; afterwards they also help up another man; and thus several climb up as high as they possibly can; and where they find difficulty, they help each other up, by thrusting one another up with their poles. When the first hath taken footing, he

draws the other up to him, by the rope fastened to his waist; and so they proceed, till they come to the place where the birds build. They there go about as well as they can in those dangerous places, the one holding the rope at one end, and fixing himself to the rock; the other going at the other end from place to place. If it should happen that he chanceth to fall, the other that stands firm keeps him up, and helps him up again; but if he passeth safe, he likewise fastens himself till the other has passed the same dangerous place also. Thus they go about the cliffs after birds as they please. It often happeneth, however (the more is the pity), that when one doth not stand fast enough, or is not sufficiently strong to hold up the other in his fall, that they both fall down, and are killed. In this manner some do perish every year.'

Mr Peter Clanson, in his description of Norway, writes, that there was anciently a law in that country, that whosoever climbed so on the cliffs that he fell down and died, if the body was found before burial, his next kinsman should go the same way; but if he durst not, or could not do it, the dead body was not then to be buried in sanctified earth, as the person was too full of temerity, and his own destroyer.

'When the fowlers are come, in the manner aforesaid,

to the birds within the cliffs, where people seldom come, the birds are so tame, that they take them with their hands; for they will not readily leave their young. But when they are wild, they cast a net, with which they are provided, over them, and entangle them therein. In the meantime, there lieth a boat beneath in the sea, wherein they cast the birds killed; and, in this manner, they can in a short time fill a boat with fowl. When it is pretty fair weather, and there is good fowling, the fowlers stay in the cliff seven or eight days together; for there are here and there holes in the rocks, where they can safely rest; and they have meat let down to them with a line from the top of the mountain. In the meantime some go every day to them, to fetch home what they have taken.

'Some rocks are so difficult, that they can in no manner get unto them from below; wherefore they seek to come down thereunto from above. For this purpose they have a rope eighty or a hundred fathoms long, made of hemp, and three fingers thick. The fowler maketh the end of it fast about his waist, and between his legs, so that he can sit thereon; and is thus let down, with the fowling-staff in his hand. Six men hold by the rope, and let him easily down, laying a large piece of wood on the brink of the rock, upon

which the rope glideth, that it may not be worn to pieces by the hard and rough edge of the stone. They have, besides, another small line, that is fastened to the fowler's body; on which he pulleth, to give them notice how they should let down the great rope, either lower or higher; or to hold still, that he may stay in the place whereunto he is come. Here the man is in great danger, because of the stones which are loosened from the cliff, by the swinging of the rope, and he cannot avoid them. To remedy this, in some measure, he hath usually on his head a seaman's thick and shaggy cap, which defends him from the blows of the stones, if they be not too big; and then it costeth him his life: nevertheless, they continually put themselves in that danger, for the wretched body's food sake, hoping in God's mercy and protection, unto which the greatest part of them do devoutly recommend themselves when they go to work: otherwise, they say, there is no other great danger in it, except that it is troublesome and artificial labour; for he that hath not learned to be so let down, and is not used thereto, is turned about with the rope, so that he soon groweth giddy, and can do nothing; but he that hath learned the art, considers it as a sport, swings himself on the rope, sets his feet against the rock, casts himself some fathoms from

thence, and shoots himself to what place he will; he knows where the birds are, he understands how to sit on the line in the air, and how to hold the fowling-staff in his hand; striking therewith the birds that come or fly away; and when there are holes in the rocks, and it stretches itself out, making underneath as a ceiling under which the birds are, he knoweth how to shoot himself in among them and there take firm footing. There, when he is in these holes, he maketh himself loose of the rope, which he fastens to a crag of the rock, that it may not slip from him to the outside of the cliff. He then goes about in the rock, taking the fowl either with his hand or with the fowling-staff. Thus, when he has killed as many birds as he thinks fit, he ties them in a bundle, and fastens them to a little rope, giving a sign by pulling, that they should draw them up. When he has wrought thus the whole day, and desires to get up again, he sitteth once more upon the great rope, giving a new sign that they should pull him up; or else he worketh himself up, climbing along the rope with his girdle full of birds. It is also usual, where there are not folks enough to hold the great rope, for the fowler to drive a post sloping into the earth, and to make a rope fast thereto, by which he lets himself down without anybody's help, to work in the manner aforesaid. Some

rocks are so formed that the person can go into their cavities by land.

'These manners are more terrible and dangerous to see than to describe; especially if one considers the steepness and height of the rocks, it seeming impossible for a man to approach them, much less to climb or descend. In some places the fowlers are seen climbing where they can only fasten the ends of their toes and fingers; not shunning such places, though there be a hundred fathoms between them and the sea. It is a dear meat for these poor people, for which they must venture their lives; and many after long venturing, do at last perish therein.

'When the fowl is brought home, a part thereof is eaten fresh; another part, when there is much taken, being hung up for winter provision. The feathers are gathered to make merchandise of, for other expenses. The inhabitants get a great many of these fowls, as God giveth his blessing and fit weather. When it is dark and hazy, they take most; for then the birds stay in the rocks: but in clear weather and hot sunshine, they seek the sea. When they prepare to depart for the season, they keep themselves most there, sitting on the cliffs toward the sea-side, where people get at them sometimes with boats, and take them with fowling-staves.'

STAFFA.

Among the cliffs of our sea-coast, the most remarkable are those of the island of Staffa. This island is remarkable for its columnar stone formations, and having its Scandinavian name from the resemblance of these columns to *staffs* or *staves*. It belongs to Argyleshire, being situated at the distance of from four to five miles from the west coast of Mull, and about seven north from Icolmkill. Its form is oblong and irregular, about one mile in length, and half a mile in breadth. 'The beauties of Staffa,' says Macculloch, 'are all comprised in its coast; yet it is only in a small space toward the south and south-east that these are remarkable, as it is here that the columns occur; westward, the cliffs are generally low, rude, and without beauty; but in the north-east quarter, there are five small caves, remarkable for the loud reports which they give when the sea breaks into them, resembling the distant discharges of heavy ordnance. The northernmost point is columnar, but it is nearly even with the water. The highest point of the great face is 112 feet from high-water mark. It becomes lower in proceeding towards the west; the greatest height above M'Kinnon's cave being 84 feet.

The same takes place at the Clamshell cave, where the vertical cliffs disappear, and are replaced by an irregular declivity of a columnar structure, beneath which the landing-place is situated. The columns in this quarter are placed in the most irregular directions, being oblique, erect, horizontal, and sometimes curved; while they are also far less decided in their forms than the large vertical ones which constitute the great face. When they reach the grassy surface of the island, they gradually disappear; but are sometimes laid bare, so as to present the appearance of a geometrical pavement, where their ends are seen; in other places displaying portions of their parallel side. The difficulty of drawing these columns is such, that no mere artist, be his general practice what it may, is capable of justly representing any point upon the island. It is absolutely necessary that he should have an intimate mineralogical acquaintance, not only with the rock in general, but with all the details and forms of basaltic columns; since no hand is able to copy them by mere inspection; so dazzling and difficult to develop are all those parts in which the general as well as the particular character consists. This is especially the case in attempting to draw the curved and implicated columns, and those which form the causeway; where a mere artist loses sight of the

essential part of the character, and falls into a mechanical or architectural regularity. That fault pervades every representation of Staffa, except one, yet published; nor are there any of them which might not have been produced in the artist's workshop at home. At the Scollop, or Clamshell Cave, the columns on one side are bent, so as to form a series of ribs not unlike an inside view of the timbers of a ship. The opposite wall is formed by the ends of columns, bearing a general resemblance to the surface of a honey-comb. This cave is thirty feet in height, and sixteen or eighteen in breadth at the entrance; its length being 130 feet, and the lateral dimensions gradually contracting to its termination. The inside is uninteresting. The noted rock Buachaile, the Herdsman, is a conoidal pile of columns, about thirty feet high, lying on a bed of curved horizontal ones, visible only at low-water. The causeway here presents an extensive surface, which terminates in a long projecting point at the eastern side of the great cave. It is formed of the broken ends of columns, once continuous to the height of the cliffs. This alone exceeds the noted Giant's Causeway, as well in dimensions as in the picturesque diversity of its surface; but it is almost neglected among the more striking and splendid objects by which it is accompanied. The great

face is formed of three distinct beds of rock, of unequal thickness, inclined towards the east in an angle of about nine degrees. The lowest is a rude trap tufa, the middle one is divided into columns placed vertically to the planes of the bed, and the uppermost is an irregular mixture of small columns and shapeless rock. The thickness of the lowest bed at the western side is about fifty feet; but, in consequence of the inclination, it disappears under the sea, not far westward of the Great Cave. The columnar bed is of unequal depth, being only thirty-six feet at the western side, and fifty-four where the water first prevents its foundation from being further seen. To the eastward, its thickness is concealed by the causeway. Thus, at the entrance of the Great Cave on this side, the columns are only eighteen feet high, becoming gradually reduced to two or three, till they disappear. The inequality of the upper bed produces the irregular outline of the island. The inclination of the columns to the horizon, in consequence of their vertical position towards the inclined plane of the bed, produces a very unpleasing effect whenever it is seen, as it is from the south-west; the inclination of nine degrees conveying the impression of a fabric tottering and about to fall. Fortunately, the most numerous and interesting views are found in positions into which

this defect does not intrude; and many persons have doubtless visited Staffa without discovering it. Although the columns have a general air of straightness and parallelism, no one is perfectly straight or regular. They never present that geometrical air, which I just now condemned in the published views. In this respect they fall far short of the regularity of the Giant's Causeway. Very often they have no joints; sometimes one or more may be seen in a long column, while in other places, they are not only divided into numerous parts, but the angles of the contact are notched. They are sometimes also split by oblique fissures, which detract much from the regularity of their aspect. These joints are very abundant in the columns that form the interior sides of the Great Cave, to which, indeed, they are chiefly limited; and it is evident, that the action of the sea, by undermining these jointed columns, has thus produced the excavation; as a continuation of the same process may hereafter increase its dimensions. The average diameter is about two feet; but they sometimes attain to four. Hexagonal and pentagonal forms are predominant; but they are intermixed with figures of three, four, and more sides, extending even as far as to eight or nine, but rarely reaching ten. It is with the morning sun only that the great face of Staffa can be

seen in perfection. As the general surface is undulating and uneven, great masses of light or shadow are thus produced, so as to relieve that which, in a direct light, appears a flat insipid mass of straight wall. These breadths are further varied by secondary shadows and reflections arising from smaller irregularities; while the partial clustering of the columns produces a number of subsidiary groups, which are not only highly beautiful, both in themselves and as they combine with and melt into the larger masses, but which entirely remove that dryness and formality which is produced by the incessant repetition of vertical lines and equal members. The Cormorant's, or M'Kinnon's Cave, though little visited, in consequence of the frauds and indolence of the boatmen, is easy of access, and terminates in a gravelly beach, where a boat may be drawn up. The broad black shadow produced by the great size of the aperture, gives a very powerful effect to all those views of the point of the island into which it enters, and is no less effective at land, by relieving the minute ornaments of the columns which cover it. The height of the entrance is fifty feet, and the breadth forty-eight, the interior dimensions being nearly the same to the end, and the length 224 feet. As it is excavated in the lowest stratum, the walls and the ceiling are without ornament;

yet it is striking from the regularity and simplicity of its form. But the superior part of the front consists of a complicated range of columns, hollowed into a concave recess above the opening; the upper part of this colonnade overhanging the concavity, and forming a sort of geometric ceiling; while the inferior part is thrown into a secondary mass of broad but ornamental shadow, which conduces much to the general effect of the whole. The Boat Cave is accessible only by sea. It is a long opening, resembling the gallery of a mine, excavated in the lowest rude stratum; its height being about sixteen feet, its breadth twelve, and its depth about 150. Upwards the columns overhang it, so as to produce a shadow, which adds much to the effect; while they retire in a concave sweep, which is also overhung by the upper mass of cliff, thus producing a breadth of shade, finely softened into a full light by a succession of smaller shadows and reflections, arising from the irregular groupings of the columns. The upper part of this recess, catching a stronger shadow, adds much to the composition, while the eye of the picture is found in the intense darkness of the aperture beneath, which gives the tone to the whole. The Great Cave is deficient in that symmetry of position with respect to the face of the island, which conduces so much to the effect of the

Boat Cave. The outline of the aperture, perpendicular at the sides, and terminating in a contrasted arch, is pleasing and elegant. The height, from the top of the arch to that of the cliff above, is 30 feet; and from the former to the surface of the water, at mean tide, 66. The pillars by which it is bounded on the western side, are 36 feet high; while at the eastern they are only 18, though their upper ends are nearly in the same horizontal line. This difference arises from the height of the broken columns which here form the causeway; a feature which conduces so much to the picturesque effect of the whole, by affording a solid mass of dark foreground. Towards the west, the height of the columns gradually increases as they recede from the cave, but their extreme altitude is only 54 feet, even at low-water. The breadth of this cave at the entrance is 42 feet, as nearly as that can be ascertained, where there is no very precise point to measure from. This continues to within a small distance of the inner extremity, when it is reduced to twenty-two; and the total length is 227 feet. These measures were all made with great care, however they may differ from those of Sir Joseph Banks. The finest views here are obtained from the end of the causeway, at low-water. When the tide is full, it is impossible to comprehend the whole conve-

niently by the eye. From this position also, the front forms a solid mass of a very symmetrical form, supporting, by the breadth of its surface, the vacant shadow of the cave itself. Here, also, that intricate play of light, shadow, and reflection, which is produced by the broken columns retiring in ranges gradually diminishing, is distinctly seen; while the causeway itself forms a foreground no less important than it is rendered beautiful by the inequalities and the groupings of the broken columns. Other views of the opening of this cave, scarcely less picturesque, may be procured from the western smaller causeway; nor, indeed, without bestowing much time and study on this spot, is it possible to acquire or convey any notion of the grandeur and variety which it contains. The sides of the cave within are columnar throughout; the columns being broken and grouped in many different ways, so as to catch a variety of direct and reflected tints, mixed with secondary shadows and deep invisible recesses, which produce a picturesque effect, only to be imitated by careful study of every part. It requires a seaman's steadiness of head to make drawings here. As I sat on one of the columns, the long swell raised the water at intervals up to my feet, and then subsiding again, left me suspended high above it, while the silence of these

movements, and the apparently undisturbed surface of the sea, caused the whole of the cave to feel like a ship heaving in a sea-way. The ceiling is divided by a fissure, and varies in different places. Towards the outer part of the cave, it is formed of the irregular rock; in the middle, it is composed of the broken ends of columns, producing a geometrical and ornamental effect, and at the end, a portion of each rock enters into its composition. Inattention has caused the various tourists to describe it as if it were all columnar or all rude. As the sea never ebbs entirely out, the only floor of this cave is the beautiful green water; reflecting from its white bottom those tints which vary and harmonise the darker tones of the rock, and often throwing on the columns the flickering lights which its undulations catch from the rays of the sun without.'

WATER-SPOUTS.

Among the remarkable and interesting phenomena of the ocean we may mention the formation of water-spouts. These are most frequently to be witnessed by navigators in the Mediterranean Sea, the Indian Ocean, or the Atlantic; but they have been occasionally seen from the sea-shore.

Meteorologists are by no means agreed as to the causes of the water-spout, and it is a matter of dispute whether their occurrence is to be ascribed to electrical agency, or to the mechanical action of what is called a whirlwind. That the phenomenon is usually attended by a development of electricity seems to be admitted, but philosophers have not ascertained whether the electricity is the effect or the cause of the water-spout. It is certain, however, that the spiral motion of the water results from the gyratory motion of the air, which itself may be occasioned by electric agency.

Various descriptions have been given of those singular phenomena by persons who have witnessed them.

Mr Steward, speaking of the water-spouts seen by him in the Mediterranean in the year 1701, says that they all consisted of a transparent tube. 'It was observable of all of them, but chiefly of the large pillar, that towards the end it began to appear like a hollow canal, only black in the borders but white in the middle; and though at first it was altogether black and opaque, yet one could very distinctly perceive the sea-water to fly up along the middle of this canal as smoke does up a chimney, and that with great swiftness and a very perceptible motion; and then, soon after, the spout or canal burst in the middle, and disappeared little by little, the

boiling up and the pillar-like form of the sea-water continuing always the last, even for some time after the spout disappeared, and perhaps till the spout appeared again or re-formed itself, which it commonly did in the same place as before, breaking and forming itself again several times in a quarter or half an hour.'

Dr Buchanan observed this phenomenon once or twice during a voyage to and from India When his attention was first called to it, he observed a dark thick cloud which threw out a long curved spout, while at the same time a thick fog rose out of the sea. After an interval of about two minutes, the spout rushed down and joined the cloud which had risen from the sea. 'The cloud from which the spout descended then moved,' says Mr Maxwell, 'slowly along, and probably by its motion produced the curvature of the spout. The fog proceeding from the sea was of the same colour as the spout, and resembled the smoke of a steam-engine. The surface of the water under the spout was during the whole time in a state of violent agitation, and a noise was heard like that of a waterfall. The spout soon withdrew itself again into the cloud from which it had descended, and the fog receded into the sea. The whole exhibition did not last more than three minutes.' The same author had opportunities at other times of observing similar appearances, and in

all cases they presented nearly the same phenomena. 'At their first formation,' he says, 'they appear of a conical tubular form, dropping from a black cloud before the disturbance of the sea is observed. The black conical cloud then descends, and the smoke-like appearance from the sea ascends, until they join. When the spout begins to disperse, the black cloud draws itself up, and a thin transparent tube is left still united to the cloud that rose from the sea. This, however, is at last broken, and the phenomenon disappears.'

The Honourable Captain Napier has made some remarks, in the *Philosophical Journal*, upon a phenomenon of the same kind which he observed, and upon the probable cause of the appearance. 'On the 6th of September 1814, in latitude 30° 47′ north, and longitude by chronometer 62° 40′ west, at half-past one P.M., the wind being variable between W. N. W. and N. N. E., the ship steering S. E., an extraordinary sort of whirlwind was observed to form about three cables' length from the starboard bow of H. M. ship *Erne*. It carried the water up along with it in a cylindrical form, in diameter to appearance like a water-butt, gradually rising in height, increasing in bulk, advancing in a southerly direction, and when at the distance of a mile from the ship, it continued stationary for several minutes, boiling

and foaming at the base, discharging an immense column of water, with a rushing or hissing noise, into the over-hanging clouds, turning itself with a quick spiral motion, constantly bending and straightening according as it was affected by the variable winds, which now prevailed alternately from all points of the compass. It next returned to the northward in direct opposition to the then prevailing wind, and right upon the ship's starboard beam, whose course was altered to east in hopes of letting it pass astern. Its approach, however, was so rapid, that we were obliged to resort to the usual expedient of a broadside, for the purpose of averting any danger that might be apprehended, when, after firing several shots, and one in particular having passed right through it at the distance of one-third from its base, it appeared for a minute as if cut horizontally in two parts, the divisions waving to and fro in different directions, as agitated by opposite winds, till they again joined for a time, and at last dissipated in an immense dark cloud and shower of rain. At the time of its being separated by the effect of the shot, or more probably by the agitation occasioned in the air by the discharge of several guns, its base was considerably within half a mile of the ship, covering a portion of the surface of the water at least half a furlong, or even three hundred feet in diameter, from one extreme

circumference of ebullition to the other; and the neck of the cloud into which it discharged itself appeared to have an altitude of forty degrees of the quadrant, while the cloud itself extended overhead and all round to a very considerable distance. Allowing, then, from the ship a base of a little more than one-third of a nautical mile, say 2050 feet, and an angle of 40° to the top of the neck, we shall then have for the perpendicular height of the spout about 1720 feet, or very nearly one-third of a statute mile. A little before it burst, two other water-spouts of an inferior size were observed to the southward, but their continuance was of short duration.'

If Captain Napier's calculation of the height of this water-spout be even an approximation to the truth, it entirely destroys that theory which attributes the phenomenon to the formation of a vacuum. Liquids will rise in exhausted tubes to the height at which they exactly balance a column of atmospheric air having the same base, and water obeying this law will rise to the height of about thirty-two feet, as it does in pumps. Now, if this force acts at all in the formation of water-spouts, it must be aided by some other agent; but what that is cannot be determined in the present state of our knowledge upon the subject: it may be a result of an electrical attraction dependent on the different electric conditions of the cloud

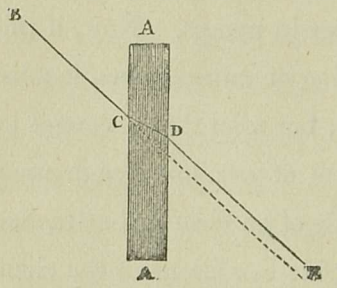
and the ascending fluid, or may be produced by the rotatory motion of the air.

OPTICAL PHENOMENA OF THE SEA-SHORE.

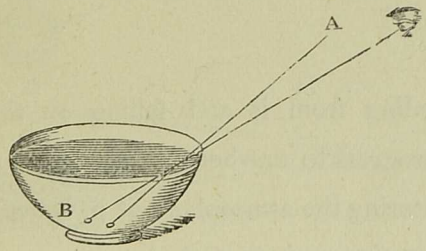
There are some optical phenomena witnessed occasionally on our sea-shores which are highly interesting, and worthy of our attention. These depend upon the difference subsisting for a time between the density of the air, or its power of refraction in different places, which produces some remarkable optical delusions. A short explanation will render the causes thus operating sufficiently obvious.

It is a well-known law in natural philosophy, that a ray of light, in passing out of one transparent medium into another, changes its direction—a course under certain circumstances—that is to say, if the media differ from each other in density or refracting power.

Let B be a ray of light falling at C on the surface of water A A, instead of passing through the water in the same direction in which it previously proceeded, that is, in the direction of the dotted line C E, it will be bent or refracted

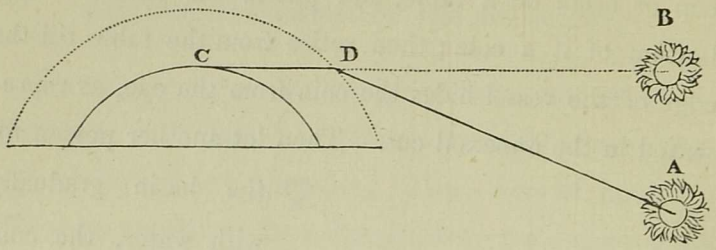


out of that direction, and will proceed to D, and thence, on issuing from the denser medium, to E. This may be illustrated in a very simple manner. Place an empty cup or basin on a table, and put in the centre of the bottom of it a coin; then retire from the table till the edge of the vessel hides the coin from the eye, as represented in the annexed cut. Then let another person fill



the basin gradually with water, the coin will then appear, although it has not in reality altered its position in the slightest degree. The reason of this has been already given in the preceding paragraph. The position of the coin is such, that as the eye is situated, the rays of light from the coin are intercepted by the edge of the vessels, and would proceed to A, so that the coin could not be seen at the point where the eye is placed. But when the vessel is filled with water, which is a medium much more dense than air, the ray of light from the coin is bent towards the eye, and the coin, as well as the bottom of the vessel, appears to be higher than it was, and to have altered its position. This natural law, by which light changes its direction in passing through media of different densities, causes the sun, or a star or planet, to be visible

to the eye before it is actually above the horizon, and while the view of it is actually intercepted by the body of the earth ; thus let A be the sun or a star, and let A D be

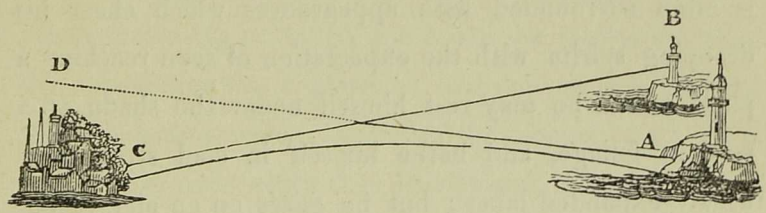


a ray of light proceeding from it and falling on the atmosphere at D in its progress to C, where an observer is situated, this ray, on entering the atmosphere at D, is bent or refracted out of its previous course and proceeds to C, so that the object A becomes visible at C, and appears in the direction of the line C B—that is to say, the object appears at B while its true position is A.

Now, in correspondence with this general law, variously modified according to the varying densities of the media through which the rays of light pass, some remarkable phenomena have been witnessed. Thus in certain states of the atmosphere, a person standing on the sea-shore has been able to see the opposite coasts, which in ordinary conditions of the intervening air was entirely invisible. Thus, an individual on the rocks at C, who usually could distinguish nothing but the top of a distant light-house on

the opposite shore, is sometimes able to perceive distinctly the whole of the building, and even part of the shore itself, which he could not perceive unless he were situated on an eminence at D.

The reason of this is easily understood from what has been already said. In the annexed figure, the observer being at C, the ray of light from A cannot



reach his eye, but in consequence of the increased density of the intervening strata of the air, the rays of light become refracted, the objects become visible, and are seen at B as if raised out of the water.

In consequence of the variable temperature of the atmosphere, it has different refractive powers, and this is the usual cause of that phenomenon called mirage. Light passing through a vacuum, or a medium of equal density, moves in right lines; but when it enters a medium of different densities, in curves. If a ray of light passes from an attenuated to a very dense medium, a portion of light will be reflected, and a part refracted. These several causes acting upon light, bending and distorting

its rays, produce a variety of singular optical deceptions; sometimes throwing the images of bodies upon dense clouds, and at other times investing terrestrial phenomena with unnatural and almost magical appearances.

In all climates exposed to an extreme temperature, whether of heat or of cold, the results of unequal refraction are observed. In the deserts of Africa, the traveller is often surrounded with appearances which cheer his drooping spirits with the expectation of soon reaching a place where he may rest himself under the shade of a verdant foliage, and bathe himself in cool streams or widely-expanded lakes; but he gazes on an airy vision, which is less substantial than the morning cloud. And so the chilled traveller in arctic climes beholds before him mighty cities, with their battlements and towers, which, alas! can give him no shelter, for they are but the distorted forms of the iceberg and the snow-capped pinnacles of barren rocks.

M. Monge, who accompanied the French army into Egypt, states that in the desert, between Cairo and Alexandria, the image of the sky was so mingled with that of the sand, as to give the appearance of a rich and fertile country. The travellers seemed to be surrounded with green islands and extensive lakes, together forming a beautiful landscape in the midst of a sandy plain. But

in vain did the exhausted party press forward to reach this happy spot, for neither the islands nor the lakes were there, nothing but a continuation of the same heated desert over which they had passed so wearily.

Dr Clarke observed a very similar appearance near Rosetta. The city seemed to be surrounded with a beautiful sheet of water, and the Greek interpreter, who accompanied the traveller, could not be persuaded that the appearance was a delusion ; but they reached Rosetta without finding water, and when they looked back upon the country over which they had passed, it appeared as a vast blue lake.

In more temperate climes this phenomenon is sometimes observed. Dr Vince has given a description of an appearance of this kind, which he saw in 1798 at Ramsgate. The topmast of a ship approaching the shore was just seen above the water in the horizon, and immediately above it in the sky, two images of the whole vessel, one erect and one inverted. But as the ship came into view the images became less distinct, though they were both visible after the ship had risen above the horizon.

From the description already given of refraction, it is easy to determine how a single upright image of a vessel below the horizon might be formed, but it may not be so evident how the inverted image is produced. The sun

is seen after it has descended beneath the horizon by ordinary refraction, or rather in consequence of the refraction of the atmosphere resulting from the common variation of density. But when a mass of air has its density increased or diminished by local causes, then an uncommon refraction is the result, and the line in which the light moves being more convex than usual, the object is proportionally thrown upwards, and an erect image may be seen at a great apparent distance above the horizon. The inverted image is produced by the crossing of the rays before they reach the eye—that is to say, the light from the hull of the vessel is so curved, that it crosses that which proceeds from the masts before reaching the eye, and consequently the image is inverted. To produce this appearance, a peculiar constitution of atmosphere is required, but it is not necessary that we should enter upon this question at present.

Many instances of the appearance of ships in the air are upon record, but the images are generally described as being in an upright position. Three persons have described this phenomenon, as seen in different places during the year 1662.

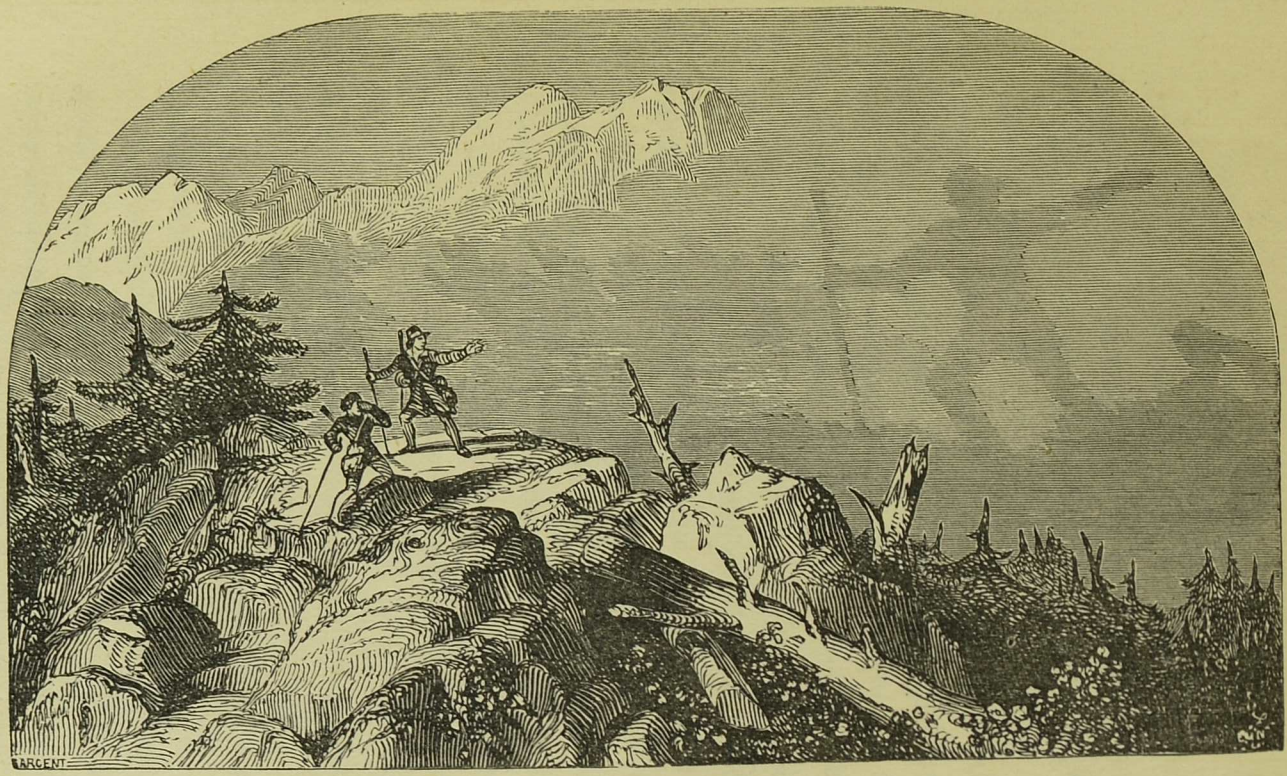
Dr Vince also states, that at Ramsgate he has seen the four turrets of Dover Castle over a hill between Dover and Ramsgate. But the most remarkable case

mentioned by this eminent philosopher, was that which he observed on the evening of the 6th of August 1806, when the image of the castle was so vividly projected on the Ramsgate side of the hill, that the hill itself could not be observed through the image.

The Brocken, a peak of the Hartz Mountains, which rises to the height of about three thousand three hundred feet above the level of the sea, has been, for centuries past, the site of spectral appearances. M. Haue has, unfortunately for the lovers of the marvellous, enabled the natural philosopher to explain the cause, and has thus divested the site of all that interest which arises from a belief in supernatural visitations. This philosopher had been long anxious to view the phenomenon, and had ascended the mountain many times for the purpose, but without success. On the 23d of May 1797, he was early on the summit of the mountain, waiting the sunrise; and, about four o'clock in the morning, the luminary made its appearance above the horizon. The sky was clear, and the rays of the morning sun were tinging the summit of the hills with its golden hue, when he saw on a cloud, in a direction opposite to that on which the sun rose, towards the Achtermanshoe, a gigantic human figure, with his face towards him. While gazing on the prodigious spectre with a feeling not free from terror, a

sudden gust of wind threatened to blow away his hat, but lifting his hand to detain it, he saw the spectre mimic his action, and was at once freed from the terror which had already crept upon him. He then changed his attitude and place, and found that the figure always followed his motions. M. Haue was then joined by a person who had accompanied him to the top of the mountain, when a second colossal spectre made its appearance, and soon afterwards a third. The figures first seen were evidently produced by the projection of the shadow of the two persons upon the clouds by the horizontal rays of the sun. The appearance of the third figure was, no doubt, caused by the duplication of one of the figures by the unequal refraction of the atmosphere.

The fata morgana is another illustration of the same illusive appearance. This curious phenomenon is seen at the pharos of Messina, in Sicily, and has, for centuries past, been celebrated in the annals of superstition. A spectator, standing on an elevated place in the city of Reggio, commanding a view of the bay, with his back to the rising sun, may often observe, when the rays form an angle of about 45° with the horizon, the objects on the shores vividly painted on the surface of the water. Palaces, castles, towers, and arches, are distinctly reflected from the surface of the water as from a mirror;



SPECTRE OF THE BROCKEN.

and men, horses, and cattle are seen rapidly passing from place to place, presenting together a beautiful picture, which the spectator gazes upon with a feeling of superstitious admiration.

Similar appearances have been frequently seen upon the lakes of Ireland, with all of which some legends are connected. The story of O'Donoughoo, who haunts the beautiful lake of Killarney, is well known to those who are lovers of the marvellous. O'Donoughoo was a celebrated chieftain, who possessed the art of magic. Being strongly solicited by his lady to give her some proof of his skill, he assumed the shape of a demon, and her courage failing, he suffered for his temerity, and disappeared. Ever since he has been accustomed to ride over the lake, on a horse shod with silver, his punishment being to continue the monotonous exercise until the shoes are worn out. On the morning of the 1st of May, thousands assemble around the lake to see him, and there can be no doubt that the figure said to have been witnessed by credible travellers, is the shadow of a man on horseback riding upon the shore.

Mr Scoresby has mentioned in his 'Account of the Arctic Regions' several curious instances of unusual refraction, observed by him during his polar voyages. While sailing along the coast of Spitzbergen, with an

easterly wind, he observed a singular transformation of the Foreland or Charles's Island. There seemed to be a mountain in the form of a slender monument, and near it a prodigious and perfect arch, thrown over a valley, at least a league in breadth. This scene, however, did not last long, but was presently followed by the appearance of castles, spires, towers, and battlements, which changed their forms so rapidly, that the metamorphoses seemed as though they were the work of an occult agent. 'Every object,' says Mr Scoresby, 'between the north-east and south-east points of the compass, was more or less deformed by this peculiar refraction.'

At other times, Mr Scoresby observed similar results produced, and, from the whole of his observations, he deduces :

1. That the effects of unusual refraction occur in the evening or night, after a clear day.

2. That they are most frequent on the commencement or approach of easterly winds.

3. That the mixture, near the surface of the land or sea, of two streams of air having different temperatures, and the irregular deposition of imperfectly condensed vapour, are the causes of these phenomena.

Man is given to superstition ; and the unassisted senses being frequently incapable of giving accurate information

as to the authenticity of the natural appearances by which he is surrounded, sometimes aid the innate propensity, and lead to erroneous conclusions. Yet all the sensations, by which we become acquainted with material existence, are produced by external nature acting upon the organs of sense, and we are consequently exposed to deception, either from the accidental construction of the organs, or the false impression conducted to them by the objects which act on them. Thus it is that the sensations produced by natural phenomena, uncorrected by a philosophical examination of causes, may encourage the superstitious feelings of our nature; and in this way we may account for many of those opinions which are to be found among the illiterate in all nations.

We are not, however, on this account to discard the testimony of our senses, but to receive it with care, if not with suspicion. The conditions under which the senses are acted upon should be considered, and the capabilities of the organs should not be overrated. The senses are not the causes of the deception, in the appearances which have been described, but they are the agents by which the deception is conveyed to the mind. To correct the errors which are not compensated for by the senses, is one of the objects of natural philosophy. We are deceived by the phenomenon of refraction, because the eye

is unable to detect the manner in which the appearance is transmitted to the organ of sight. By experiment, it is discovered that in passing through a fluid medium the rays of light are refracted, and hence we infer that the same effect must be produced when they pass through the atmosphere. The eye might be for ever fixed on the heavenly bodies, without discovering that their apparent is not their real place; and we might still have imagined the heavens to have a diurnal revolution round the earth, if experiment and extended observation, guided by reason, had not discovered the circumstances under which our senses are acted upon. But it must not be supposed that the organs of sense are insufficient for the purposes for which they were formed. Such a sentiment would be derogatory to the skill displayed in their construction, and their adaptation to the nobler principles of our nature. The organs of sense are sufficient to enable man to supply his wants and to gather pleasure from external nature; and if we may be deceived by appearances, the improvable reason may detect the error, and explain the cause.

CHANGES WHICH HAVE OCCURRED ON OUR SEA-COASTS.

In the course of past ages, several very remarkable alterations have taken place in various parts of our

sea-shores, which a rambler by the margin of the ocean cannot but regard as a highly interesting subject of thought. Lyell states the following particulars on this subject:

'If we follow the eastern and southern shores of the British islands, from our Ultima Thule in Shetland, to the Land's End in Cornwall, we shall find evidence of a series of changes since the historical era, very illustrative of the kind and degree of force exerted by tides and currents, co-operating with the waves of the sea. In this survey we shall have an opportunity of tracing their joint power on islands, promontories, bays, and estuaries; on bold, lofty cliffs, as well as on low shores; and on every description of rock and soil, from granite to blown sand.

The northernmost group of the British islands, the Shetland, are composed of a great variety of rocks, including granite, gneiss, mica-slate, serpentine, greenstone, and many others, with some secondary rocks, chiefly sandstone and conglomerate. These islands are exposed continually to the uncontrolled violence of the Atlantic, for no land intervenes between their western shores and America. The prevalence, therefore, of strong westerly gales, causes the waves to be sometimes driven with irresistible force upon the coast, while there

is also a current setting from the north. The spray of the sea aids the decomposition of the rocks, and prepares them to be breached by the mechanical force of the waves. Steep cliffs are hollowed out into deep caves and lofty arches; and almost every promontory ends in a cluster of rocks, imitating the forms of columns, pinnacles and obelisks.

'Modern observations shew that the reduction of continuous tracts to such insular masses is a process in which nature is still actively engaged. "The isle of Stenness," says Dr Hibbert, "presents a scene of unequalled desolation. In stormy winters, huge blocks of stones are overturned or are removed from their native beds, and hurried up a slight acclivity to a distance almost incredible. In the winter of 1802, a tabular-shaped mass, eight feet two inches by seven feet, and five feet one inch thick, was dislodged from its bed, and removed to a distance of from eighty to ninety feet. I measured the recent bed from which a block had been carried away the preceding winter (A. D. 1818), and found it to be seventeen feet and a half by seven feet, and the depth two feet eight inches. The removed mass had been borne to a distance of thirty feet, when it was shivered into thirteen or more lesser fragments, some of which were carried still farther, from 30 to

120 feet. A block, nine feet two inches by six feet and a half, and four feet thick, was hurried up the acclivity to a distance of 150 feet."

'At Northmavine also, angular blocks of stone have been removed in a similar manner to considerable distances by the waves of the sea.

'In addition to numerous examples of masses detached and driven by the waves, tides, and currents from their place, some remarkable effects of lightning are recorded in these isles. At Funzie, in Fetlar, about the middle of the last century, a rock of mica-schist, 105 feet long, ten feet broad, and in some places four feet thick, was in an instant torn by a flash of lightning from its bed, and broken into three large, and several smaller fragments. One of these, twenty-six feet long, ten feet broad, and four feet thick, was simply turned over. The second, which was twenty-eight feet long, seventeen broad, and five feet in thickness, was hurled across a high point to the distance of fifty yards. Another broken mass, about forty feet long, was thrown still farther, but in the same direction, quite into the sea. There were also many smaller fragments scattered up and down.

'When we thus see electricity co-operating with the violent movements of the ocean in heaping up piles of

shattered rocks on dry land, and beneath the waters, we cannot but admit that a region which shall be the theatre, for myriads of ages, of the action of such disturbing causes, might present, at some future period, if upraised far above the bosom of the deep, a scene of havoc and ruin that may compare with any now found by the geologist on the surface of our continents.

'In some of the Shetland Isles, as on the west of Meikle Roe, dikes, or veins of soft granite, have mouldered away; while the matrix in which they were enclosed, being of the same substance, but of a firmer texture, has remained unaltered. Thus, long narrow ravines, sometimes twenty feet wide, are laid open, and often give access to the waves. After describing some huge cavernous apertures into which the sea flows for 250 feet in Roeness, Dr Hibbert, writing in 1822, enumerates other ravages of the ocean. "A mass of rock, the average dimensions of which may perhaps be rated at twelve or thirteen feet square, and four and a half or five in thickness, was first moved from its bed, about fifty years ago, to a distance of thirty feet, and has since been twice turned over.

'"But the most sublime scene is where a mural pile of porphyry, escaping the process of disintegration that is devastating the coast, appears to have been left as a

sort of rampart against the inroads of the ocean. The Atlantic, when provoked by wintry gales, batters against it with all the force of real artillery—the waves having, in their repeated assaults, forced themselves an entrance. This breach, named the Grind of the Navir, is widened every winter by the overwhelming surge that, finding a passage through it, separates large stones from its sides, and forces them to a distance of no less than 180 feet. In two or three spots, the fragments which have been detached are brought together in immense heaps, that appear as an accumulation of cubical masses, the product of some quarry."

It is evident, from this example, that although the greater indestructibility of some rocks may enable them to withstand, for a longer time, the action of the elements, yet they cannot permanently resist. There are localities in Shetland, in which rocks of almost every variety of mineral composition are suffering disintegration; thus the sea makes great inroads on the clay slate of Fitfel Head, on the serpentine of the Vord Hill in Fetlar, and on the mica-schist of the Bay of Triesta, on the east coast of the same island, which decomposes into angular blocks. The quartz rock on the east of Walls, and the gneiss and mica-schist of Garthness, suffer the same fate.

'Such devastation cannot be incessantly committed for thousands of years without dividing islands, until they become at last mere clusters of rocks, the last shreds of masses once continuous. To this state many appear to have been reduced, and innumerable fantastic forms are assumed by rocks adjoining these islands, to which the name of Drongs is applied, as it is to those of similar shape in Feröe.

'The granite rocks between Papa Stour and Hillswick Ness afford an example. A still more singular cluster of rocks is seen to the south of Hillswick Ness, which presents a variety of forms as viewed from different points, and has often been likened to a small fleet of vessels with spread sails. We may imagine that in the course of time Hillswick Ness itself may present a similar wreck, from the unequal decomposition of the rocks whereof it is composed, consisting of gneiss and mica-schist, traversed in all directions by veins of felspar-porphyry.

'Midway between the groups of Shetland and Orkney is Fair Island, said to be composed of sandstone, with high perpendicular cliffs. The current runs with such velocity, that during a calm, and when there is no swell, the rocks on its shores are white with the foam of the sea driven against them. The Orkneys, if carefully

examined, would probably illustrate our present topic as much as the Shetland group. The north-east promontory of Sanda, one of these islands, has been cut off in modern times by the sea, so that it became what is now called Start Island, where a lighthouse was erected in 1807, since which time the new strait has grown broader.

'To pass over to the mainland of Scotland, we find that in Inverness-shire there have been inroads of the sea at Fort George, and others in Morayshire, which have swept away the old town of Findhorn. On the coast of Kincardineshire, an illustration was afforded, at the close of the last century, of the effect of promontories in protecting a line of low-shore. The village of Mathers, two miles south of Johnshaven, was built on an ancient shingle beach, protected by a protecting ledge of limestone rock. This was quarried for lime to such an extent that the sea broke through, and in 1795 carried away the whole village in one night, and penetrated 150 yards inland, where it has maintained its ground ever since, the new village having been built farther inland on the new shore. In the Bay of Montrose, we find the North Esk and the South Esk rivers pouring annually into the sea large quantities of sand and pebbles, yet they have formed no deltas; for

the waves, aided by the current, setting across their mouths, sweep away all the materials. Considerable beds of shingle, brought down by the North Esk, are seen along the beach.

'Proceeding southwards, we learn that at Arbroath, in Forfarshire, which stands on a rock of red sandstone, gardens and houses have been carried away since the commencement of the present century by encroachments of the sea. It had become necessary, before 1828, to remove the lighthouses, at the mouth of the estuary of the Tay, in the same county, at Button Ness, which were built on a tract of blown sand, the sea having encroached for three quarters of a mile.

'The combined power which waves and currents can exert in *estuaries* (a term which I confine to bays entered both by rivers and the tides of the sea) was remarkably exhibited during the building of the Bell Rock Lighthouse, off the mouth of the Tay. The Bell Rock is a sunken reef, consisting of red sandstone, being from twelve to sixteen feet under the surface at high-water, and about twelve miles from the mainland. At the distance of 100 yards, there is a depth, in all directions, of two or three fathoms at low-water. In 1807, during the erection of the lighthouse, six large blocks of granite, which had been landed on the reef,

were removed by the force of the sea, and thrown over a rising ledge to the distance of twelve or fifteen paces; and an anchor, weighing about 22 cwt., was thrown up upon the rock. Mr Stevenson informs us, moreover, that drift-stones, measuring upwards of thirty cubic feet, or more than two tons-weight, have, during storms, been often thrown upon the rock from the deep water.

'Among the proofs that the sea has encroached on the land bordering the estuary of the Tay, Dr Fleming has mentioned a submarine forest which has been traced for several miles along the northern shore of the county of Fife. But subsequent surveys seem to have shewn that the bed of peat containing tree-roots, leaves, and branches, now occurring at a lower level than the Tay, must have come into its present position by a general sinking of the ground on which the forest grew. The peat-bed alluded to is not confined, says Mr Buist, to the present channel of the Tay, but extends far beyond it, and is covered by stratified clay from fifteen to twenty-five feet in thickness, in the midst of which, in some places, is a bed full of sea-shells. Recent discoveries having established the fact that upward and downward movements have affected our island since the general coast-line had nearly acquired its present shape, we must hesitate before we attribute any given change

to a single cause, such as the local encroachment of the sea upon low land.

'On the coast of Fife, at St Andrews, a tract of land, said to have intervened between the castle of Cardinal Beaton and the sea, has been entirely swept away, as were the last remains of the Priory of Crail, in the same county, in 1803. On both sides of the Firth of Forth, land has been consumed; at North Berwick, in particular, and at Newhaven, where an arsenal and dock, built in the reign of James IV., in the fifteenth century, has been overflowed.

'If we now proceed to the English coast, we find records of numerous lands having been destroyed in Northumberland, as those near Bamborough and Holy Island, and at Tynemouth Castle, which now overhangs the sea, although formerly separated from it by a strip of land. At Hartlepool, and several other parts of the coast of Durham composed of magnesian limestone, the sea has made considerable inroads.

'Almost the whole coast of Yorkshire, from the mouth of the Tees to that of the Humber, is in a state of gradual dilapidation. That part of the cliffs which consist of lias, the oolite series, and chalk, decays slowly. They present abrupt and naked precipices, often 300 feet in height; and it is only at a few points that the

grassy covering of the sloping talus marks a temporary relaxation of the erosive action of the sea. The chalk-cliffs are worn into caves and needles in the projecting headland of Flamborough, where they are decomposed by the salt spray, and slowly crumble away. But the waste is most rapid between that promontory and Spurn Point, or the coast of Holderness, as it is called, a tract consisting of beds of clay, gravel, sand, and chalk rubble. The irregular intermixture of the argillaceous beds causes many springs to be thrown out, and this facilitates the undermining process, the waves beating against them, and a strong current setting chiefly from the north. The wasteful action is very conspicuous at Dimlington Height, the loftiest point in Holderness, where the beacon stands on a cliff 146 feet above high-water, the whole being composed of clay, with pebbles scattered through it.

'In the old maps of Yorkshire, we find spots, now sand-banks in the sea, marked as the ancient sites of the towns and villages of Auburn, Hartburn, and Hyde. "Of Hyde," says Pennant, "only the tradition is left; and near the village of Hornsea, a street called Hornsea Beck has long since been swallowed." Owthorne and its church have also been in great part destroyed, and the village of Kilnsea; but these places are now removed

farther inland. The annual rate of encroachment at Owthorne for several years preceding 1830, is stated to have averaged about four yards. Not unreasonable fears are entertained that at some future time the Spurn Point will become an island, and that the ocean, entering into the estuary of the Humber, will cause great devastation. Pennant, after speaking of the silting up of some ancient ports in that estuary, observes, "But, in return, the sea has made most ample reprisals; the site, and even the very names of several places, once towns of note upon the Humber, are now only recorded in history; and Ravensper was at once a rival to Hull (Madox, *Ant. Exch.* i. 422), and a port so very considerable in 1332, that Edward Baliol and the confederated English Barons sailed from hence to invade Scotland; and Henry IV., in 1399, made choice of this port to land at, to effect the disposal of Richard II.; yet the whole of this has long since been devoured by the merciless ocean; extensive sands, dry at low-water, are to be seen in their stead."

'Pennant describes Spurn Head as a promontory in the form of a sickle, and says the land, for some miles to the north, was "perpetually preyed on by the fury of the German Sea, which devours whole acres at a time, and exposes on the shores considerable quantities of beautiful amber."

'According to Bergmann, a strip of land, with several villages, was carried away near the mouth of the Humber in 1475.

'The maritime district of Lincolnshire consists chiefly of lands that lie below the level of the sea, being protected by embankments. Great parts of this fenny tract were, at some unknown period, a woody country, but were afterwards inundated, and are now again recovered from the sea. Some of the fens were embanked and drained by the Romans; but after their departure the sea returned, and large tracts were covered with beds of silt, containing marine shells, now again converted into productive lands. Many dreadful catastrophes are recorded by incursions of the sea, whereby several parishes have been at different times overwhelmed.

'It has been lately proposed by Sir John Rennie and others, to rescue from the dominion of the sea a large part of what is called "the Wash," between the counties of Lincoln and Norfolk. The plan for accomplishing this object consists in deepening and straightening the channels of the rivers Ouze, Nene, Witham, and Welland, all of which are to be confined between well-formed banks, and united into one grand channel in the centre of the Wash. The land already gained by

similar operations since the middle of the seventeenth century is of vast extent, and the additional space which the projectors hope to reclaim on the opposite shores of Lincoln and Norfolk would amount to 150,000 acres, and be half as large again as the county of Rutland in area.

'So great is the quantity of mud suspended in the tidal waters of the rivers entering the Wash, that the accumulation of soil by "warping," wherever the force of the winds and currents can be checked, is surprisingly rapid. Thus, for example, when a portion of the old channel of the Ouze, containing 800 acres, was deserted by an alteration of the drainage, it was warped up, without any artificial aid, to the height of twenty-five feet in five or six years.

'We come next to the cliffs of Norfolk and Suffolk, where the decay is in general incessant and rapid. At Hunstanton, on the north, the undermining of the lower arenaceous beds at the foot of the cliff, causes masses of red and white chalk to be precipitated from above. Between Hunstanton and Weybourne, low hills, or dunes, of blown sand, are formed along the shore, from fifty to sixty feet high. They are composed of dry sand, bound in a compact mass by the long creeping roots of the plant called Marram (*Arundo arenaria*).

Such is the present set of the tides, that the harbours of Clay, Wells, and other places, are securely defended by these barriers; affording a clear proof that it is not the strength of the material at particular points that determines whether the sea shall be progressive or stationary, but the general contour of the coast.

'The waves constantly undermine the low chalk-cliffs, covered with sand and clay, between Weybourne and Sherringham, a certain portion of them being annually removed. At the latter town I ascertained, in 1829, some facts which throw light on the rate at which the sea gains upon the land. It was computed, when the present inn was built, in 1805, that it would require seventy years for the sea to reach the spot; the mean loss of land being calculated, from previous observations, to be somewhat less than one yard annually. The distance between the house and the sea was fifty yards; but no allowance was made for the slope of the ground being *from* the sea, in consequence of which, the waste was naturally accelerated every year, as the cliff grew lower, there being at each succeeding period less matter to remove when portions of equal area fell down. Between the years 1824 and 1829, no less than seventeen yards were swept away, and only a small garden was then left between the building and the sea.

There was, in 1829, a depth of twenty feet (sufficient to float a frigate) at one point in the harbour of that port, where, only forty-eight years before, there stood a cliff fifty feet high, with houses upon it! If once in half a century an equal amount of change were produced suddenly by the momentary shock of an earthquake, history would be filled with records of such wonderful revolutions of the earth's surface; but if the conversion of high land into deep sea be gradual, it excites only local attention. The flag-staff of the Preventative Service station, on the south side of this harbour, was thrice removed inland between the years 1814 and 1829, in consequence of the advance of the sea.

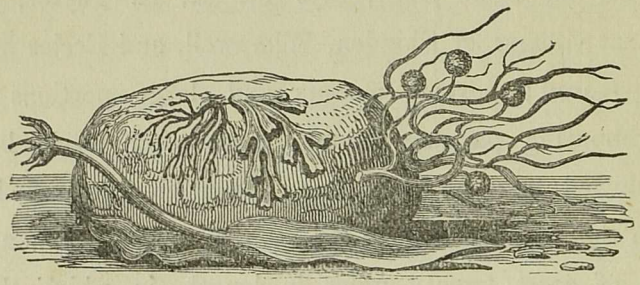
'Farther to the south, we find cliffs composed, like those of Holderness before mentioned, of alternating strata of blue clay, gravel, loam, and fine sand. Although they sometimes exceed 300 feet in height, the havoc made on the coast is most formidable. The whole site of ancient Cromer now forms part of the German Ocean, the inhabitants having gradually retreated inland to their present situation, from whence the sea still threatens to dislodge them. In the winter of 1825, a fallen mass was precipitated from near the lighthouse, which covered twelve acres, extending far into the sea, the cliffs being 250 feet in height. The

undermining by springs has sometimes caused large portions of the upper part of the cliffs, with houses still standing upon them, to give way, so that it is impossible, by erecting breakwaters at the base of the cliffs, permanently to ward off the danger.

'On the same coast, says Mr R. C. Taylor, the ancient villages of Shipden, Wimpwell, and Eccles have disappeared; several manors and large portions of neighbouring parishes having, piece after piece, been swallowed up; nor has there been any intermission, from time immemorial, in the ravages of the sea along a line of coast twenty miles in length, in which these places stood. Of Eccles, however, a monument still remains in the ruined tower of the old church, which is half buried in the dunes of sand within a few paces (60?) of the sea-beach. So early as 1605, the inhabitants petitioned James I. for a reduction of taxes, as 300 acres of land, and all their houses, save fourteen, had then been destroyed by the sea. Not one-half that number of acres now remain in the parish, and hills of blown sand now occupy the site of the houses which were still extant in 1605. When I visited the spot in 1839, the sea was fast encroaching on the sand-hills, and had laid open on the beach the foundations of a house fourteen yards square, the upper part of which had

evidently been pulled down before it had been buried under sand. The body of the church has also been long buried, but the tower still remains visible.'

ALGÆ OR SEA-WEEDS.



The marine Algæ or Sea-weeds afford a subject of most interesting study to those who frequent the sea-side. The following observations are from an excellent little manual by Miss Gifford, called the *Marine Botanist.*

'Their structure in many instances is exceedingly simple, consisting in some species of strings of cellules loosely adhering together; others present the appearance of branched threads, which in those kinds of a more perfect structure are joined together and form the stem and branches. In the higher tribes, many kinds possess distinct stems and leaf-like fronds, resulting from a membranaceous expansion of the stem, which continues its

course through the frond, and assumes the character of a midrib or vein (presenting in this instance, a manner of growth nearly analogous to that of the fronds of Ferns). At a later period what constituted originally the midrib of the frond becomes a branch, as in Delesseria. Many Algæ are parasitical on the larger species, others have knob-like, flat leather-like or fibrous roots, by which they adhere to rocks, stones, shells, and other substances. It is doubted whether they derive any nourishment from these roots, which seem to partake more of the character of clasping fibres or tendrils than of a true root. The fructification of the Algæ is in general very minute, requiring the aid of a good microscope for its detection. It either consists of wart-like minute bodies termed *capsules*, or of spots variously disposed in, or on the surface of the fronds, called *granules*; the spots in which the granules are placed are termed *sori*. Some plants bear both these kinds of fruits; when such is the case, the *capsules* are described as the *primary* and the *granules* as the *secondary* fruit. This is done for greater clearness in the descriptions, and is not intended to convey the idea that one form is of more importance than the other, as both the seeds (*sporules*) contained in the *capsules* and the *granules* are each alike capable of producing a new plant. Many species of Fucoideæ are furnished with air-vessels,

which float them in the water. In the Fucus vesiculosus, these vesicles arise within the substance of the frond; while in the curious Sargassum bacciferum, or Gulf-weed, they are currant-shaped, and borne on short stalks. This was the species encountered by Columbus when entering the Gulf of Mexico: it is generally found floating in vast masses, quite unattached to any other substance. This and another species of the same genus are occasionally thrown, after violent storms, on our Atlantic coasts, but neither kinds are natives of our seas. The name Sargassum is derived from the Spanish *Sargazo*, a term applied to the floating masses of sea-weed that occur in some latitudes. This plant is called by the French Raisin des Tropiques, probably from the form and abundance of the air-vessels.

'Similarity of colour in marine-plants is a characteristic feature that often accompanies plants of an allied structure. Thus the olive-green series (Melanospermeæ) contains plants of the most perfect structure and largest size. The red series (Rhodospermeæ) are remarkable for the delicacy of their tissue, and for possessing a double system of fructification, that is, producing both *capsules* and *granules*. While the grass-green series (Chlorospermeæ) possess the simplest structure, and their *seeds* at certain periods are endowed with a singular power of

locomotion; whether voluntary or not, is still a matter of dispute amongst botanists.

'Though the colour may often serve as an index whereby to determine the series, &c., to which a species belongs, the young student must be careful not to trust too implicitly to this guide; taking care to collect such plants as grow in a favourable situation for the development of their natural hues. Many of the red series, when growing in unfavourable situations, assume a yellowish-green or whitish colour. "Laurencia pinnatifida," Dr Harvey observes, "is particularly variable in this respect. When this species grows near low-water mark, it is of fine, deep purple-red; a little higher it is a dull purple-brown; higher still, a pale brownish-red; and, at last, near high-water mark, it is often yellowish or greenish. Chondrus crispus, too, when found in shallow water, is often of a bright herbaceous green; and Ceramium rubrum passes through every shade of red and yellow, and at last degenerates into a dirty-white before it ceases to grow. All these species vary in form and size as they do in colour, and the various anomalous shapes that they assume are almost sure to deceive a young botanist into the belief that the varieties are so many different species." The Cystoseira ericoides, when seen growing under water, appears clothed in the most

beautiful rainbow hues, but when removed from the water is found to be of a dark olive-green: a few others possess this remarkable property, which is termed iridescent.

'In enumerating the different uses of sea-weed, its importance to the various animals inhabiting the sea first claims attention. Innumerable animalculæ, which form the principal food of the whale and of many species of fish eaten by man, derive their sustenance from the Algæ, which is as necessary to them as the vegetation of the land is to the different living creatures upon it. Thus

> "Huge ocean shews, within his yellow strand,
> A habitation marvellously planned,
> For life to occupy."

'The following observations made by Captain Grey, during the course of his homeward voyage from Australia, are interesting in connection with this subject, and also as relating to animals of whose habits and means of existence we have, from the nature of the element they inhabit, but little acquaintance. Captain Grey says: "In 26° N. lat. we entered a portion of the sea covered with patches of sea-weed, around which swarmed numerous eel-like fish, crabs, shrimps, and little blue fish. These last swam under those floating islands, sometimes leaving them for a little distance, but they always

returned or swam to another: the crabs crawled in and out amongst the sea-weed, and other fish of a large size came to these spots to deposit their spawn; so that we were in an archipelago of floating islands, teeming with busy inhabitants and animal enjoyment. August 30th, a pine-tree passed us, covered with barnacles, and surrounded by fish, which swam about this floating island, eating such things as fell from it. No portion of the globe is more thickly inhabited, or affords, in proportion to its size, a greater amount of animal enjoyment than did this wave-tossed isle. On it were innumerable barnacles, several species of teredo; one of which, having its head shaped like a screw divided into two equal portions, I believe to have been quite new. Many varieties of crabs and minute insects, shaped like a slug, fed on the sea-weed growing on the log." A description which reminds one forcibly of that given by Milton, in his account of the Creation, where he says:

"Forthwith the sounds and seas, each creek and bay,
With fry innumerable swarms, and shoals
Of fish, that with their fins and shining scales
Glide under the green wave, in sculls that oft
Bank the mid sea: part single, or with mate
Graze, the sea-weed their pasture, and through groves of coral stray."

[1] The Fucus vesiculosus affords excellent winter pro-

vender for cattle. Turner says: "In the islands of Jura and Skye they regularly feed upon it during winter. It is the *Küe-tang* of Norway, and cow-weed of the north-west of Scotland, and the west of Ireland: in Gothland, the people boil it with coarse flour, and feed their pigs upon it, whence they call it *swine-tang*." Dr Drummond observes, that "it is much used by the poorer classes about Larne (near Belfast) for feeding pigs. Boiling water being poured upon it, which softens and renders it glutinous, it is then mixed with greens or potatoes, or even given by itself. Many persons have assured me that the pigs are not only very fond of it, but that they thrive upon it remarkably well." Fucus serratus is also used as winter provender in some northern countries; and in Norway is called *bred-tang*, being given to the cattle, sprinkled with meal.

'During the late severe winter (in 1847), many of the poor along the western and north-west coasts of Ireland subsisted almost entirely upon sea-weed, probably the *dulse* Rhodomenia palmata, which is by far the most abundant edible species: it is the *dulliosg* of the Highlanders, and *dillish* of the Irish. After being soaked in fresh water, it is eaten either boiled or dried, and in the latter state has something of a violent scent and flavour. Iridæe edulis is also eaten by the poor, either

raw, or cooked in the frying-pan. Alaria esculenta is said to be much eaten in Scotland, and frequently exposed for sale in the markets, along with the young fronds and stems of Laminaria digitata and saccharina. The two species, Chondrus crispus and mamillosus, constitute the *Carrageen,* or *Irish Moss*, which when bleached white and boiled into a jelly, forms a nutritious food for invalids and delicate people. When properly prepared, it is nearly as agreeable to the taste as calf's-jelly or blanc-mange. Porphyra laciniata and vulgaris are sold under the name of *Laver* in England, *Sloke* or *Slokaun* in Scotland and Ireland; it is eaten after being well boiled, when it forms a favourite vegetable with many persons. In Wales it is fried with oatmeal, and brought to table under the name of *Laver-bread;* this, I am informed, is very palatable, and is a dish much relished by those who are accustomed to eat it. But of all those used for food, Dr Harvey says, " Gigartina lichenoides, an East Indian species, resembling our G. compressa, which, if as abundant, would be equally valuable, deserves the first rank. This, under the name of *Ceylon Moss*, is much used in the East as a nutritive article of food, and for giving consistence to other dishes. It is of a very gelatinous nature, and when boiled down is almost wholly convertible into jelly, which is of a purer nature than that obtained

from our Chondri. Large quantities are annually sold. The famous *edible nests* of China, the finest of which sell for their weight in gold, are constructed by a species of swallow from some undetermined plant of this genus, allied to G. lichenoides."

'As a manure, sea-weed is much valued by the dwellers along many of our sea-shores. A lady resident of the Norfolk coast, informs me that she has found it "capital manure for most garden plants, and that it is quite as good for forcing sea-kale by Christmas, as stall litter, the only care necessary is not to let it heat *too* fast." In the Channel Islands, the "*vraicking*," or sea-weed harvest, presents a picturesque and busy scene; along the beach of some large bay, at low-water, numbers of people may be seen busily engaged, either in collecting the *vraic* into heaps, filling their carts, or loading their boats with it, which they do to such an extent as to sink them nearly to the water's edge; allowing only sufficient space in the centre of the load for a man to place himself in, who, when seated in the midst of this mass of sea-weed, looks not unlike an Esquimaux paddling along in his skin-clad boat, with his head alone visible.'

Professor Harvey, in his charming *Sea-side Book*, thus refers to the marine algæ:

'Sea-weeds are usually classed by botanists in three

great groups, each of which contains several families, which are again divided into genera; and these, in their turn, are composed of one or many species. The number of species as yet detected on the British coasts is about 370, and they are grouped into 105 genera. I cannot, in this place, enter into the niceties of classification to which botanists resort in working out the history of these plants, but must confine myself to the general features of the great groups, and their distribution. Taken in the order in which they present themselves to us on the shore, and limiting each by its most obvious character, that of colour, we may observe: that the group of Green Sea-weeds (*Chlorospermeæ*) abound near high-water mark, and in shallow tide-pools within the tidal limit; that the Olive-coloured (*Melanospermeæ*) cover all exposed rocks, feebly commencing at the margin of high-water, and increasing in luxuriance with increasing depth, through the whole belt of exposed rock; but that the majority of them cease to grow soon after they reach a depth which is never laid bare to the influence of the atmosphere; and that the Red Sea-weeds (*Rhodospermeæ*) gradually increase in numbers, and in purity of colour, as they recede from high-water mark, or grow in places where they enjoy a perfect shade, or nearly total absence of light, and are never

exposed to the air, or subjected to a violent change of temperature.

'The Green Sea-weeds are the simplest in structure, and the least varied in species, on different coasts, and consequently the least interesting to the collector of specimens. With the exception of the beautiful genus *Cladophora*, which contains about twenty species, our British *Chlorosperms* are chiefly composed of *Ulvæ* and *Enteromorphæ*, whose forms vary with so little order, that it becomes difficult, and, in some instances, hopeless, to attempt to classify the varieties. The *Enteromorphæ* are the first to make their appearance about high-water mark, covering loose boulders or smooth rocks with a slippery vesture of bright green, or filling the shallow tide-pools with grassy fronds. These plants consist of tubular membranes, simple or branched, appearing to the naked eye like fine green silk, and shewing to the microscope a surface composed of minute cells, full of granules. The commonest species near high-water mark is *E. compressa*, which commences of a very stunted size, and with thread-like branches, if exposed to the air, and gradually acquires length and breadth as it grows in deeper water. When fully developed, it has a frond divided nearly to the root into many long, sub-simple branches, which bear a second or

third series, all of them much attenuated at their insertion, and more or less distended at the extremity. The diameter of the tube varies extremely, and the broader and simpler individuals are only to be known from *E. intestinalis*, by their being branched; the tube in the latter species being absolutely simple. To the *Enteromorphæ* succeed *Ulvæ*, distinguished from *Enteromorphæ* merely by being flat, instead of tubular. The beautiful lettuce-like plaited leaves found in tide-pools belong to plants of this genus, the commonest species of which is *U. latissima*. It has a very broad, more or less ovate, plaited leaf, of a brilliant green, and remarkably glossy, when in perfection reflecting glaucous tints, if seen through clear sea-water, and is certainly a very ornamental species. It is sometimes brought to table as a laver, or marine sauce, but it is much inferior in flavour to the Purple Laver (*Porphyra laciniata*), a plant of the same family, equally beautiful, equally common, and more generally collected for food. The purple Laver grows on exposed rocks near low-water mark, and, though called purple, assumes at different seasons of the year different shades of colour, according to its age. In form it resembles the Green Laver (*Ulva latissima*), but it is of a still more delicate substance, consisting of a perfectly transparent and very thin membrane, elegantly

dotted with closely-set grains, to which it owes its colour. When these grains are in perfection they are of a dark violet-purple; and this is the case in winter and early spring, when the plant is collected for table. Later in the year, the fronds are of stunted size, and more or less olivaceous colour, and much less suitable for gathering. The plant appears to be of very rapid growth and decay, a few weeks sufficing for its full development. Like many fugitive plants, however, it is not confined to one season, but continues to develop throughout the year; but with this difference, that the plants developed in the summer are very much smaller, more tenacious, and of a dull colour. These last are regarded by some authors as a different species, and called *P. umbilicata.*

'There is a circumstance connected with the history of our common *Ulvæ*, *Enteromorphæ*, and *Porphyræ*, which deserves notice. Most of the species common to the European shores are found in all parts of the world to which a marine vegetation extends. In the cold waters of the Arctic Sea, *Ulva latissima*, *Enteromorphæ compressa*, and *Porphyræ laciniata*, vegetate in abundance; and these same plants skirt the shores of tropical seas, and extend into the southern ocean as far as Cape Horn. Vegetation, at least with its most obvious

features, ceases in the south at a much lower parallel than in the arctic regions, and the shores of the antarctic lands appear to be perfectly barren, producing not even an *Ulva*. But the fact of the great adaptability of plants of this family to different climates, is beautifully illustrated by the last land-plant collected by the acute naturalist attached to our antarctic expedition. The last plant that struggles with perpetual winter was gathered at Cockburn Island, 64° S. (a latitude no greater than that of Archangel, where the vine is said to ripen in the open air), and this proved to be an *Ulva* (*U. crispa*), identical with a small species which may often be seen in this country on old thatch, or on damp walls and rocks, forming extensive patches of small green leaves. It is not common to find marine-plants with so wide a distribution; but a nearly equal extent of sea is characterised by another of the British *Chlorosperms*, of a much greater size and more complex structure. On most of the rocky coasts of Britain may be gathered in tide-pools, or rocks near low-water mark, an Alga of a bright green-colour and spongy texture, cylindrical, and much branched, the branches dividing pretty regularly by repeated forkings, and the whole invested, when seen under water, with a downy coat of colourless filaments. The name of this plant is *Codium*

tomentosum. Under the microscope it is found to be wholly composed of small threads, of a tenacious, membranous consistence, filled with a dense granular fluid, closely and intricately matted together; the threads in the centre of the branches having a longitudinal direction, while those of the circumference are horizontal, presenting their closely-set tips to the surface of the frond. This plant abounds on the shores of the Atlantic, from the north of Europe to the Cape of Good Hope; it appears to be equally common in the Pacific, extending along the whole western coast of the American continent; it is found in the Indian Sea, and on the shores of Australia and New Zealand; nor is there any certain character by which the specimens of one country may be known from those of another.

'Allied to the *Codium* in structure, and not uncommon in rock-pools, is a slender and extremely elegant little plant, *Bryopsis plumosa*, which consists of a multitude of soft green feathers, gracefully connected together Its substance is exceedingly flaccid, and the branches fall together when removed from the water, but immediately expand on re-immersion. Few of our marine-plants are more beautiful; and the pleasure of admiring its graceful characters may be indefinitely prolonged, as it is one of the plants which may be most easily grown in bottles of

sea-water. Whilst it continues to vegetate, it will keep the water sweet and pure, and no care is needed except to close the mouth of the bottle, so as to prevent evaporation. The *Bryopsis*, in all its characters, has the structure of a vegetable; nor does it much resemble the Zoophytes in aspect. And yet it is one of those plants which closely link the lower members of the vegetable kingdom with those of the animal. Through *Bryopsis*, the passage is very clear into *Acetabularia*, an elegant Mediterranean plant, which closely resembles a Zoophyte, and which was, indeed, till lately, classed in that division of animals. Instances of this kind of seeming connection between the two great kingdoms of the organised world, meet us frequently among the lower groups of either, and often, as in this case, where connection is least looked for. The genus *Cladophora*, to which I have already alluded, consists of the branching species of the green division of the old genus *Conferva*. These plants are formed of strings of cells, one cell growing from the apex of another, so as to form a jointed thread. The species are distinguished by differences in the branching, in the proportionate length of the cells, and in their diameter; and nearly all of them are beautiful objects. They mostly form scattered tufts, in rock-pools, but some occur gregariously in extensive

patches, covering rocks or Fuci with a bright-green fringe.

'I shall now notice a few of the more common of the Olive-coloured group of sea-weeds, or *Melanospermeæ*, so called because their reproductive grains, or spores, are of a dark colour, or so opaque that they appear dark when seen by transmitted light. This group consists of much more perfectly formed plants than those we have just noticed. They are, also, commonly of much greater size: the largest of all sea-plants belong to them. The Olive sea-weeds commence to grow, as I have already said, just within the margin of the tide, and they extend throughout the whole of the littoral zone, and to the depth of one or two fathoms below low-water mark. The first species we meet with is *Fucus canaliculatus*, the smallest and most slender of the British Fuci. It grows in scattered tufts, one or two inches high, on rocks about high-water mark, and is at once known by having narrow channelled stems and branches, without air-vessels. It rarely grows in water of a greater depth than three or four feet, and never in places where it is not exposed for several hours daily to the air. To it succeed *Fucus nodosus*, a large species, with leathery, thong-like stems, distended at intervals into knob-like air-vessels, and covered in winter and spring with bright-

yellow berries; and *F. vesiculosus*, a more membranous kind, having a forked leaf, traversed by a midrib, and bearing numerous air-vessels in pairs, at either side of the rib. This species is gregarious, covering wide patches of rock from a foot or two below high-water to low-water mark. Growing thus, at different times, in a very different depth of water, it varies greatly in size. The specimens found near high-water mark are small, and generally without air-vessels, those organs not being required to float the plant in shallow water; while all that grow in deep water are abundantly provided with them, and have fronds several feet in length, that stand erect in the water, buoyed up by the air-vessels. About the level of half-tide, a fourth species of Fucus makes its appearance, *Fucus serratus*, distinguished from all the rest by its toothed margin, and the absence of air-vessels. This species abounds on all the rocks, to the limit of low-water, growing, like *F. vesiculosus*, in society. These four species are all the true Fuci that are common to every part of the coast, and that impart to the vegetation of the rocky sea-beach its peculiar olive-brown character. All of them, but particularly *F. serratus* and *F. vesiculosus*, are employed in the manufacture of kelp, an impure carbonate of soda, obtained by burning the dried stems of these plants. Before the

alteration of the tariff, and especially in war-time, when the market was badly supplied with alkali, great revenues were obtained by the owners of rocky shores from the trade in kelp; but now that soda is procured by an inexpensive chemical process from rock-salt, the manufacture of kelp has been much neglected, and has dwindled down to insignificance. At present, the only demand for this commodity is from the manufacturers of iodine, the chief source of that valuable substance being found in the *Algæ* of this family. It is much to be regretted that a trade, once so valuable to a large population on the western coast of Scotland and Ireland, where the means of livelihood are scanty, should have ceased to yield a profitable return; but these are revolutions to which all manufactures are subject. At some future time, other uses may be found for the abundant crop of these plants which our shores supply. At present, large quantities come into use, either in the state of ashes, or in a fermented state, as a valuable manure for green crops. Their value as manure is said to be enhanced in districts most removed from the sea; and this may not be merely on the principle that "cows afar off have long horns," but the mineral substances they contain may be less abundant in the soils of inland districts than in those nearer the coast, to which the

spray of the sea must carry a considerable quantity of these salts.

'None of our common *Fuci* are known beyond the waters of the Atlantic except *F. vesiculosus*, which occurs in the Mediterranean Sea, and again in the Pacific, on the Western shore of North America. This species, indeed, is the most patient of the family in enduring a great variety of conditions. As to climate, it submits to the frozen rigour of the Arctic circle, and to the tropical fervour of the Canary Islands. In the latter country, however, it appears to be on the very verge of extinction, the fronds being reduced to the smallest compass, consisting of little more than the root and the fructification; just as we see annuals grow in a poor and dry soil frequently dwindle to a pair of leaves and a flower, and these of the smallest size. Comparing the specimens from the Canary Islands with those grown in deep water in the North of Europe, we find so much difference that they will hardly be suspected of being relations; yet the two forms may readily be traced into each other, and this without going beyond the evidence collected on our own shore. A change similar to that caused by heat in the plant from the Canaries is induced in this country by the very opposite conditions of fresh water and muddy soil. The *Fucus balticus* of northern

writers, which is found in very muddy enclosed arms of the sea, near high-water mark, and under the influence of fresh water, is a variety of *F. vesiculosus* much resembling, especially when in fruit, the starved variety found in the Canaries. This affords us a striking instance of the opposite means which nature often employs to bring about the same result, and may teach us that the adaptations which we find in the various races of animals and plants have some other controlling cause than the circumstances in which the species find themselves. All we can determine on this subject seems to be, that every species of animal or plant has its natural condition, known only, in the first instance, to the Author of nature; and that a departure from that natural condition, in either direction, will alter the character of the individual. But, until we have tested the matter by direct experiment, we cannot pronounce on the result. No one, by reasoning on the subject, would be prepared for the fact that the heat of the tropical sea would exercise the same transforming power on a particular plant as the mud and fresh water of a colder climate. A similar difference in the causes which effect the same end, may be noticed in comparing the means by which nature provides a season of rest for the plants of tropical and of temperate climates. In

temperate climates, the cold and wet of autumn and winter strip the trees, and reduce the greater part of the vegetable kingdom to a state of torpor. Between the tropics, the same effect is brought about by the heat and drought of summer. The leaves of tropical trees, within certain parallels, are burned off the branches, while buds, coated with hard scales, are formed, that preserve the embryo foliage till the return of genial showers shall call forth the dormant powers of life. A tropical forest, so stripped, has much of the aspect of a wintry one in a temperate climate; and, physiologically, the condition of vegetation is the same. But what can be more opposite than the atmosphere — the light through which the pictures are seen? The snow-clad earth, the clear and bracing air, and the dark-blue sky of a climate like that of Norway or Canada, contrast strongly with the burnt-up, dusty soil, air like the breath of a furnace, the hazy distance in which every object dances with a flickering motion, and the fierce heat that pours down from a pale-blue sky. Yet the effect on vegetation is the same—a season of rest is provided in either case, which is absolutely necessary to insure the healthy growth of the plants of these opposite climates.

'Close along the margin of the sea, either above or

below high-water mark, may be seen on most rocky shores, small circular, somewhat scurfy patches, consisting of minute, rigid branching plants. These, when dry, look perfectly black, but on the return of moisture, exhibit a clear olive tint, while their tissues soften, and the frond becomes pliable. The patches I allude to consist of two species or varieties of the genus *Lichina;* the smaller one, *L. Confinis*, growing just above high-water mark, where it is wetted by the spray without being submerged; the larger, *L. pygmœa*, growing in places inundated every tide. These little plants have sometimes been considered as *Algœ*, sometimes as belonging to the class of *Lichens*. By those who regard them as Algæ, they are placed in the group of Melanosperms; but their fructification little resembles that of any of the genuine members of this group, while it has a considerable affinity to that of many Lichens. Most botanists now, therefore, consider them, as their first observers proposed, to belong to the true Lichens. Their submarine locality alone connects them with the Algæ. But submerged Lichens are by no means anomalous; several undoubted members of that family grow in places habitually flooded, such as the rocky beds of mountain rivulets, or even along the margin of the sea, within the range occupied by the *Lichinœ*.

'About the limit of ordinary low-water, and to the depth of one or two fathoms beyond that limit, the rocky shore is fringed with a broad belt of luxuriant sea-plants, mostly consisting of the family called *Laminarieæ* —among which some of the larger members of the *Fucoideæ*, and a great number of the *Floridecæ*, or Red Sea-weeds, find a favourable locality. The *Laminarieæ*, or oar-weeds, are the largest of all sea-plants. Their stout woody stems, and broad, ribbon-like, glossy olive leaves, must be familiar to every one. When seen through clear water, as you pass over them in a boat, they form a picture resembling a miniature forest of palm-trees, as their great fronds stand expanded in the water, while fishes swim in and out among the flat branches. None of those of our climate attain a length of more than twelve or fourteen feet, and even at this size the weight of a single frond is very great. But these are pigmies compared to some of the gigantic *Laminarieæ* of the Southern, Pacific, and Atlantic Oceans, where great trunks, twenty feet long and upwards, support huge bunches of leaves that form, when expanded, a circle of equal diameter. One species is said to have stems reaching to the enormous length of fifteen hundred feet, buoyed up by air-vessels from a great depth, and extending afterwards for a considerable

distance along the surface of the sea. This plant, *Macrocystis pyrifera*, is found through most parts of the Pacific Ocean, and abounds in the southern parts of the Atlantic, but has not been noticed in the Northern Atlantic. Its stems are slender, becoming much branched, and bear a profusion of lanceolate, serrated leaves, each of which springs from an oblong air-vessel. Another species (*Nereocystis Lutkeanus*) from the north-west coast of America, has stems resembling whipcord, three hundred feet in length, which support a great air-vessel at their extremities, six or seven feet long, crowned with a bunch of dichotomous leaves, each thirty or forty feet in length. On the air-vessels of this gigantic sea-weed, the Sea Otter, according to the observations of an excellent observer, finds a favourite resting-place, when fishing; while the long tenacious stems furnish the rude fishermen of the coast with excellent fishing-lines.

'In tide-pools exposed to the sun, and also on the bottom of the sea beyond the tidal influence, the family of *Dictyoteæ* is found; generally scattered, but sometimes growing in society. These are the most beautiful members of the group of Melanosperms, and some of them, especially *Padina Pavonia*, or the peacock's tail, highly curious productions. This charming plant is only

known with us on the south coast of England, where it occurs in many places; but it is one of the commonest shore-plants of the tropical sea, and also fringes the margin of the Mediterranean. It is an annual, appearing with the early summer, and fading before the autumn sets in. When growing, its fan-shaped fronds are rolled up into cups, while the delicate fibres with which they are bordered, and which form concentric bands over their surface, decompose the rays of light, and reflect the most beautiful glaucous and prismatic tints. The remainder of the Melanosperms, including the *Sphacelariæ* and *Ectocarpi*, are plants of small size, filamentous and much branched, and form bunches or tufts, growing for the most part on other plants. Thus, most of the *Fuci* and *Laminariecæ* become covered, as the season advances, with small parasites belonging to these families—and others grow on the smaller Algæ in tide-pools. Several are objects of much beauty.

'With a short account of the Red Sea-weed or Rhodosperms, I shall conclude this hasty sketch of the various tribes of Algæ. The Red Sea-weeds are by far the most numerous in species, the most beautiful in form and colour, and the most perfect or elaborate in structure of all the class of Algæ. They also characterise a greater depth of water. Many of them grow beyond

the influence of the tide, and can only be procured by the dredge, except when a strong gale loosens them from their position, and throws them up on the beach. The majority grow close to low-water mark, and are to be seen only for an hour or two at the spring-tides; so that a person visiting the shore at neap-tides may leave it ignorant of half its treasures. The favourite locality of the more delicate *Floridecæ* (as the Rhodosperms are frequently called), is on the perpendicular sides of deep tide-pools under the shade of larger plants. In such places, either *Fucus serratus* or *Himanthalia lorea*, commonly grows on the top of the rocky margin, while the fronds rest on the surface of the water. On removing the *Fuci*, a host of delicately beautiful *Floridecæ* will often be revealed. This is the usual position of the various species of *Griffithsia*, some of the most beautiful of the filiform Algæ. Where the pools are not shaded by large plants on the margin, the northern aspect will be found most fertile, especially when ledges of rock project beyond the rest; and such is the favourite locality of *Delessirias anguinea*, whose beautiful rosy leaves, veined with darker striæ, are the delight of amateur collectors of sea-weeds.

'Most *Floridecæ* flourish in clear water. But this is not the case with several of the *Callithamnia*, the most

delicate of the filiform kinds, whose slender pinnated fronds, when laid out on paper, resemble minutely beautiful tracery-work, and mock the attempts of the pencil to do them justice. The species of this genus flourish most in places where a coating of mud covers the rocks, or where the water itself is habitually muddy. Often the botanist, searching for *Callithamnia*, must content himself with bringing home handfuls of mud which merely exhibit the presence of some red filaments, till washed out; yet from this unpromising soil the most charming plants are often procured. A well-known and most successful collector of these plants, is in the habit of visiting, at low-water, in a boat, the muddy base of a small harbour-pier, and gathering indiscriminately any lump of red which the muddy surface of the pier affords, and from the washings of these lumps, *Callithamnium gracillimum*, *C. thuyoideum*, *C. byssoideum*, and *Dasya ocellata*, and other rarities are procured. Mud-banks yield some of the most beautiful *Polysiphoniæ*, as for instance, *P. variegata;* but most of this genus prefer the purer water of rock-pools. The exquisite *P. parasitica* is found only in clear water, at the verge of low-tide, or on the banks of Nullipores, which characterise a still lower level.

'I have spoken of the *Floridecæ* or Rhodosperms, as

the Red Sea-weeds; but it must not be supposed that they are all of a clear red colour—nor does colour supply us with more than an imperfect guide in determining them. The red colour appears to depend in great degree on the amount of direct light which reaches the growing plant. The same species which exhibits a full red colour when growing in the shade, assumes every variety of paler tint till it ends in a clear yellow, as it grows under the influence of sunshine, and in shallower water. This is very apparent in the *Chondrus crispus*, or Carrigeen, well known for producing a peculiar gelatinous principle used in cookery and medicine. When this plant grows in places shaded from the sun, its fronds are of a very dark purple, reflecting prismatic colours from the surface; but growing, as it frequently does, in shallow pools exposed to full sunlight, it becomes green and even yellowish-white before it altogether ceases to vegetate. Similar changes may be observed in many other common species, especially in *Ceranium rubrum* and *Laurencia pinnatifida*. Light does not always act as a destroyer of colour among these plants—in some tribes it affects them by darkening the purples into browns, as in the *Polysiphoniæ*. Among these, *P. fastigiata*, which grows parasitically on *Fucus nodosus*, in places where it is exposed to the air for

several hours every day, assumes the dark brown of a member of the olive group. Mere colour, therefore, may lead the student into error, if he decide solely by it, to the neglect of peculiarities of structure and fructification.

'Several of the Rhodosperms are in different countries either employed as articles of food or used in the arts, in the manufacture of strong sizes and glues. Their nourishing principle appears to reside in a peculiar compound found in several kinds, to which the name Carrigeen has been given by the chemists. It was first extracted, as the name imports, from *Chondrus crispus*, the Carrigeen of our coasts, a plant which may be collected to an unlimited extent on all rocky parts of the British shores. The fronds, properly prepared by drying, will keep for any length of time, and a strong jelly may be extracted, when required, by simply boiling in water. Similar jellies are yielded by other species of *Chondrus*, as well as by the *Gigartinæ*, *Gracilariæ*, and certain *Gelidia*, some of which yield mucilages of so great strength as to be employed as glue. There have recently been imported into this country samples of an eastern species, *Gracilaria spinosa*, which, under the name *Agar-Agar*, is largely consumed in China, both as an article of food, and as yielding a very strong

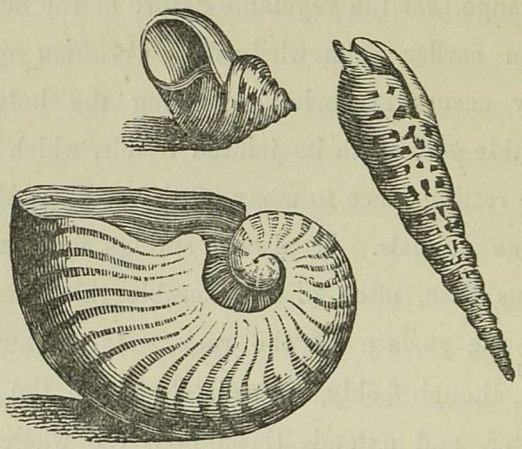
glue. The jelly prepared from it is certainly superior to that yielded by our *Chondrus*. A Swan River species (*Gigartina speciosa*, Sond.) affords a gelatine of perhaps equal value. Both these might be obtained in abundance, should a demand for them arise. These few instances, selected out of a multitude, shew that the *Algæ* are not undeserving the notice of the economist, especially in a country where the constant increase of population renders desirable every effort to increase the supply of food. That the vast stores of Carrigeen which our coasts afford, have been wholly neglected during the recent famine, is the result partly of ignorance, and partly of the invariable companion of ignorance—prejudice.

'The only other Rhodosperms which I shall notice are the very curious tribe of *Corallineæ*—the jointed Corallines of Linnæus—plants which have been regarded, almost universally since the time of Ellis, as members of the animal kingdom. This tribe is most numerous in species as we approach the tropics, and the British examples are not many; but one of them, *Corallina officinalis*, is so common on all our coasts, that it must have attracted the notice of every one who has paid any attention to marine productions, and it will serve as a type of the family. It will at once be seen that this

plant differs from other sea-weeds in being of a calcareous nature, effervescing when thrown into an acid solution; and in this respect it resembles a true coral. It neither produces Polypes, however, nor exhibits any animal character, while it yields spores, contained in receptacles perfectly analogous to those of the Algæ of the red series, to which its colour also allies it. These spores were observed and figured by Ellis; and it is therefore the more strange that the vegetable nature of the family has not been earlier acknowledged. *Corallina officinalis* generally occurs in society, covering the bottoms of shallow tide-pools with its jointed fronds, which afford a welcome resting-place to many of the smaller Algæ and to marine animals. It always springs from a broad, calcareous base, often of considerable thickness, which incrusts the surface of the rock. It commences to vegetate, though feebly, immediately within the limit of high-water, and extends throughout the whole littoral zone, gradually acquiring fuller development as the water deepens; and the best specimens are always to be found nearest to low-water mark. It is occasionally dredged from the depth of three or four fathoms, or perhaps more; but specimens from water of that depth are less perfect than those collected about low-water mark, clearly shewing that, at that level, the species is

in the situation best adapted to its nature. The species of the genus *Corallina* are very imperfectly known, and many supposed species may ultimately prove to be merely varieties of this common and very generally diffused plant, which in some form or other inhabits the shores of most temperate latitudes.'

SHELLS AND SHELL-FISH.



From the subject of sea-weeds we now turn to the living inhabitants of the beach, all of which present features of great interest to the student of natural history, and even to the ordinary observer. In this little work, however, it is impossible to do more than notice a few of the vast multitude of living beings which belong to this department of zoology.

Suppose we examine one of those little rock-pools left full of water on the retreat of the tide. If we lift up the fronds of the sea-weed which hang down in the water, we shall probably discover several animals worthy of our notice. The crab, the star-fish, the sea-anemone, the hermit-crab, and a variety of mollusks, with numbers of smaller creatures, may at once be discovered in such a place.

Let us examine one of the hermit-crabs which generally inhabit the discarded shell of a whelk. This creature belongs to a peculiar genus, termed *pagurus*, and forms a kind of intermediate link between the crab and the lobster. It has ten legs, including its two large pincers, and hence belongs to the class of Decapods, but it differs from its relations in being but partly encased in defensive armour; the tail being entirely naked, and thus exposed to danger. This exposed condition of so important a part of the hermit's person would be a most inconvenient circumstance, surrounded as he is with numerous swift-footed and rapacious foes. He is possessed, however, of an instinct which amply compensates for this apparent defect; and finding himself unable to live in the society of his voracious congeners, with a delicate caudal extremity subject to be impolitely tampered with by their pincers, he secures himself by entering some shell suited to his own

size, in which he resides like the 'crabbed' old cynic Diogenes in his tub, with this great advantage over the philosopher, that he can carry his house about with him with perfect facility. That this remarkable habit is not forced by mere accident upon our hermit, is obvious from his structure. His tail is capable of assuming a spiral form, so as to fit into the chamber of the shell, and it is terminated by certain hard movable pieces, worked by a powerful muscle, by means of which the creature can fix itself securely in its domicile, and carry it about with him without danger of losing it, and withdraw into it or otherwise as he chooses. With instinct and mechanism thus beautifully adapted to each other, the hermit-crab first selects deserted shells of a small size, suited to his juvenile dimensions, but, as he approaches his majority, he is obliged to appropriate others of greater size, till at last he occupies that of the full-grown whelk. It is highly probable, however, that he frequently makes himself master of the shell he inhabits by means only justifiable in the world of waters, among whose denizens 'might constitutes right:' the rapacious hermit seizes upon and devours the unhappy mollusk whose abode he covets, and who, deceived by the destroyer's external resemblance to its own harmless race, suffers him to approach, and so falls into his remorseless grasp. The stealthy manner in

which these remarkable creatures may be seen moving about the rocks in search of food, gives considerable colour to this supposition, which is strengthened also by the extreme freshness of the shells in which the hermit-crabs are frequently found. If the hypothesis be correct, the *Pagurus* serves thus to check the increase of those mollusks on which it is presumed to prey, and so tends to maintain a balance in that portion of the animal kingdom.

Permitting our hermit to make his escape, which he does with great good-will, we shall now turn to our crab properly so called, who, with outstretched pincers, is still 'shewing fight' in a most courageous and resolute manner. The specimen we have taken is that of the common crab. It is of small size, being about three inches across the back; its colour is a dirty green, and it is found all along our shores, lurking beneath the *Algæ*. These crabs are extremely active, and on a calm day, when the water is clear and smooth, it is highly amusing to observe their motions, as they pursue each other among the sea-weed or over the sand. We have sometimes with great interest watched their proceedings, as our boat lay motionless on the water, and observed one, which had been lurking beneath the broad fronds of a laminaria, suddenly dart out with amazing agility after a

flounder, not bigger than a five-shilling piece, which came shuffling past its retreat, and continue the pursuit with a rapidity not much inferior to that of its affrighted prey. The number of species of crabs belonging to our coasts is considerable. Pennant enumerates more than two dozen, differing more or less from each other, although possessed of certain common characteristics. We shall mention a few of these.

There are two extremely minute species known on our coasts, belonging to the genus *Pinnotheres*. These little creatures are only about a quarter of an inch in size across their shells, which are rounded and convex, and of a delicate texture, and brownish in colour; they are called the pea-crabs. One of them (*Pinnotheres pisum*) is frequently found within the shell of the common mussel when taken from deep water, and the other (*P. veterum*) is chiefly discovered in the wing-shell, or *Pinna* (so called, it is supposed, from their resemblance to the *pinnæ*, or plumes, worn by the Roman soldiers), an immense bivalve, said to measure sometimes three feet in length. The habit of this crab in occupying the interior of the *Pinna* along with its proper occupant, is very remarkable. It does not, as might be presumed, enter for the purpose of preying upon the animal, but, so far as appears, merely for protection. This practice was observed by the

naturalists of classic times, who imagined that the office which the crab discharged was that of intimating to its friend, the *Pinna*, the moment at which to close its shell, upon such wandering fish as might enter and serve for its food. Hence the ancient name of this minute member of the crab family was *Pinnophylax*, or the *Pinna's* keeper. The Greek poet Oppian tells the fable thus :

'In clouded deeps below the *Pinna* hides,
And through the silent paths obscurely glides ;
A stupid wretch, and void of thoughtful care,
He forms no bait, nor lays the tempting snare ;
But the dull sluggard boasts a crab his friend,
Whose busy eyes the coming prey attend.
One room contains them, and the partners dwell
Beneath the concave of one sloping shell ;
Deep in the watery waste the comrades rove,
And mutual interest binds their constant love :
That wiser friend the lucky juncture tells
When in the circuit of his gaping shells
Fish wandering enter ; then the bearded guide
Warns the dull mate, and pricks his tender side ;
He knows the hint, nor at the treatment grieves,
But hugs the advantage, and the pain forgives.
His closing shells the *Pinna* sudden joins,
And 'twixt the pressing sides the prey confines :
Thus fed by mutual aid, the friendly pair
Divide their gains, and all the plunder share.'

Besides the large species usually found in our markets, there are several of very remarkable forms. One of these is the wrinkled-crab, the shell of which, as the name

implies, is corrugated or wrinkled transversely; the velvet-crab, the shell of which is covered with a velvet-like coat of hair, and is of a fine reddish brown and blue colour. Both these varieties and a few others have the two last joints of their fourth pair of legs flattened and fringed with fine hairs, and these, used as oars, enable them to move through the water with great rapidity. Another remarkable species is the masked-crab, so called from the circumstances that the depressions and protuberances on the back of its shell are so arranged as to present the resemblance of a human face. Another kind, known by the general title of the *Maiadæ*, have long legs and oval bodies, almost entirely beset with strong and sharp thorns of various sizes; then there are the spider-crabs, with bodies more or less oval, and legs of great length, and having a very considerable resemblance to the insect after which they are named. All these creatures possess some attributes in common, although differing in certain particulars. Their forms furnish instances of great compactness: the head is comparatively minute, and concealed under the thorax; the segments of the abdomen are also small, and protected by a strong shield which clasps over them; and the whole body is enclosed in a strong and substantial box, the form of which enables it to resist a great degree of pressure.

Crabs, like all other crustaceans, throw off their external covering annually. This, it is obvious, is absolutely requisite to their existence, for as the young animal increases in dimensions, it must perish if not liberated from its unyielding envelope. The facility with which this operation is performed is truly wonderful. At first sight it would seem as difficult for the creature to escape from its shell, as it would be for a young gentleman, in the days when armour was worn, to liberate himself from a suit of mail, every part of which was firmly soldered together, without being capable as usual of being separated into pieces. Yet, great as this difficulty apparently is, the wise Author of nature has provided for its easy and convenient performance.

The history of the crab in its earliest state of being was long involved in mystery. The discoveries made on this subject are truly wonderful. Naturalists at first supposed that, on being excluded from the egg, the young crab at once appeared in the form of the older animals of its kind. This notion was considered the more correct from the multitudes of very minute crabs, evidently the young of the larger species, so frequently to be found along the sea-shore. Yet nothing was further from the truth: the young crab does not possess the remotest similitude to its progenitors, and exhibits a figure in the

highest degree grotesque. While less than an eighth of an inch in size, it consists of a body shaped like a Russian helmet, being hemispherical, with a spike or horn rising from its centre. In front are two large eyes, near which are the antennæ and a long beak, and from the margin of the helmet depend four pair of legs, furnished with hairs at their extremities, and from behind these legs hangs a long tail, jointed and fringed at the end. Thus accoutred, the little creature swims through the water like one of the *Infusoria*. On its first moulting, the Zoea, as it is called, passes through one stage of its metamorphosis, assuming a figure known to naturalists under the name of Megalopa, from the size of its organs of vision. The eyes, instead of being sessile, as before, are now elevated on footstalks ; the claws are developed ; but the tail is not yet laid aside, and is still employed in swimming. Another moulting issues in a further change of form. The abdomen or tail folds under the thorax, and the little crab appears complete, though still of a diminutive size. It now gives up its natatory propensities, seeks the bottom of the water, hides among the sea-weed, and at the usual times casts its crust, as it advances to maturity and increases in size.

The Dutch naturalist Slabber was the first to observe the metamorphosis of the Zoea into the Megalopa ; and

both these were subsequently proved, by Mr Vaughan Thompson, to be the embryo of the shore-crab. The account was at first received with considerable scepticism, but it is now proved to be perfectly accurate, and there can be no doubt that all the crab and lobster tribe undergo a similar metamorphosis.

The crab may be said to form the type of the great family of the *Crustacea*, which comprehends a vast multitude of animals, of whom, it is probable, we do not know more than the fourth. The species found in the tropics exhibit the greatest variety, in structure, form, and colour. Some are of great magnitude, others extremely minute; some are sombre in hue, others adorned with various brilliant and beautiful colours. In all these instances, however, naturalists have discovered that there prevails a general plan of organisation, more or less modified, as we ascend from the lowest of the *Crustacea* to those like the crab and lobster, of the most complex structure.

The Limpet is another very common inhabitant of almost every rocky pool. It is called *patella* from its resemblance to a dish, and it belongs to the numerous order known as Gasterpods.

Our readers are all familiar with the tenacity with which the limpet can adhere to the rock it chooses as its

abode. The process by which this is accomplished is highly interesting. The body of the limpet, which is also its foot, it has the faculty of forming into a smooth surface, round the outer rim of which is a lip. This surface and the lip being placed in close contact with the stone, the central portion of the animal's body is raised by muscular contraction, and as neither the air nor the water can gain admittance beneath the shell, a vacuum, more or less complete, is formed, and the shell is pressed down upon the rock by the weight of the superincumbent atmosphere. A shell, of which the lower surface has an area of an inch square, thus adheres with a force of fifteen pounds; while the conoid form of its upper portion is such as to present the least possible resistance to the waves, the utmost force of which cannot detach the animal from its favourite spot. The structure of the patella is much more remarkable than is generally supposed. The tongue is a most singular instrument. In ordinary circumstances it is imperceptible, being, when the animal is at rest, retracted into its stomach. It consists, nevertheless, of a membraneous parchment-like string, from two to three inches in length, about half a line in diameter, flat like tape, and having the end shaped somewhat like a spoon. On subjecting it to the microscope, it is found to be (its size being considered) a most

powerful apparatus. Along its whole length it is set with teeth, re-curved like the top of a bill-hook, or the upper mandible of an eagle's bill, and disposed in rows, four teeth in each alternate row, and two, differently shaped, in the intermediate space. In order to form some idea of the effect of this piece of mechanism in tearing the substance forming the food of the limpet, let the reader imagine a leather strap, five or six feet in length, and an inch in breadth, set with a thousand hook-shaped lancets of fine steel, and exquisitely sharp, with four of these lancets abreast, and between each row of four, a couple of strong Limerick hooks, and let him suppose this strap, thus prepared, to be forcibly drawn across the body of an animal, or the stem of a plant. It is obvious that such an apparatus, minute although it be in the instance of the limpet, must soon destroy the object of attack. The chiton is the only member of the family of *Gasteropoda* which is a multivalve. It may be found, like the limpet, adhering to rocks on the recess of the tide. It is a slug of an oval form; its back is covered with eight plates of shell, placed across, or transversely, resembling the plates peculiar to ancient armour. This creature, like the limpet, fixes itself by creating a vacuum, and is so flat, and adheres with such tenacity, that it is very difficult to remove it. It often attaches itself to the

keels of ships, and thus traverses the ocean. It can roll itself in a ball like the wood-louse. It is interesting to remark regarding this little boat-shaped mollusk, that it may be considered as in some degree a modern representative of those creatures called trilobites, which swarmed in the primitive seas in which the Silurian strata were deposited. Although not three-lobed, it somewhat resembles them in form, being oval, and covered with armour divided into plates; and it is probable also that the habits of the trilobite were similar, and that, like the chiton, it adhered to the smooth surfaces of rocks by means of a sucker. It is true that the trilobite and the chiton are representatives of different orders of being, but the resemblance now referred to is not unworthy the naturalist's notice, when it is considered that the creatures whom the chiton may be presumed to resemble, existed in so remote an era in the history of our planet, so many thousands of years before man or any of the mammalia appeared.

Many gasteropodous mollusks, inhabiting spiral shells, are herbiverous, feeding exclusively on marine plants, but a large number feed only on animal substances. The shells of both these divisions differ in structure, and the difference points out the occupant's mode of life. The shells of those which feed on plants only have circular

mouths, without the sulcus or furrow on one side which is perceptible in the whelk tribe. Of these the periwinkle and its varieties, which pasture upon the bladder-fucus and other marine plants, are a type. On the other hand, in those which feed on animal substances, the mouth of the shell is furnished at one end or side of its rim with a canal or furrow, more or less distinct, and of these the whelk is a well-known example. This division of the class devour any animal substances they find in the water, prey upon each other, and make war with other mollusks. The mouths of these two genera, and the organs with which they collect their food, exhibit a remarkable distinction, which a careful examination with a lens easily detects. Those that browse on plants possess a comparatively simple apparatus, consisting of a mouth and lips, furnished with cutting instruments, by which they can readily penetrate the tough external coating of the various *Algæ* which form their food. Those, on the other hand, which have, in procuring nutriment, to deal with materials much less tractable than the leaves and stems of the fuci—such as the shells of other mollusks, through which they must force a passage—are supplied with a powerful as well as complex piece of mechanism for that purpose. The whelk affords an excellent example of this, and the apparatus itself is a most striking display of means

obviously adapted to a special end, and adapted, too, with all the unerring accuracy and efficiency which characterise the admirable mechanism displayed in the structure of animals. The whelk is armed with a strong muscular proboscis, acted on by a beautiful and complex system of muscles, and which, therefore, it can extend at will to a considerable length, retract within its body, and move in every direction. This proboscis is a wonderful piece of mechanism. It consists of an external muscular tube, to which the muscles are fixed, and in this tube is a cylindrical implement, of which the outer cylinder or tube forms a sheath, not only for its protection, but to add to the facility with which it works. This inner organ opens at its extremity, and so forms the mouth of the animal; the mouth is surrounded by two strong muscular lips; and within the lips is the tongue, armed with spines, the action of which, conjoined with that of the lips, can perforate the hardest shells; and an orifice being thus made, the tongue is protruded into it, and by means of its hooks draws forth by degrees the body of the unfortunate and helpless victim of its ingenious and persevering attack. This proboscis may be said to combine within itself the multiple action of a centre-bit or an auger, a rasp and pincers, as well as being the tongue, the mouth, and the throat of the animal which uses it.

The Tyrian dye, so celebrated by classic writers, as affording the regal purple, was the produce of a species of whelk. This dye was necessarily very expensive, from the very small quantity which each shell-fish afforded, and this circumstance placed it entirely out of the reach of any but persons of the greatest wealth. Its colour was extremely rich and beautiful, but it has been long since superseded by the much cheaper, and no less beautiful colours of the same kind, afforded by the processes of modern chemistry. The mollusk which affords this colour is the *Purpura lapillus*, one of our commonest species, and well known to every frequenter of the sea-shores. It is about an inch in length; the shell is very hard and thick, and is either white or ornamented with broad bands of yellow or brown, running in a spiral direction round it. Hundreds of them may be found on the same rock associating with limpets and periwinkles. The colouring matter is contained in a vein or gland extending across the body of the animal; it is easily collected by opening the receptacle containing it after the shell has been carefully broken. The effect of light upon the dye is extremely remarkable. On being taken from the animal, it is of a pale-yellow hue, but on being applied with the pencil to a piece of linen, the yellow becomes very rich; in a few minutes, however, it deepens into a

delicate green; the next change it undergoes is into grass green; and from this hue it gradually alters into a blue green; from which it changes to indigo and blue. It is now approaching its ultimate and permanent condition. The blue gradually assumes a reddish tinge, which, mingling with the prevailing blue, produces first violet, then purple, and at length the tint settles into lake. That these very interesting vicissitudes of colour are produced by the operation of light upon the dye, is beyond doubt; they take place in a few hours, when it is not exposed to the direct rays of the sun, and the process is greatly accelerated by the immediate influence of the solar beams. A chemical analysis of the substance possessing intrinsic properties so remarkable would be highly interesting. It would probably suggest some peculiar relations which certain substances bear to light, and thus might prove of considerable utility and value in some of the arts. In a purely scientific point of view, it would be of much interest in its relation to those intricate questions which continue to puzzle our philosophers, as to the peculiarity in the structure of the petals of flowers which enable them to exhibit different hues; and it might tend to explain the mysterious fact, that an organic change takes place in substances artificially dyed, inasmuch as a blind man has been enabled to

discriminate between different colours by the sense of touch.

The eggs and egg-clusters of some species of whelks are extremely remarkable. On wandering along the shore after a storm, one frequently finds, among the froth and sea-weed cast up by the violence of the waves, a light yellow body of a sponge-like texture, eight or nine inches in length and half as broad, composed of several globular subdivisions attached together, and consisting of numerous little semi-transparent flattish bladders all united together by their margins. The whole substance is extremely light, and may be readily mistaken for some sort of sponge. It is, nevertheless, a congeries of eggs of the large whelk *Buccinum undatum*, which inhabits deep water, and attaches these masses to the rocks, from which they are severed by the force of the waves. The eggs of the *Purpura*, above referred to, are still more remarkable. They may be found on the recess of the tide adhering to the surface of flat stones. These eggs are not attached together, as in the instance just described, but stand separate from each other on the stone where they are deposited; they are about the third of an inch in height, and consist of little urn-shaped bodies raised upon a foot or stand, and resembling in a striking manner a common egg-cup. We remember, when we first

discovered them near Blackrock, in the Bay of Dublin, how greatly we were astonished at their form, and how we mistook them for some species of plant which had hitherto escaped our notice.

Before proceeding to those objects which are to occupy our attention on our next visit to the sea-shore, we shall only further remark, that every species of mollusk will richly repay the trouble requisite in the study of its history. There is not one of these creatures whose structure does not exhibit the utmost beauty; and however great their variety may be, the marvellous adaptation of that structure to their mode of life, affords a continually recurring evidence of the care of Divine Providence over the humblest of his creatures.

Turning from the order to which the limpet belongs to those mollusks which are called bivalves, from having two shells attached by a hinge, we shall describe one or two of the most common as a type of the rest. For this purpose, we shall first notice the common cockle.

We perceive that the shelly covering of this well-known member of the great family of mollusks consists of two pieces; not, as in the oyster, nearly flat, but almost hemispherical in shape. They are united together by a hinge, the processes of which are firmly attached by means of a ligament

of great strength, and yet extremely elastic, so as to act as a kind of spring, on opening the shell, precisely in the manner in which the spring of a watch-case throws open the lid when the power that keeps it close is relaxed. This hinge and its elastic ligament afford a most beautiful illustration of that divine Wisdom which so accurately adapts the means to the end in the structure even of the humblest creatures. The hinge and ligament differ in form in the different species of bivalves, and their modifications mark out the various genera in the classification of Linnæus. In some, as in the oyster and mussel, the hinge is very simple, consisting of a ligament only; in the gaper or Mya there is a single tooth in addition to the ligament; and as we advance from the oyster or mussel toward the Arca, the processes of the hinge become more complicated, till in the latter we perceive, in addition to the ligament, a number of tooth-like processes beautifully adapted and fitted to each other. None of these differences are undesigned or unnecessary. They are all intended to furnish a greater or less degree of compactness to the joint, so as to adapt it to the circumstances in which the animal is placed; and were we fully aware of all their peculiarities of habit, mode of life, exposure to greater or less danger from pressure or other causes, we should find that in every

instance those differences are expressly designed by the great Author of nature for a particular end. But to return to our cockle.

On opening the valves, we perceive that the whole of the inner surface of the shell is lined with a soft membrane, which encloses the body of the animal as in a cloak, and is therefore called the *mantle.* It is found in all the varieties of mollusks, and although subject to great modifications, is a most essential part of their structure. Among the marvels of creative power, perhaps there is not one more marvellous than the office which this apparently simple membrane performs. Strange to say, it is a piece of mechanism for the formation of the shell by which the mollusk is covered. It is, in fact, a chemical apparatus, simple in the extreme, so far as mere appearances are concerned, and yet utterly inimitable by the highest efforts of human ingenuity. This wonderful membrane is furnished with a series of most admirably constructed glands, which secrete carbonate of lime for the substance of the shell, and colouring matter for its adornment. The glands at the margin of the mantle are occupied in adding continually to the edge of the shell, as its occupant increases in size, while the inner surface of the mantle adds to the thickness of the shell, depositing that beautifully smooth pearly substance so remarkable

in its interior surface. Thus, for example, the fine mother-of-pearl on the inside of the oyster-shell, and the beautiful colours of yellow, blue, pink, green, brown, red, crimson, and violet, which ornament and diversify the outside of others, are all the work of the mantle! What the peculiarity of structure in the glands of this marvellous organ may be, by which the carbonate of lime is first secreted and then applied to its purpose; in what manner the colouring matter is elaborated; from what materials it is obtained, and what is its chemical composition — these and many similar questions are such as to demand for their solution the highest exercise of human skill; but in many instances they are so intricate as to demand it in vain.

Within the mantle thus lining the cockle-shell is the body of the animal, consisting of a firm muscular substance, in which are the stomach, the liver, and other viscera. But what most attracts our attention is a peculiar organ tipped with a fine yellow colour. This is the creature's foot, and is a highly organised implement, possessed, in common with the cockle, by other species of bivalves, but in some existing only in a rudimentary condition. This foot is an organ of locomotion; by means of it the cockle not only buries itself rapidly beneath the sand,

but by protruding it suddenly, is able to move in jerks along its surface.

If we turn from the cockle to the common scallop, we shall discover some modifications in the structure of the bivalves that are highly interesting. There is of course the usual mantle requisite to the growth or enlargement of the shell, and within it the body of the mollusk, which presents a general resemblance to those of other bivalves, but with certain remarkable peculiarities. The mantle is of a delicate flesh colour, instead of being, as in the cockle, of a pale yellow ; around its margin are numerous semi-pellucid thread-like appendages, which the animal can protrude or retract at will : these are its tentacula. They are extremely delicate ; yet are they not only furnished with muscles by which they can be moved in all directions, and protruded from the shell or retracted at the will of the animal, but supplied with a system of nerves, distributed over their surfaces, so as to suit them to their office as organs of touch. But what is most remarkable in the structure of the mantle is, that along its margin is a row of singularly brilliant eyes, so placed that each eye is able to look out into the watery world around through one of the grooves in the fluted shell. These eyes are about half as many in number as the grooves themselves. In the full-grown scallop, each eye

is about half as large in circumference as the head of a small pin; but, small as they are, they are, as already mentioned, remarkably brilliant, exhibiting, without any hyperbole, the lustre of minute diamonds surrounded with a dark rim or setting. This supply of organs of vision is altogether singular; for why should the pecten be furnished with so many, and these apparently so perfect, while the majority of its congeners are destitute of them? For this it is scarcely possible to furnish a reason; and yet that there exists some special necessity for these bright little optics is certain; for the all-wise Creator does nothing in vain — confers no faculty without its purpose. But what can the purpose be in this particular instance? To what use does our pecten apply his numerous shining eyes? Is he a sage among mollusks, occupied in calmly contemplating the manners of bivalves in general, in order to establish some favourite hypothesis of a shell-fish philosophy? Is he a censor in the sub-aqueous realms, noting, with Argus-like power, the conduct of his passionless brethren of the deep, that he may ascertain how they comport themselves under various trying circumstances? Or have his organs of vision reference merely to his own personal affairs? Do they only aid him to choose the viands on which he is to dine, or to admire the variegated coat and beaming eyes of his

mate? The truth is, we know not wherefore the distinction should be; but how great soever our difficulty may be, of this we may be assured, that a final cause does exist, and that for some specific end the scallop has been thus rendered superior to his friends the cockle and the oyster. It is but right to state, however, that some naturalists have doubted whether these diamond-like points were really organs of sight, or only an apparatus designed for unknown and inexplicable uses; but we gladly confess that such doubts we entirely repudiate, not only because those points so much resemble eyes, even when viewed with the unassisted vision, but because we have examined them with a powerful microscope, and found that each eye consists of a lens surrounded by a vitreous covering, and otherwise exhibiting too close a resemblance to an organ of vision to be supposed suited to any other less important or less obvious use, and because their position, too, conjoined with their structure, is such as to dispel all reasonable doubt upon the subject.

We shall now direct our attention to the urchin and the star-fish, with which a ramble by the sea-beach renders us familiar.

The urchin belongs to the family of *Echinidæ*, a race whose pedigree extends far into the ages of hoar antiquity, having existed thousands of years before man became a

denizen of this terraqueous globe. The species now existing, indeed, are not found in a fossil state, save in very recent deposits; but their ancestors flourished in prodigious multitudes during the secondary epoch, and the tertiary, and are found imbedded in the oolite and chalk formations; some shaped like helmets, some elliptical in form, some turbinated, and others heart-shaped, like those of the present day. The urchin is therefore an object of interest to the geologist as well as to the student of natural history. The egg-urchin is doubtless familiar to our readers. The shell is globular, but somewhat depressed, so that the diameter perpendicular to the orifice in the shell is less than that at right angles to such diameter—that is, from one side of the sphere to the other. If we in the first instance examine the shell, we shall find it in the highest degree worthy of admiration. Unlike the crab or the lobster, the urchin does not cast its shell; it is therefore obvious, that for the animal to escape from its hard envelope by the narrow orifice in it would be impossible. The shell, therefore, is made to increase with the size of the wearer, and this necessity gives origin to a wonderfully complex as well as beautiful arrangement. It is plain, that were the panoply to consist all of one piece, its diameter could not increase; but the difficulty is admirably provided for.

The sphere consists of hundreds of minute segments of a pentagonal shape, fitted to each other like the stones of an arch or a dome. The whole of the interior is lined with a delicate membrane, which likewise intervenes between the various segments of which the shell consists. It is the office of this membrane to add to the size of the shell as the animal within it grows in bulk. It performs, therefore, the function of the 'mantle' in the bivalve and other mollusks, as already described, by secreting carbonate of lime, and applying it to add to the thickness of the shell generally, while it increases its circumference by gradual additions to each of the sides of the segments composing it. So, in the full-grown urchin, the number and form of the divisions in its shelly covering are the same as in the young animal, and they differ only in size. By this beautiful provision, the gradual enlargement of the sphere takes place without any alteration in its form, or in the relative size or position of its various compartments. Were we to suppose that there existed a necessity for a bridge gradually to increase its dimensions up to a certain point, we could imagine no other available plan than this. Either the whole structure must be taken to pieces, and built with stones either larger in bulk or more numerous, or the stones originally employed must increase in breadth and

length by the addition of new matter at their sides and ends—a process, however, far beyond the limits of human contrivance.

Other parts of the structure of this creature are no less striking and interesting than those now described. The shell, when denuded of its spines, appears marked out on its surface from top to bottom by five double rows of small holes, into ten spaces, shaped somewhat like the gores employed in forming a paper-balloon. Each of these spaces is studded with rows of minute hemispheres. These little points, which appear merely as ornaments when the shell is cleared of the spines, are a portion of an admirable piece of mechanism. To each of them is fixed one of the spines, furnished with a socket, into which the little point fits so that the spine revolves on it precisely in the manner of what engineers call a universal-joint, formed with a ball and socket—a structure ex-exmplified in that of the human shoulder-joint; with this difference only, that in the latter the socket is stationary, and the ball of the *humerus* revolves in it, whereas in the urchin the ball is at rest, and the socket of the spine plays round it. The spines are moved by muscles put into action by motor nerves, and serve as organs of locomotion, and, perhaps, also as weapons of defence. From each pair of the minute holes already spoken of issues a sucker

like those of the star-fish, by which the animal attaches itself to any surface, and assists itself in changing its place. Among the spines, moreover, are numbers of minute pincers, called by naturalists *pedicellariæ*, consisting of a stalk or column, with a knob at the end furnished with three hard teeth, some obtuse, and others elongated in shape. The use of these pincers is altogether unknown; but enough has been said to exhibit the complexity of structure for which even the external organs of the urchin are remarkable. If we examine the mouth, its mechanism will be found much more elaborate than that of the whelk, as previously described. It is scarcely possible, indeed, to convey a suitable notion of it, without pointing out the parts in a living specimen; but sufficient may be said to incite the reader to examine for himself. The teeth, or rather the jaws, of the urchin consist of five pieces of a triangular shape, fitting together, and forming a cone, in the centre of which there is an additional tooth. This cone occupies the middle of the orifice in the base of the shell, and the teeth or jaws of which it consists are attached to the arches around that orifice by powerful muscles, and are furnished with others, enabling them to work upon each other so as to triturate and grind the substances on which the animal preys; for which purpose the surfaces of the

jaws are so completely adapted, that very hard substances exposed to their action must be speedily bruised into a pulp.

Like the urchin, the star-fish may be considered the representative of a very ancient race of beings inhabiting the earliest seas. These creatures, known to the geologist as Encrinites, consisted of a stalk by which they were attached, like other zoophytes, or like sea-plants, to a particular spot, and having the body of the animal on the other end, formed of arms or rays diverging from the centre. These animals, which, from the immense masses of encrinital marble formed by their remains, must have existed in inconceivable multitudes, have all become extinct, and are represented by a very few species, attached, like them, to one spot. The star-fishes, or *Asteriadæ*, have their bodies divided generally into five lobes or rays, more or less elongated. In some instances the rays form the points of five angles into which the body is divided. These rays are covered with a tender skin on their upper surface, which to the touch appears as if filled with a soft pulp. The lower surface, however, exhibits a very complex structure. A channel or groove runs along that surface from the centre to the point of the ray, between two walls of shelly matter, constituting part of the skeleton. This channel or groove contains a

multitude of suckers placed on the ends of transparent footstalks, and serving for the threefold purpose of attaching the star to a particular spot, enabling it to seize upon its food, and to move from place to place. Each of these feet thus terminated by a sucker issues from a hole in the channel already spoken of, and is a tube filled with liquid, which is injected into it from a gland at its base by means of muscular pressure; on the withdrawal of which pressure the liquid retreats into the gland, and the feet collapse. Thus a simple but effective mechanical arrangement enables the star-fish either to retract or extend his feet as he will. The degree of force with which any individual of these suckers acts is inconsiderable, but the number of them compensates for this, and by their united action, a power fully equal to all the requirements of the animal is obtained. The *Ophiuridæ* are a kind of star-fishes very common along our coasts. The generic term adopted by the late distinguished naturalist, Professor Edward Forbes, accurately describes their general form. Their bodies are small and round, and furnished with five long and slender arms, which, instead of having a very sluggish motion, as in the ordinary star-fish, move and twist about with great activity, and by their resemblance to the tails of small serpents, suggest the generic term. The rapidity

of motion possessed by these arms enables the creature to crawl with considerable celerity.

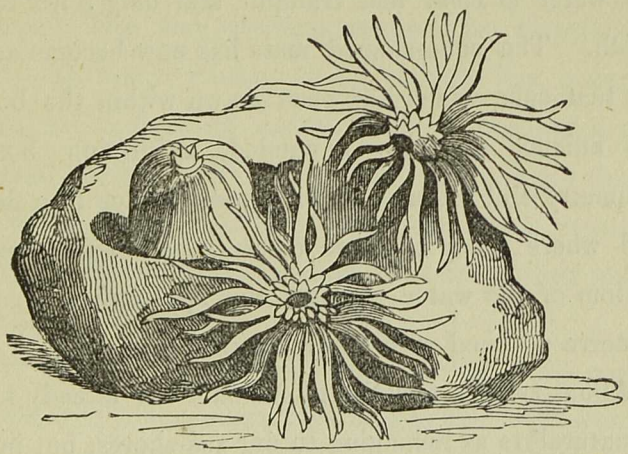
There are many varieties of star-fishes, including those now referred to, and several of them possess much elegance. The 'feather-star' is a very beautiful species. The body is small and covered with jointed filaments; it has five long and slender arms, feathered along their sides with numerous pinnæ, furnished with hooks or claws, by which it is enabled to adhere with great tenacity to the rocks or sea-weed. Its anatomy exhibits a structure of a most elaborate character, but difficult to describe without having recourse to very minute detail. The body is generally of a fine rose colour, and in some instances it is ornamented with bands of crimson and yellow. The sun-star is also a beautiful species; the disk being surrounded by twelve broad rays. The colour of this species is variable. In some instances, the whole animal is a brilliant red; in others, the disk alone is red and the rays white, and occasionally the entire surface is purple.

Several species of these remarkable creatures are called 'brittle stars,' from their peculiarity of falling to pieces on being removed from their native element. The 'feather-star' above mentioned is extremely fragile, and when taken at sea, can rarely be kept entire. This power of self-destruction may perhaps be altogether

involuntary, but in some instances it seems as if an act of will on the part of the star-fish. Professor Edward Forbes having taken a fine specimen of the lingthorn (*Luidia fragilissima*), the largest of our star-fishes, measuring about two feet in diameter, gives the following graphic account of its suicidal propensities, written with much humour: 'Never having seen one before, and quite unconscious of its suicidal powers, I spread it out on a rowing-bench, the better to admire its form and colours. On attempting to remove it for preservation, I found only an assemblage of rejected members. My conservative endeavours were all neutralised by its destructive exertions, and it is now badly represented in my cabinet by an armless disk and a diskless arm. Next time I went to dredge on the same spot, determined not to be cheated out of a specimen in such a way a second time, I brought with me a bucket of cold fresh water, to which article star-fishes have a great antipathy. As I expected, a *Luidia* came up in the dredge—a most gorgeous specimen. As it does not generally break up before it is raised above the surface of the sea, cautiously and anxiously I sunk my bucket to a level with the dredge's mouth, and proceeded in the most gentle manner to introduce *Luidia* to the purer element. Whether the cold air was too much for him,

or the sight of the bucket too terrific, I know not, but in a moment he proceeded to dissolve his corporation, and at every mesh of the dredge his fragments were seen escaping. In despair I grasped at the largest, and brought up the extremity of an arm, with its terminating eye, the spinous eyelid of which opened and closed with something exceedingly like a wink of derision.'

SEA-ANEMONES AND JELLY-FISHES.



The *Actiniæ*, or sea-anemones, as they are poetically called, are to be found on every part of our sea-shores where there are rocks. When the tide has receded, they may be seen attached to the sides of the rocks beneath the overhanging sea-weeds. Their appearance when thus discovered is by no means attractive. It is that of

a small hemisphere, or cone, in the centre of which is an orifice closed up, something like the mouth of a bag when tightly drawn together by the string. Those of a red colour are exceedingly like a piece of flesh, and on being touched, the resemblance is still more striking, from the tough, muscular sensation they convey. It is only in a deep pool, or during high-water, that the sea-anemone puts on its charms. In some of the creeks on our rocky shores, it is seen in great perfection from a boat, when the water is clear and tranquil, and only a few feet in depth. The cone-shaped mass has now become active; the tentacula, which had been drawn within the body of the animal, are now expanded, exhibiting both in symmetry and colour a striking resemblance to a flower; and where many of these creatures are assembled, the bottom of the water presents the appearance of a gay parterre adorned with many-coloured blossoms.

About twenty varieties of *Actiniæ* are already known to naturalists as belonging to our sea-shores, but beyond doubt there remain many others to reward their search. The specific names of many of these are those of the flowers they are supposed to resemble, and others have appellations derived from other circumstances. Thus the cereus, the daisy, the pink, the aster, the sunflower, are floral appellations applied to some of them; while others

derive their titles from their prevailing colour, from the gem-like adornment they exhibit, or from some peculiarity of form and structure.

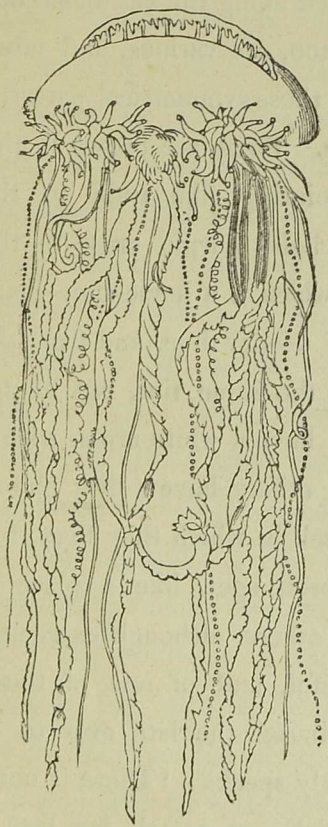
The most common is the *Actinia mesembryanthemum*, so called from the resemblance between the form of its tentacula when expanded and the starry petals of its floral namesake. It is not possessed of much beauty; its stalk, or body, is thick and smooth, the edge of its disk is surrounded by a single row of tubercules, the tentacula are numerous and slender, and the colour that of a dark crimson. This very common species is far surpassed in beauty by many others, which, though less generally known, are denizens of various parts of our sea-shores. We shall mention a few of these, although no description can do justice to the beauty of these remarkable creatures, as seen under advantageous circumstances in their native element.

The *Cereus*, which we have found on the Welsh coasts, and which inhabits several localities on the south-western shores of England, has its body marked with longitudinal furrows, or *sulci*. Its summit, when expanded, is furnished with slender tentacula, from a hundred and twenty to two hundred in number; the body is of a pale chestnut colour, and the tentacula are sea-green, varied with purple.

The daisy-anemone (*Actinia bellis*) is a remarkably beautiful species, also found on the south-western shores of England, and in some other localities. It has a cylindrical stalk, from an inch to about three inches in length, which is of a fine red colour. When the disk is expanded, it exhibits a radiated surface, much greater in circumference and diameter as compared with the body, than is the case in other species. This disk is covered by short tentacula, several hundreds in number, and disposed in separate rows or circles, each row nearer the centre than the other, having the tentacula pointing like radii of a circle toward the circumference, with the exception of the inner row, in which they are elevated more or less from the plane of the disk. These tentacula exhibit considerable variety of colour. In some they are dark-brown or yellowish-brown, ornamented with white spots, while the disk itself is tinted with gray, lilac, white, and is sometimes dark-brown, ornamented with scarlet lines diverging from its centre. This species is exceedingly like a beautiful flower.

Another remarkable species is the *Actinia gemmacea*. It derives its specific appellation from the circumstance that its cylindrical stalk or body is marked with lines of tubercules like gems, reaching from the base to the top. When retracted, it assumes the form of a bell with the

mouth downwards, and the gem-like rows of tubercules converge in an elegant manner from the base to the closed aperture of the mouth. The body is of a rose colour. Six of the rows of tubercules are white, and the intermediate ones of a gray or ash colour. When expanded, the disk appears variegated with different hues, green and white, scarlet and black, and the tentacula, chiefly of a fine olive, add greatly to the beauty of this 'gem of the sea.'



We shall now say a word on the subject of those jelly-fishes with which every frequenter of the sea-shore is more or less familiar.

We are most familiar with the larger kinds, so often found lying on the beach after the tide has retired; but the species are extremely various as well as numerous. Some are so minute that they can only be seen by the aid of the microscope; others have a

diameter of two or three feet. Many have hemispherical bodies; others are orbicular. Some are furnished with tentacula, which stream behind them as they pass through the water; others, again, are without these appendages. They differ also in their means of locomotion: one species urges itself onward by contracting its disk, and another by means of minute paddles ranged along the circumference of its body. Their colours, too, are various, and often singularly beautiful, exhibiting those symmetrical patterns produced by the kaleidoscope. Some are brown in the centre, with sixteen lines pointing like radii to the circumference; some have a light purple cross in the middle, between each bar of which is a horse-shoe mark of a similar, although much deeper hue, and from the circumference diverge rays of the same tint, but lighter than the rest; others, again, have a white cross, with a black spot on each arm; and others have a disk almost as translucent as the water itself in which they float, but in its centre is a bright crimson spot, like a piece of cornelian encased in crystal; others, although extremely minute, are still more beautiful, and of one of these, whose tints are white and crimson, the late ever to be lamented Forbes thus elegantly speaks: 'There is not a medusa in all the ocean which can match for beauty with the minute creature now before us, though its

smallness is such, that a split pea would overtop it. Yet, small though it be, it has shape, colour, and substance so disposed, that as yet no explorer of the sea has met with another like it. It is gorgeous enough to be the diadem of sea-fairies, and sufficiently graceful to be the night-cap of the tiniest and prettiest of mermaidens.' These creatures inhabit all our seas, and are often visible in immense multitudes floating with the tides; they are supposed to feed on small fish and insects, which they seize with their tentacula. Some of these apparently harmless mollusks possess a stinging property, from which their name of sea-nettles has been derived. This property, however, pertains only to a few of the kinds familiar to our shores, probably to three or four; and the only one which possesses it in any considerable degree is the *Cyanea capillata*, or hairy cyanea, which produces, on being touched, a burning sensation similar to that caused by the sting of the common nettle. Persons swimming have sometimes come in contact with the long tentacula of this medusa, and have not only been marked with red lines, not unlike the cut of a thin whip, wherever the acrid substance of the mollusk has come in contact with their skin, but have suffered considerable pain and feverishness in consequence. This particular species is very common, and must have been

seen by all our readers, either lying helpless on the beach or floating at sea. Its disk is of a brown colour, with festooned edges, from beneath which issue an immense number of tentacula of various dimensions, many of them consisting of long strings, extending far behind it as it flaps along beneath the surface. The title of Crinita might, perhaps, be appropriately applied to it, as resembling a comet and its tail, which the old Greek astronomers distinguished by that name. The *Acalephæ* possess the wonderful power of emitting light. In the seas of warmer latitudes, this power produces very striking effects, to which, indeed, it is impossible, by the most eloquent description, to do adequate justice. So innumerable are the medusæ in the tropics, that the point of light emitted by each renders the whole surface of the midnight deep radiant, while the ship, as it urges her way, exciting into greater activity their illuminating powers, is surrounded not only with sparks of phosphorescent fire, but with broad flashes of light running along the top of every surge which strikes her sides, while in some instances globes of fire appear below the surface, produced by the larger jelly-fishes. If, during a very dark night, one could descend a few fathoms below the surface, the appearance, on looking upwards, would be beautiful in the extreme.

presenting, in the orbs of greater or lesser magnitude, scintillating in countless galaxes overhead, much of the aspect of the heavens on a starry night 'fretted with golden fires.' In our own seas, similar but much less brilliant phenomena occur, and few occupations are more delightful to the naturalist than, on rowing homewards along some romantic shore, to watch in the deepening twilight the phosphorescent radiance of the larger *Acalephæ*, as the boat glides silently past them, or to admire the showers of sparks that fall from the oars at every stroke, produced by the microscopic animals of the same kind.

The order of *Acalephæ* now referred to are distinguished from others by their mode of swimming, which is effected, as already mentioned, by the sudden contraction of the diameter of the mushroom-shaped body, which, striking the water on the under part, is driven forwards by the reaction of that medium. This movement, which is easily perceived in smooth water, has a sort of resemblance to the act of breathing performed by the lungs, and from this fancied similarity the general name of *Pulmonigrade* is applied to the whole of this order of jelly-fishes. But there are others whose mode of progression depends, not on the alternate contraction and dilatation of the body, but on the movement of

innumerable minute hairs, which strike the water precisely like a series of minute paddles, ranged in rows along the outside of the living machine. To this order, accordingly, the name *Ciliograde* is applied, because of their motion being thus effected by the instrumentality of cilia. One of the most fascinating examples of this order is the little medusa which naturalists have absurdly enough called Beroë, as if this beautiful and symmetrical creature exhibited any resemblance whatever to the decrepid old woman whom Juno impersonated in her interview with Semele. The Beroë is from half an inch to about an inch in length; its body is pellucid; it is shaped like a nutmeg, and divided into gores, as it were, by eight equidistant bands or ridges, much in the same way that a terrestrial globe is subdivided by the lines from south to north marking the longitude. Depending from the body are two tentacula, five or six inches in length, and furnished with a number of slender fibres like tendrils, all of which can, at the will of the creature, be drawn up within its body. These tentacula are either for securing its prey, or attaching itself to some point of support, or for both purposes. The locomotive machinery of this singular medusa is worthy of the highest admiration. A minute examination of the bands or ridges already mentioned exhibits the extraordinary fact, that

on the surface of each of them are a multitude of flat plates, formed by hairs or cilia, with their edges placed together like the plume of a feather. These paddles the creature puts in motion, and the power is sufficient to propel its obicular body through the yielding element. By reversing the motion of the paddles, it can move backwards, and by moving those on one side only, it can turn round. 'Man justly boasts his steam-boat,' says Professor Jones, 'and with pride points to those paddle-wheels with which he walks upon the waves. The paddle-wheels are here more perfect far than ever were contrived by human ingenuity, for all the cumbrous enginery required by man to urge their movements is not needed; each float, self-moving, keeping time with all the rest.' This wonderful creature, thus employing so marvellous and complicated a mechanism, is nevertheless amazingly simple in structure, so far as appearance would lead us to suppose, for it is so translucent, that during day it is visible only by the iridescent hues shot forth from its paddles, as they strike the water, and in darkness it shines with a blue phosphoric light, reminding one of a bubble inhabited by some sea-fairy, whose diadem glows through the fragile covering in which she is encased.

Another order of the same class derives its title

(*Physograde*) from the circumstance of its movements being chiefly accomplished by means of a species of air-bladder with which it is furnished, and which it distends in order to rise to the surface. The well-known *Physalia*, or Portuguese man-of-war, is an example of this order, and can hardly be considered one of our native species, although occasionally found on the shores of the south of England and Ireland.

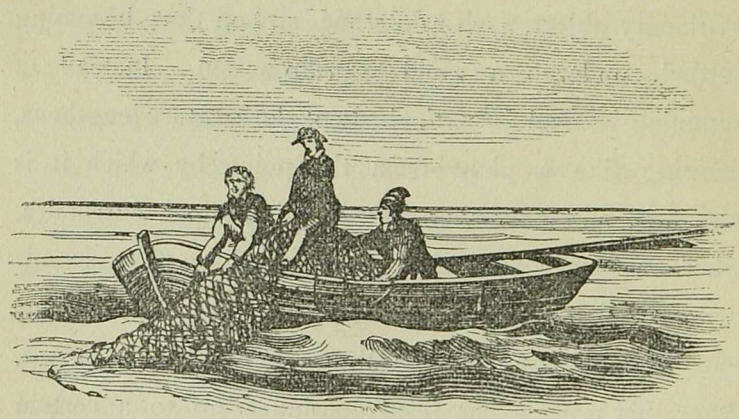
Another order is that of the *Cirrhigrade*, of which the Velella is an example. This remarkable creature, like the preceding, sails on the surface of the sea, and may be found in multitudes on our south-western shores during summer and autumn. It has a flattish oblong body, which, although membraneous and fleshy, is transparent, and is tinged with dark-blue spots; but, unlike any of the preceding species, it possesses a sort of skeleton or framework, also transparent, and of a horny texture, furnished with a plate, which, when the animal is on the surface, is raised, and serves as a sail, by which it is wafted onward. From the lower part of the body numerous dark-blue appendages hang downwards, by means of which, in the absence of a breeze, this animated skiff can row itself onward, or steer when going before the wind.

Until very recently, the mode in which the young of

the *Acalephæ* are produced was wholly unknown, although much curiosity was naturally felt on such a subject. Discoveries, however, have been within the last few years made by several distinguished naturalists, which greatly add to the interest with which they are regarded. It appears that the medusa gives birth to a multitude of minute bodies, gelatinous like itself, and in shape somewhat oval, like the seeds or sporules of some of the sea-weeds, but clothed with minute cilia, or hairs, which, by their vibration, propel the minute body through the water. Yet these minute bodies are not the young medusa, as appears from the process they undergo. After a certain brief period, these buds, as they have been appropriately called, fix themselves to some stationary object, such as a stone, and on thus becoming settled, undergo a rapid transformation. Instead of retaining its oval form, the body of the creature lengthens, growing like a plant from the point by which it is attached, and becoming wider at its upper extremity, where a mouth is formed, surrounded by four prominences, which speedily undergo a change, and become long tentacula, not unlike those of the sea-anemones. After this process has been continued up to a certain stage of maturity, the young medusæ begin to be formed, and the stalk assumes the appearance of a series of cups

with the edges divided into lobes, and placed one within another. At last, in each of these cups an independent life becomes developed, the upper one separates from the rest, drops off, and immediately begins to swim by means of the alternate contraction and dilatation peculiar to the parent medusa. The second hemisphere soon follows the first, separating like ripe fruit from the stem on which it grew; and so on in succession, one after another, the juvenile jelly-fishes set forth on their journey through the waves, as soap-bubbles blown from a pipe wander through the air.

FISH OF OUR SEA-SHORES.



When we look at the ocean in a general and superficial manner, regarding its surface only, the portion of that

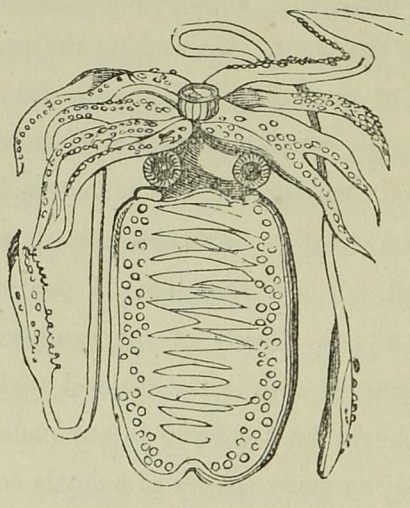
vast expanse beneath which our researches can be carried only in a limited and altogether imperfect degree, it appears far less rich in living forms than the earth on which we tread. But our impressions on this subject become very different when we carry our investigations even imperfectly below the surface of the world of waters. We are then, indeed, led to the conclusion that the interior of the subaqueous realms, so far from being a wilderness, teem with life and activity, and contain far greater richness of organic forms than any of the terrestrial portions of our globe. Darwin, in the delightful narrative of his voyages, observes in reference to this subject, that our forests do not conceal so many animals as the low woody regions of the ocean, where the sea-weed rooted to the bottom of the shoals, and the severed branches of fuci, loosened by the force of the waves and currents, and swimming free, unfold their delicate foliage upborne by air-cells. There is abundant reason to believe that the denizens of the ocean far exceed in number and variety of form the inhabitants of the land. Only think of the unspeakable multitudes of migratory fish, such as pilchards and herrings, that at certain seasons visit our shores, and of the myriads of other kinds that at all times frequent our bays, estuaries, and firths! In those beautiful lochs that, in the west of

Scotland, extend ten, twenty, and thirty miles into the country, there is scarcely a spot where a baited line, dropped from a fishing-boat, will not be instantly seized upon by a fish of some kind or other, as if the depths of those waters swarmed with various tribes of their finny inhabitants. How greatly is this impression of the luxuriance of animal life in the ocean deepened, when we look at the results of the naturalist's investigations, even in the shallow waters along our shores, and still more when we have recourse to the microscope! The expression, 'universality of life,' ceases to be a hyperbole, and becomes a literal and simple truth. 'In the oceanic depths,' says Humboldt, 'far exceeding the height of our loftiest mountain-chains, every stratum of water is animated with polygastric sea-worms, cyclidiæ, and ophrydinæ. The waters swarm with countless hosts of small luminiferous animalcules, mammaria of the order acalephæ, crustacea peridinea, and circling nereides, which, when attracted to the surface by peculiar meteorological conditions, convert every wave into a foaming brand of flashing light.' In like manner, Darwin, in his journal of the voyage of the 'Beagle,' referring only to one species of sea-weed of the southern ocean, observes: 'The number of living creatures of all orders, whose existence continually depends on that of

the kelp, is wonderful. A great volume might be written describing the inhabitants of one of these beds of sea-weeds. Almost every leaf, excepting those that float on the surface, is so thickly incrusted with corallina as to be of a white colour. We find exquisitely delicate structures, some inhabited by simple hydro-like polypi, others by more organised kinds, and beautiful compound Ascidiæ. On the flat surfaces of the leaves various patelliform shells, Trochi, uncovered mollusks, and some bivalves are attached. Innumerable crustacea frequent every part of the plant. On shaking the great entangled roots, a pile of small fish, shells, cuttle-fish, crabs of all orders, sea-eggs, star-fish, beautiful Holothuridæ—some taking the external form of the nudebranch mollusks—Planariæ, and crawling nereidous animals of a multitude of forms, all fall out together. I can only compare these great aquatic forests of the southern hemisphere with the terrestrial ones in the tropical regions. Yet, if the latter should be destroyed in any country, I do not believe nearly so many species of animals could perish as under similar circumstances would happen with the kelp.' Facts are justly said to be stranger than fiction. There can be little doubt that real existences are far more wonderful than the figments of fancy; and all that we already know of the ocean, so far as our sphere of

observation extends, renders it certain that the sea contains inhabitants, which, not only in number but in variety of size, form, colour, character, and habits, are more wonderful by far than anything dreamt of in our philosophy, exceeding in all these particulars all that the most exuberant fancy can picture.

Perhaps there are none of the visitants of our shores more wonderful in all respects than the Cuttle-fish, of which we have several varieties. This tribe of creatures



are by naturalists called Cephalopods, a word which may be translated 'head-footed,' and arises from the fact that the feet or arms of the animal are attached to the head. Here is one left by the receding tide, let us examine it, and remark its peculiarities as well as a brief investiga-

tion will allow. The body, you perceive, is soft, although it feels not unlike a kind of cartilage, and it forms a sort of sheath for the breast; the arms or feet, eight in number, are arranged around the top of the head, and are covered with a multitude of small circular disks, raised above the surface of the adjoining skin. From the midst of these arms extend two long tentacula, which are thickened at the ends, and furnished like the shorter arms with similar disks or suckers. The mouth of the fish consists of a powerful beak like that of a parrot; the eyes are large and prominent, and when the creature is alive and in vigour, are not only bright and staring, but have a look of intelligence and even of ferocity. The singular appearance of this creature is accompanied by habits no less remarkable. The members or limbs already referred to are used by it both as arms and legs. It walks on the bottom of the water with them, having its mouth and head downwards, and its body upwards; it also swims partly by their means, and employs them, moreover, in the capture of its prey, to which it attaches itself by means of the suckers before mentioned, which are furnished with muscles for creating a vacuum, as is the case with the suckers of the lump-fish or the remora. As to its jaws or mandibles, they are a very formidable weapon, and can easily break open

many species of crustaceous and shell-fish. One would think that the soft body of the cuttle-fish would avail it little against the attack of a lobster with its formidable claws. There can be no doubt, however, that even a lobster is no match for a large cuttle-fish, naked and exposed although the latter appears to be. By means of its suckers, it can easily tie together the pincers of the lobster so that they cannot open, and while its prey is thus rendered helpless, it can tear off with its powerful beak, as with a forceps, the crust in which the lobster's body is encased.

But we have left unnoticed a most remarkable part of this creature's structure, associated with some singular instinctive habits. On examining that part of the animal from which the head protrudes, a tube or funnel is discovered, which is connected with its branchiæ or breathing organs. To these organs the water is admitted, as it is admitted to the gills of fishes, but by a different apparatus; it gains access by valves which allows it to enter on the muscular dilation of the creature's body; and when the water so admitted has communicated its oxygen to the blood, it is expelled by the tube referred to, as in the case of fishes it is driven out at the gills. But the cuttle-fish can employ this funnel or tube to another purpose; for, by ejecting the

water from it with force, it is, by the reaction of the surrounding medium, enabled to dart backward with amazing velocity, out of the reach of danger. While, therefore, it swims forward with rapidity by means of the fin-like expansion of the extremity of its body, it possesses, in the hydraulic apparatus now mentioned, an additional organ of locomotion in a contrary direction.

Another most remarkable peculiarity distinguishes the cuttle-fish. It is provided with an organ which secretes a black fluid, by means of which they can darken the water so as to escape their pursuers. This ink, besides furnishing the 'sepia,' is said likewise to yield the Indian ink, so well known to artists. In Italy, a similar ink, although not so black, is prepared from it; and Cuvier is known to have used it to colour the plates for the memoir of these animals. It is interesting to add, that the ink-bag having been found in a fossil state in the Belemnitę, a kind of cephalopod which has been entombed in the solid rock for countless ages, Dr Buckland presented some of it to Chantrey, requesting him to ascertain its worth as a pigment; and a drawing having been made with it, and shewn to a celebrated artist, he pronounced the sepia to be excellent, and inquired by what colourman it was prepared.

There are several species of cuttles, each differing in

some respect from the specimen now referred to. These it is unnecessary to describe, but we cannot quit the subject without noticing a member of the family, peculiar in form and habits even among the very peculiar race it belongs to. Let us fancy ourselves to have met with one of these on the beach. It is low-water, and the creature has been left by the receding tide, but perhaps not unwillingly, for he is not only alive but moving along in an inverted position, and although at a leisurely pace indeed, still making some progress. This is the celebrated Polypus of the ancients, and is called the Octopus, from its eight feet, or the common Poulpe. The body of this creature is almost globular; it is furnished with eight feet or arms, each having two hundred and forty suckers arranged in a double series. It is without the two long arms possessed by its relative the cuttle-fish; but it can walk with comparative facility; in the water, it can swim rapidly backwards. This animal, with its staring eyes and uncouth shape, is undoubtedly of a very repulsive aspect, and must not a little terrify the unhappy creature it pursues and catches with its suckers; the ferocity of its look is doubtless an accurate index of the fierceness of its disposition. This is illustrated by the following anecdote. Although referring to a foreign member of the poulpe family,

it may perhaps indicate the character of our native species.

In his account of the natural history of the sperm whale, Mr Beale mentions that on one occasion, while engaged in collecting specimens of shells on the shores of the Bonin Islands, he encountered a most extraordinary animal, which was crawling on the rocks toward the water. It was creeping on its eight legs, which being soft and flexible, bent under the weight of its body, and served indeed to raise it only a little from the surface along which it was moving. It seemed alarmed, and made great efforts to escape, but the naturalist had no idea of consenting to the termination of so unexpected an interview with the odd-looking stranger. In his first attempt to prevent its escape, he placed his foot upon one of its legs; but so great was its strength, that although he pressed upon it with considerable force, it easily liberated itself. Determined, however, to secure his prize as a remarkable specimen of its class, he then seized one of the legs in his hand, when the animal struggled with such vigour that it seemed as if the limb would be torn off in the contest. The animal in the meantime held itself fast to the rock by its suckers, and Mr Beale gave it a sudden jerk to disengage it. This seemed to excite it into fury; and after successfully

resisting the attempt, it suddenly let go its hold of the rock and sprang on its assailant's arm, which was bare, and, fixing itself by its suckers, endeavoured to attack him with its powerful beak. The sensation of horror caused by this unexpected assault may be readily imagined. Mr Beale states that the cold and slimy grasp of the ferocious animal induced a sensation extremely sickening, and he found it requisite to call to the captain, who was occupied in gathering shells at a little distance. Mr Beale, aided by his friend, then made his way to the boat, and the poulpe was at last destroyed with the boat-knife, but it did not surrender till the limbs by which it so tenaciously adhered were successively cut off. The body of this Cephalopod was not larger than a man's fist, but it measured more than four feet across its extended arms.

In the tropical seas, the poulpe is said to arrive at an enormous size. Mr Pennant, on the authority of a friend long resident among the Indian Islands, and who was a diligent observer of nature, states that the natives affirm that some have been seen two fathoms broad over their centre, and each arm nine fathoms in length. It is also well known that the Indians, when navigating their little boats, are in great dread of those frightful monsters, and always provide themselves with an axe to

cut off their arms, which, if thrown across their boats, would place them in imminent danger. The pearl-divers, too, are said to be sometimes seized by one of those monsters of the deep, from whose grasp, under such circumstances, there is no release. Possibly the account given by Mr Pennant's friend may have been exaggerated by the terrors of the Indians who were his informants; but besides the general fact that the tropical seas nourish creatures of far greater magnitude than those of temperate latitudes, authentic instances are recorded in which the octopus has actually been found of great size. During Cook's first voyage, the carcass of one was discovered floating in the sea, surrounded by aquatic birds which were feeding upon it; and having examined the remains of this animal, which were deposited in the museum of the Royal College of Surgeons, Professor Owen stated that its body must have been four feet in length, and its arms at least three feet more. There is, therefore, the highest probability that the tropical seas are inhabited by monsters of far greater magnitude of the same species. Dr Shaw thus speaks on the subject: 'The existence of some enormously large species of the cuttle-fish tribe in the Indian northern seas can hardly be doubted; and though some accounts may have been much exaggerated, yet there is sufficient cause for

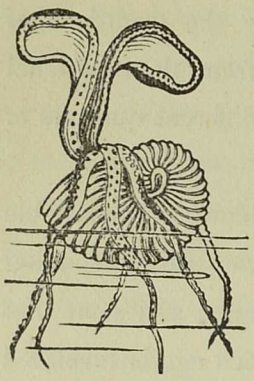
believing that such species may very far surpass all that are generally observed about the coasts of European seas. A northern navigator, of the name of Dens, is said some years ago to have lost three of his men in the African seas by a monster of this kind, which unexpectedly made its appearance while these men were employed, during a calm, in raking the sides of the vessel. The colossal fish seized three men in its arms, and drew them under water in spite of every effort to preserve them. The thickness of one of the arms, which was cut off in the contest, was that of a mizzen-mast, and the suckers of the size of pot-lids.' A variety of statements have been made in different places, and at various periods, all tending to strengthen the belief that such enormous octopods exist, and it is not easy to avoid concurring in the opinion of a celebrated naturalist, who has discussed the subject with great ability, that the different authorities who have referred to it 'are sufficient to establish the existence of an enormous inhabitant of the deep — a cuttle-fish possessed of characters which, in a remarkable degree, distinguish it from every other creature with which we are familiar;' and further, that it would be 'contrary to an enlightened philosophy to reject as spurious the history of an animal, the existence of which is rendered so probable by

evidence deduced from the prevailing belief of different tribes of mankind, whose opinions it is evident could not have been influenced or affected by the traditions of each other, but must have resulted from the occasional appearances of the monster itself in different quarters of the globe.'

The eggs of the cuttle-fish are almost as remarkable as the animal itself. They are oval, or rather spindle-shaped bodies, about the size of grapes, and somewhat like them in colour. One end of each egg is furnished with a fleshy stalk, and the other is prolonged to a nipple-shaped point, and the skin is tough like india-rubber. By means of the stalk, the egg is attached to branches of sea-weed, and numbers of them united to the same substance, a cluster is formed by no means unlike a bunch of grapes, and appearing to an observer unacquainted with their real character, to be some species of sea-plant. These eggs, or bladders, contain at first a yolk of a white colour, enclosed in transparent albumen; but as it advances toward maturity, the contents assume the form of the young cuttle-fish, which is at length excluded like the chick from the shell by the opening of the envelope in which it is enclosed.

The Nautilus is an animal of the same class as the cuttle-fish, regarding which we shall present

our readers with the following extract from Professor Harvey:



'No British cuttle-fish possesses an external shell, though furnished with an internal one, in the shape of a horny or calcareous, lanceolate, or somewhat boat-shaped body, lodged in a cavity of the mantle; exactly analogous to the shelly plates of such Mollusca as *Aplysia* and *Limax*. But one of the most beautiful of all shells —the Argonaut or Paper Nautilus—is the coat of an animal of this class, not very unlike a common cuttle-fish in form, and having an organisation essentially similar. Alas for poetry!—the stories of the argonaut, believed for nearly two thousand years, are now exploded. Modern observers have clearly shewn that the argonaut does not make use of its expanded arms as sails, or its tapering legs as oars, or of its keeled shell as a boat; but, on the contrary, that it passes most of its time crawling on the bottom of the sea like a snail, with its shell turned keel upwards; and that when it does swim through the water, as it can do with great speed, its arms and legs are applied to purposes very different from oars or sails. The arms (*sails*) are closely

pressed to the surface of the shell, which they cover completely with a fleshy coat; and the taper legs (*oars*) are brought together and directed in a straight line from the head. And thus prepared for swimming, the argonaut drives itself backwards at a rapid rate, by alternate imbibition and expulsion of water through its siphon. The Pearly or Chambered Nautilus is the shell of another animal of this class, considerably different in organisation from the cuttle-fish or the argonaut, and obviously of a lower type of structure. It essentially differs from either in having *four* instead of *two* sets of gills, and has therefore been placed by Professor Owen in a distinct order, of which it forms almost the only living representative. Very different, however, was the condition of this order in the waters of the early world, where species of Nautilus and of allied forms existed in great profusion. Upwards of sixty fossil species of Nautilus are found in British strata, with many hundred kinds of Ammonites, Orthoceratites, &c., genera which are no longer known to exist in a living state. And it is exceedingly remarkable that our modern Nautilus belongs to a generic type which has existed from the earliest times, from which remains of animals of this class have been preserved; while many extensive genera of similar animals of later creation have become totally

extinct. Thus, of the true Ammonites, or Snake-stones —fossils resembling the horns of Jupiter Ammon, and which were inhabited by animals resembling the animal of the Nautilus—though many hundreds flourished in times long posterior to the creation of Nautili, and none were in existence so early as the first true Nautilus, not one has come down living to the modern sea, and the last members of the race were entombed in the chalk-deposits. The successive changes which have passed over the animal and vegetable worlds in revolving ages offer us subjects of contemplation of the most interesting character, in which the mind is at one time carried back to what has been "before the world was," and at others, stretches equally forward to what shall be hereafter. In tracing fossil remains in strata, deposited at successive periods, we come to beds in which remarkable forms, such as the Ammonite, meet us for the first time; and, having ascertained that none exist in any *lower* bed, we are forced to admit that, at the time when that bed was in course of formation, these creatures were first introduced on the stage of life. All *lower* beds tell of a creation existing *before* them, and the animals contained in such are therefore older denizens of the world. Again, having fixed the stratum in which the Ammonite first appears, we examine the strata above it, and find

the number of those fossils gradually increasing, until we reach a bed in which the genus attains its maximum; and thence we find a gradual diminution of species in all superior beds. No new forms are introduced, but the old ones drop off one by one, until at last the whole race disappears—every species of the extensive group being numbered with the dead. Nor is this a solitary instance of what researches into the fossil world reveal to us. It is the general lot of every organic being introduced into the world. Not only are the individual animals mortal, but the very species are destined to destruction. Some types have a longer life than others. The Nautilus still maintains its ground, though its genus dates back untold ages before the creation of the Ammonite, whose last representative must have perished ages before the creation of man. We see the whole life of the Ammonite genus — and we can perceive, by its diminished number, that the Nautilus is approaching its close. But the circumstances which regulate the extinction of the one or the other are unknown to us. Changes of climate may now and then cause the destruction of a race; but the extinction of species, and of generic types, seems to proceed on too regular a plan to be dependent on secondary causes, and must, I think, be referred to laws originally imposed on each species at its creation.'

One of the most remarkable of our fishes is the Fishing-Frog, or Angler. It is found on various parts of the coasts of Great Britain and Ireland, and although not seen in great numbers, is by no means rare. Its form and habits fully entitle it to its name. Its upper parts are of a brown colour, and the under surface of the body is white. Its figure is not unlike that of an enormous tadpole; the head is enormously disproportioned to its body, and is of extraordinary shape, and furnished with a mouth of prodigious dimensions, the under jaw extending far beyond the upper, and both furnished with an array of teeth. The gills, unlike those of other fishes, instead of sloping away and attaching themselves under the throat, are prolonged behind the pectoral fins, and open in a kind of armpit by a narrow orifice. Around the immense head are numerous filaments, or tentacula, and from a little beyond the middle of the upper lip, arise other and much longer filaments, one of which carries on its extremity a little membrane or flag of a brilliant metallic lustre, while the position of the eyes in the centre of the almost horizontal face, all combine to render it an ugly and even hideous creature. The instinct and habits of this strange fish are not less remarkable than its figure. It is extremely voracious, as might be expected from the

magnitude of its mouth, and it moves about after its prey like other fishes, sometimes in mid-water and sometimes even at the surface, but its ordinary mode of satisfying its appetite exhibits a most singular degree of address, and is said not only to imitate the angler in fishing with a line and bait, but to make use of a kind of net formed by the great sacks connected with its gills. Couching close to the ground in places frequented by other fish, it stirs up the mud with its pectoral fins, so as to be hidden from the view of its prey, and then elevates the fishing-rod or tentacula attached to its upper lip, the little flag on the top of which attracts the notice of the unwary fish passing by, which, approaching to examine what seems to be a suitable kind of bait, is instantly seized by the greedy monster lying in wait below. It takes multitudes of fish in this manner, which it stows away either in its stomach or in the bags or sacks already mentioned. Many anecdotes are told illustrative of the boldness and voracity of this fish. In one instance, a fisherman having hooked a cod-fish, on drawing it up, felt a heavier weight attach itself to his line. This proved to be a large angler which had seized upon the cod as it was drawn up; and on bringing it to the surface, it received a severe blow on the head before it let go its prey, which it expected to have

secured. On another occasion, an angler seized upon a conger-eel which had taken the bait; but the latter, in its efforts to escape, after having, it is probable, been in the stomach of its enemy, found its way out by struggling through the opening of the gills. The angler was thus completely secured, and both were drawn into the boat. It is said that one of these voracious fish has been known to swallow a large cork used as a float to a deep-sea line. Dr Parnel states that some fishermen at Queensferry, in the Firth of Forth, observing the water much discoloured at a particular spot, proceeded to discover the cause, and on poking the bottom with a long-handled mop, found it seized upon by an angler, who had been busy plying his vocation, and probably mistook the mop for some new kind of fish. He found his indiscriminate voracity fatal to him, however; for not being able to extricate his teeth from the woolly substance of the mop, he was hauled on board, and found to be nearly five feet in length. It is further remarked by Yarrell, that 'when this fish is captured in a net, its captivity does not destroy its ravenous appetite, but it generally devours some of its fellow-prisoners, which are sometimes taken from its stomach alive.'

The family of fishes distinguished by mailed cheeks, and hence called by naturalists, *Buccæ Loricatæ*, are

frequent on our shores. Among these, the Gurnards are well known, of which there are eight varieties. These fish derive their name of gurnards, nowts, or crooners, from the very singular circumstance that they utter a growling or grunting noise while disporting themselves in the water, and when pulled up by the line. They are all distinguished by the singular appearance of their heads, which are variously armed with spines and bristles. One of the most beautiful of these fishes is the Red Crooner, or Cuckoo Gurnard, so called from the note it emits, being supposed to resemble the voice of its sylvan namesake. Its colouring is rich and beautiful. It is rose-red above, and the sides and abdomen are dull white, tinged with red. It is common on many of our shores, as are several of the other species, which are variously coloured, some being gray, clouded with brown, and others brownish red, tinged with yellow-green. In some places there exists a prejudice against them as food, but they are all worthy of notice as wholesome and nutritious, and many of the species are esteemed excellent.

Associated by naturalists with the family of the 'mailed cheeks' are the tribe of Sticklebacks, the fresh-water species of which are well known to our boyhood as inhabiting almost every little pool or stream. They

are the smallest of our fish. Of these there are several kinds, all remarkable for having their backs armed with spines, which they can raise or depress at will. Two of the species belong to our sea-shores; one of these is the fifteen-spined stickleback, which is found on many parts of the coast from the north of Scotland to the Land's End. The author of this work has found it in some parts of the Irish coast, and especially in the southern shore of the Bay of Dublin. It is larger than any of the fresh-water species, but it is only six or seven inches in length. Like its relations of the fresh-water, it is extremely rapacious. On this subject, Mr Yarrel quotes the following account from Mr Couch: 'On one occasion, I noticed a specimen engaged in taking its prey from a clump of sea-weed; in doing which, it assumed every posture between the horizontal and the perpendicular, with the head downwards and upwards, thrusting its projecting snout into the crevices of the stones, and seizing its prey with a spring. Having taken this fish with a net, and transferred it to a vessel of water in company with an eel of three inches in length, it was not long till the latter was attacked and devoured head-foremost; not indeed altogether, for the eel was too large a morsel, so that the tail remained hanging out of the mouth, and it was obliged to disgorge

the eel partly digested. It also seized from the surface a moth that fell on the water, but threw up the wings.'

Goldsmith, whose authority, by the way, as a writer on natural history is not very high, observes that 'fishes seem all, except the whale, to be entirely divested of those parental solicitudes which so strongly mark the members of the more perfect terrestrial animals.' Poets, echoing the sentiment, have imagined that the want of warm blood must necessarily indicate the absence of those affections which are, by a figure of speech, called warm. But nothing can be more erroneous. The care which all fishes take in depositing their spawn is a sufficient proof. But some fishes evince the same kind of care of their eggs that birds exhibit, and among those thus distinguished for parental solicitude is the little stickleback above mentioned. This little creature builds itself a nest in some quiet nook among the rocks, forming it, like a bird, of various marine plants, fuci, or confervæ, and intermingling them with coralines. The nest is pear-shaped and about eight inches in length, and the materials of which it is formed are bound together by the ingenious little labourer with a thread run through and through in every imaginable direction. This thread is of great length, as fine as silk, somewhat elastic, and seems com-

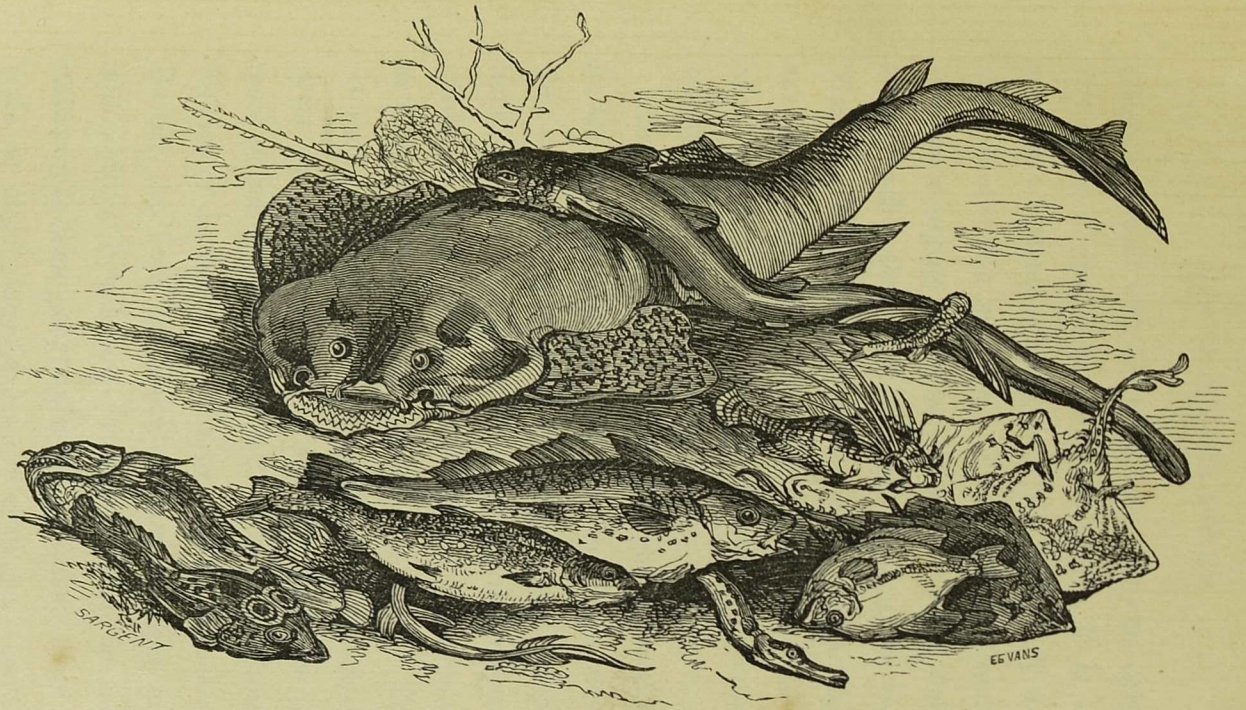
posed of some albuminous secretion with which nature has provided the finny architect. In the middle of this nest the fish lays its eggs, in regular masses, about an inch in diameter, consisting of several hundreds, each the size of a small shot, and of a white or amber colour. It has been supposed that the fish first deposits its eggs in the sea-weed, and then gathers it round them and binds it together in the mode above stated. The stickleback has been watched for several weeks, and found in constant attendance upon the nest thus carefully constructed. 'During the period of hope and expectation,' says Dr Johnston, 'they become fearless, and will allow themselves to be taken up by the hand repeatedly. There can be no doubt their object in remaining near their nest is to guard against the attacks of such animals as might feel inclined to prey upon their contents.'

Our sea-shores are happily not infested by the species of the shark tribe, which are the dread of those who frequent the tropical seas. The larger and more formidable monsters of this family are seldom met with on the British coasts, although, according to Pennant and other naturalists, the White Shark, the most formidable of all the tribe, has occasionally visited our seas; and specimens of other kinds, whose usual abode

is a more southern latitude, have also been captured on various parts of our coasts. The species of shark which is peculiar to our shores is the well-known dog-fish, of which there are several kinds. They are all of small size, but, like their larger congeners, extremely voracious: and on some parts of our coasts cause great loss and inconvenience to the fishermen, by seizing and destroying the fishes which have been caught upon their lines. Some members of the shark tribe bring forth their young alive, and others produce eggs from which the young are afterwards excluded, as in the case of other fishes. This is the case with the dog-fish. The eggs are well known to the frequenters of the sea-beach as 'mermaid's purses.' Their shape is very remarkable, being oblong, convex on one side, of a yellowish horn colour, and semi-transparent. There are four corners, from each of which extends a tendril, resembling what is called by anglers Indian weed, by which the egg or purse becomes attached to sea-weeds, or other marine substances. In some instances, there are only two of those tendrils; and in others, they are only at one end of the egg or purse. In the centre of this remarkable envelope the young dog-fish is coiled up, and during its fœtal state, is nourished by an umbilical bag of a pyriform shape, filled with a yellowish vitelline matter.

When it arrives at maturity, it makes its escape by an opening in the purse near its head.

Another very remarkable race of fishes ought here to be mentioned, which are known to naturalists as the family of the Pipe-fishes. The appearance of all this tribe is most singular. Their bodies are long and slender, snouts much elongated, and the whole body is covered with plates, like a coat of mail, and the plates are so disposed that the body is rendered angular. They possess no ventral fins, and in the majority of cases, neither pectoral nor caudal fins. But what is more remarkable still is the fact, that like the kangaroo these fishes are furnished with a marsupial cavity into which their young may retreat. Of this tribe there are seven species known on our shores, and differing from each other in various minute respects. Perhaps the most remarkable of these is the species known as the short-nosed Sea-horse, which is a kind of pipe-fish somewhat rare on the British shores, although frequent on the continental coasts. The name is suggested by the resemblance which the head of the fish bears to that of a horse. The animal, it appears, is accustomed to use its tail as a prehensile instrument, for which the shape and position of the plates by which it is covered adapt it, and it is enabled to twist it round marine-



GROUP OF FISH.

plants, and wait with its head free, ready to dart upon any object it desires to make its prey. It is said to swim in a vertical attitude, with the tail ready to catch any object within its reach. Two of these singular fish sometimes engage in combat, when they twist their tails round each other, and struggle with great violence. The eyes have the faculty of moving independently of each other, and this, along with the brilliant iridescence about the head, and its blue bands, give it a considerable resemblance to the chameleon.

However remarkable the forms, and astonishing the habits of such fishes as those we have now described, they are not for a moment to be compared, in point of importance, to the gregarious tribes that frequent our coasts, and which, from their prodigious numbers, as well as their excellence, are of incalculable value. The first we shall mention is the Cod and Haddock family. This great class comprehends no less than eighteen species, more or less familiar to our readers, as the Whiting, the Pollack or Lythe, the Seithe or Coalfish, the Ling, the Burbot, the Tusk, the Hake, and several other varieties. The British Islands are situated in what is called, in reference to their geographical distribution, their metropolis or chief place of resort: they are, therefore, all denizens of our seas, and we obtain a large share of the

benefits derived from them. Taking the common cod and the haddock as the types of this class of fishes, we shall make particular reference to them.

The common Cod is a well-known fish. It is almost universally distributed in cold and temperate latitudes, where it is extensively captured as an article of commerce. Its most southern range is about the latitude of Gibraltar, but it has never been known to be taken in the Mediterranean. It extends far to the north, and occurs in vast multitudes on the shores of Newfoundland, and other parts of the North American coast. It is found also in great profusion on the coast of Norway, and round the whole of the British Islands, becoming, however, more plentiful as we advance northwards. Great numbers are taken off the Western and the Shetland Islands, and, according to Yarrell, the coasts of Lincolnshire and Norfolk yield a large supply to the metropolis.

The cod inhabits deep water, being rarely found in places of less depth than from twenty-five to fifty fathoms, unless for some special attraction as regards their supply of food. They are extremely voracious, devouring all kinds of small fish, mollusks, worms, and crustacea. Crabs of considerable size are sometimes found in their capacious maws. Instances have occurred in

which they are known to have swallowed pieces of silver, coins having been occasionally found in their stomachs, to which they are attracted by their glittering appearance, and which may have been lost during shipwrecks or otherwise.

The Cod affords one of the most remarkable instances on record of fecundity. In a single fish, the ova have been found to amount to the extraordinary number of nine millions three hundred and eighty-four thousand! In the summer months, the fry are seen in company with sprats, herring, &c., and are then from three to five or six inches in length, and freckled with light brown and yellow; their growth, however, is extremely rapid, and they speedily attain to maturity. They are invariably captured with the hook and line, a method requisite from the depth of water at which they are found. They may be taken with almost any kind of bait. The following particulars are from the pen of the celebrated Cuvier: 'The flesh of these fishes, which is white, firm, and of most excellent flavour, renders them exceedingly valuable to us. It is capable of being preserved in a state fit for eating much longer than that of most other species of this class. Its consumption is consequently extended through the four quarters of the globe. Almost all the parts of the cod are adapted for

the nourishment of man and animals, or for some other purpose of domestic economy. The tongue, for instance, whether fresh or salted, is a great delicacy; the gills are carefully preserved, to be employed as baits in fishing; the liver, which is large and good for eating also, furnishes an enormous quantity of oil, which is an excellent substitute for that of the whale, and applicable to all the same purposes; the swimming-bladder furnishes an isinglass not inferior to that yielded by the sturgeon; the head in the places where the cod is taken, supplies the fishermen and their families with food. The Norwegians give it with marine-plants to their cows, for the purpose of producing a greater proportion of milk. The vertebræ, the ribs, and the bones in general, are given to their cattle by the Icelanders, and by the Kamtschatdales to their dogs. These same parts, properly dried, are also employed as fuel in the desolate steppes of the shores of the icy sea. Even their intestines and their eggs contribute to the luxuries of the table.' To this account, we may add that the oil, although capable of being used instead of that of the whale, possesses most valuable medicinal qualities, and, at the same time, is so highly nutritive, and so easy of digestion, as to be peculiarly suited to persons of delicate health.

The Haddock is a fish scarcely less valuable than the

preceding, and when in high condition, is certainly an excellent fish, better, perhaps, than the common cod. It frequents all the coasts of Britain and Ireland, but is most plentiful on our eastern shores; and in the Bay of Dublin the largest and finest of the species are taken, sometimes weighing so much as sixteen pounds. It cannot, however, be salted so well as the cod, and this circumstance renders it less extensively useful. It is, however, preserved in a variety of ways. At Findon, in Aberdeenshire, it is smoked and dried in a peculiar manner, and from the process acquires a very agreeable flavour. The fish thus preserved are called 'Finnan Haddocks.' It is requisite, however, to use them within a short time after being thus cured; but they may also be completely dried, so as to keep for a considerable length of time.

The Seithe or Coalfish, already mentioned, is also a well-known member of the cod family, the fry of this species being extremely common in many of our estuaries and shores, and known as the Podley. On the northern coasts of Scotland, the southern shores of the Bay of Dublin, and many other parts of Ireland, they are taken with the rod from the rocks, or from a boat, in large numbers, and often of full size. The coalfish is so called from its black colour. It is a fish of very elegant

proportions, and from its figure, possesses great activity and strength. It is frequently taken near the top of the water, by means of a fly formed of a white feather, which, when drawn through the water, has the appearance of the fry of some fish, and as such is taken by the seithe. This mode of angling is much practised on various parts of the coast, and particularly in those romantic lochs which abound on the west coast of Scotland. With reference to this mode of fishing, Mr Colquhoun observes:

'The fish generally caught in this way are lythe and seithe, although mackerel will rise freely also; when fishing for the former, good double gut may be strong enough, but if large fish are expected, I should always recommend triple. Seithe take best in the morning and evening, and a slight breeze is rather an advantage; although the fly is sometimes sunk a little with lead, it is more often fished with at the top. You may begin at any state of the tide, and row over all the sunk banks and places where the fish frequent, at a slow rate, with three or four rods placed regularly in the stern of the boat. When a small seithe is hooked, pull it in at once, and out with the rod again as fast as possible; sometimes nearly all the rods have a fish at the same time. In lythe-fishing, you need not launch your boat

till low-water; sink the fly with a couple of buck-shot, and troll on the prow, when it descends perpendicularly; this is easily seen at that state of the tide. When you hook a large fish, try to prevent it getting down, or you may be obliged to throw the rod overboard, in case the lythe should break away; but if you can manage to swing it about at the top for a short time. it will soon be unable to offer any resistance.

'Trolling with the white feather has this recommendation, that it may be enjoyed by an invalid or party of ladies—and, certainly, a more delightful way of spending the cool of a summer evening cannot be imagined; rowing slowly along those romantic shores—hearing the distant gurgle of the dwindled mountain-brook in its steep descent, and ever and anon passing the blue curling smoke of a shepherd's or fisherman's grass-topped hut upon the banks.'

We shall now turn to another class of fishes, known as the Herring and Pilchard family, and of which there are eight species peculiar to our shores, including, besides three kinds of herring and the pilchard, the Anchovy, Whitebait, and two kinds of Shad. By far the most valuable of these are the two fishes first mentioned, which we shall particularly refer to as representatives of the family in which naturalists have comprehended them.

The Herring is well known, but many points in its natural history have not been fully investigated. Neither its migrations, nor the causes which produce its different degrees of excellence in different localities, seem to be understood. As to the migrations for which this fish is remarkable, several writers, including Pennant, have been of opinion that the immense shoals which visit our shores betake themselves, during their absence, to the arctic seas, to recruit themselves after the process of spawning has been accomplished on our coasts, and that in spring they again proceed southwards, first appearing off the Shetland Isles in April and May, and thence dividing into columns, proceeding along the shores of Britain and Ireland as far as the coast of France.

Other and more recent writers, including Dr M'Culloch and Mr Yarrell, are opposed to this view, chiefly from the circumstance that the herring is extremely rare in the Arctic Ocean, and voyagers to those inclement regions having taken no notice of them, and there being no fisheries of any consequence on the coasts of Greenland or even Iceland. Their opinion is, that the herring, during its absence from our shores, merely retires to the deep water, approaching again the shallows at the spawning-season. This opinion receives, moreover considerable support from the fact that this

fish sometimes appears in great abundance in southern localities before it has been seen in the north, and it is further corroborated by the consideration that the pilchard, which is so closely allied to the herring, and which was also supposed to retreat to the north, is now known permanently to reside upon our coasts, and so far from being given to migrate to great distances, is very much restricted in its movements. As to the herring, however, the facts regarding its habits in this respect are not sufficiently numerous to warrant an accurate conclusion.

It is obviously for the purpose of spawning that this fish approaches the coast; not only because in comparatively shallow places the temperature of the water is higher, but from the increased supply of oxygen thus to be obtained, both conditions being requisite to that important process. This having been accomplished, they again, as it is presumed, retire to the depths of the sea. Those who are best able to speak on the subject, state that their food, during their sojourn on the coast, differs from that which they obtain in the deep places they have quitted, as is the case with the various salmonidæ. In the depths they ordinarily inhabit, their food is understood to be minute entomostraca, but when near the shore, they prey upon the fry of their own

species, or small medusæ and crustacea: they are said even to be taken with a rod, and to rise like trout at a small white fly. On approaching our shores, the herring are in such prodigious multitudes, that if a gale happen to blow upon the shore, great quantities are often driven upon the beach. This has frequently occurred, both on the western and eastern coasts of Scotland; and on one occasion, in Fifeshire, the mass of herring cast ashore, during a strong south-east wind, and in the highest condition, would have been worth many thousands of pounds, had there been salt and hands sufficient in the districts to cure them.

The mode of catching these fish is by drift-nets, with the mesh proportioned to the size of the herring's head. The net may be seen at any of our fishing-villages. It is attached by its upper edge to the drift-rope by shorter and smaller ropes, the drift-rope itself being buoyed up by floats at various intervals; the net is made to hang vertically in the water, and the fish having put their heads into the meshes, cannot draw them back, the twine getting behind their gills. The herring-fishery is of vast importance, employing, as it does, a great many hands, and affording a large amount of wealth to those engaged in it. From many of the fishing-villages in Scotland, great numbers of the men make their departure annually

to the north in large boats, built for the purpose, to engage in the fishery, delivering their cargoes to be cured on the coast where they fish, to agents employed to cure them by the merchants who engage the fishermen. Large quantities of salt herrings are exported every year to the continent.

The species we are now to notice is the Pilchard, a smaller fish than the herring, but much resembling it. This fish is far from being of such general occurrence on our shores as the preceding species, and, of late years, it appears to have considerably retracted its range. It is stated to have been abundant in some parts of the eastern coast of Scotland, especially the Firth of Forth, almost thirty years ago, since which time it has almost entirely disappeared, and is rarely found on the Scottish coast, only a few being occasionally taken off Berwickshire. Indeed, the northern range of this fish on the east side of England does not appear to extend beyond the Straits of Dover, and on the west, beyond the parallel of the southern coasts of Ireland. There is a pilchard-fishing at Bantry Bay, in that country, but the great locality for this purpose is the coast of Cornwall; and some idea of the extent and value of these fisheries may be formed when it is recollected that in 1827 the total number of persons employed in prosecuting them was

10,521, and the total amount of capital invested in this operation was not much short of half a million of pounds sterling.

The two modes of fishing for pilchard are the drift-net and the scean. The former is the same as that already spoken of as employed for the capture of herring; the latter, however, may be briefly described. Three boats are required for this purpose. The first boat, which is called the scean-boat, is furnished with a net two hundred and twenty fathoms in length, and twelve in depth. The second boat, called by the sailors the vollyer—supposed to be a corruption of the word follower—also has on board a net called the tuck-scan, eighteen fathoms deep and a hundred and twenty in length; the third boat, which is called the lurker, has no net. On the discovery of a shoal of pilchard, the 'lurker' proceeds to ascertain its size and position, so as to direct the movements of the other boats. If the investigation proves satisfactory, a rope from the end of the scan is extended to the second boat, or vollyer, and the net is cast into the sea, forming a curved line across the course of the fish. Both boats unite the ends of their sceans, and the lurker takes its station at the opening, and by lashing the water and other means, labours to prevent the fish from escaping At last the net is

closed, and the ends laced together, and if the tide be strong, or the take of fish great, it is secured by grapnels, and the contents removed at low-water, or at such times as are most convenient for the carriage and salting. It sometimes happens, that so large a quantity of pilchard has been enclosed in one scean, that a whole week has elapsed before all the fish could be brought ashore. On such an occasion, the quantity captured is enormous. While the drift-net already referred to may take, at one haul, from ten to twenty thousand fish, an instance has occurred in which two thousand two hundred hogsheads of pilchard have been taken in one scean at the same time; and another, in which three thousand hogsheads were secured, each hogshead being computed to contain three thousand five hundred fish. The number thus captured at one haul exceeded ten millions. Pilchard are cured in various ways, and exported to different parts of Europe, as well as to the colonies.

The Sprat or Garvie-herring is another species which deserves notice. This fish is from five to six inches in length, and occurs in vast quantities at certain periods of the year, both in the Firth of Forth, and in several parts of the English coasts, especially in Kent, Norfolk, and Suffolk.

The Whitebait is the smallest of this family of fishes, its length being only from three to four inches. This small fish has attained no small degree of celebrity from being an object of great request to the epicures of the British metropolis. Its excellence, however, is such as to merit the high reputation it possesses.

In concluding this short account of the chief migratory and gregarious fishes of our shores, one or two considerations urge themselves on our attention. The enemies of all this tribe of fishes are extremely numerous. Not only are they pursued by almost every inhabitant of the deep, but by almost every aquatic bird. They are liable to be cast ashore in incredible quantities, and man himself destroys them in whole ship-loads at a time. Notwithstanding all this devastation, however, there is no diminution of their numbers, so inexhaustible is their fecundity. Nor do the many dangers they encounter on quitting the deep-seas deter them from following their usual course; but, guided by the instinct implanted by their Creator, they approach the shores in countless swarms, in the highest season, and, as it were, throw themselves into the hands of the fishermen.

We are not to presume with many authors, both ancient and modern, that all the inferior animals have been created, and all their instincts bestowed, only for

man's benefit. The Author of Life evidently intended that each of the creatures to whom he gives animation shall possess enjoyments suited to its state, and be directed by instincts adapted to the condition or elements in which it exists, independently of any use to which man, with his manifold necessities, may apply them. But while we admit this, and at the same time keep in view that the finny tribes, on approaching our shores, contribute to prolong the lives of many animals besides man, we cannot but conclude that the immense numbers of these migratory and gregarious fishes, notwithstanding the havoc to which their ranks are exposed, the powerful instinct which attracts them to the shore when they are in the best condition, the facility with which they are taken, the excellence of their flesh, and its capability of being cured and preserved for use, are all circumstances that, in a remarkable degree, indicate the divine care which, in providing for the wants of man, provides with no less attention for the interests of those creatures on whom he is rendered dependent.

In referring to the fishes peculiar to our shores, another class remains to be noticed—the class to which naturalists have given the general title, pleuronectes, from the Greek words signifying their peculiarity of swimming on one side. This race of fish includes in it five different genera,

and these comprehend eighteen species. One or two of them may be pointed out as types of the rest.

The first to be mentioned is the Plaice, which is the representative of seven species, including the Flounder, the Dab, the Fluke, and others. This is a well-known fish, and is held in high estimation for its excellence and delicacy. According to Pennant, it sometimes attains the weight of fifteen pounds, but it is more usually found to weigh eight or nine pounds, and this is considered a large size. The largest of this class is the Halibut, of which specimens have been taken of seven and a half feet in length, and three hundred and twenty pounds in weight. It occurs in greater numbers on the eastern coasts of Scotland and Ireland than on the coast of England. Like all its congeners, it is extremely voracious, and has been known to swallow the lead at the end of a fisherman's line.

But the most remarkable species of this class is the Turbot, the excellence of which has caused it to be as highly valued in modern, as it is known to have been in ancient times. Unlike the preceding species, which is of an oblong shape, the Turbot is nearly circular, as its ancient name, *rhombus*, implies. It is found on most parts of our coasts, but it gradually increases in number toward the south, and is found in large quantities on the

eastern shores of England. It has long been taken off the coast of Berwickshire, Northumberland, Durham, Yorkshire, and the extensive banks of sand east of Dover, from which large supplies are obtained. The Turbot also occurs in large numbers on various parts of the Irish coast. It is usually found from eighteen inches to two feet in length, and weighing from four to ten pounds; but fish of twenty, seventy, and it is said over a hundred and ninety pounds, have been occasionally captured.

Several species of those fishes known as the Ray or Skate family, are common to our shores. They belong, like the shark, to the cartilaginous order, and are remarkable for their great breadth, which is produced by the immense development of the pectoral fins. The celebrated Torpedo belongs to this family, and it has occasionally been taken in our seas. But the most common is the Blue-Skate, or Gray-Skate, which is found in great plenty on almost every part of the coasts of Great Britain and Ireland. The usual size of this fish is from two to four feet, but some examples have occurred weighing two hundred pounds. The Thornback is another species very common on the shores of the south of England. Both kinds are highly esteemed as delicate and nutritious food. Like some species of the shark

tribe, the skate brings forth its young in purses of an oblong shape, about four inches long, and of a black or dark-brown colour, membraneous, and similar in appearance to thin horn; each of the corners is prolonged to a point. In this envelope the young skate lies coiled up, with his long tail towards his head, and is nourished by an umbilical bag, and in due time the little captive makes his escape by an opening in his envelope. These purses from which this little occupant has made his escape are frequently cast upon the beach, and are well known as skate-barrows, a name derived from their resemblance to a hand-barrow.

BIRDS FREQUENTING THE SEA-SHORE.

The sea-shore affords ample opportunity for the study of more than one branch of natural history, and those who delight in frequenting it will find a great variety of objects presented to their notice, all of which are interesting and instructive.

In a little work like this, it is not to be expected that we can attempt to do more than point out a very few of those objects. Indeed, any one department of the natural history of the sea-shore might easily of itself occupy a ponderous volume, without in any degree

exhausting the subject of which it treats. All we now purpose doing is to direct our young readers' attention to a few of the numerous feathered denizens or visitors of our sea-shores.

In those localities where the tide recedes to a great distance, leaving uncovered an extensive tract of sand, numbers of birds may be seen of different kinds. Let us suppose ourselves wandering along a beach of this character. Gulls of various kinds may be seen scattered over the sands, some standing motionless, some marching with stately step along the distant margin of the sea, and others congregated on the shallow pools left by the receding tide. Bands of terns are hovering and screaming over the edge of the water; divers, in small coveys or flocks, are floating further out; and ever and anon disappearing below the surface, intent on prey: bands of nimble-footed sand-pipers are running along the shore or flying with rapid wing, and suddenly alighting again in the distance; and over a portion of the beach which is somewhat muddy in that particular spot, several large birds, with long legs, long bills, and long necks, and of a gray colour, some wading in the water, and others busily occupied in thrusting their long bills into the soft mud or sand in search of food. Their various cries mingle together, and uniting with the murmur of the distant

waves—for the tide has receded perhaps half a mile and more—form a sort of wild music, which, although very different from the notes of the feathered denizens of the woods, is far from disagreeable. Let us select some of the more remarkable of those feathered bipeds for our more intimate acquaintance.

On yonder distant rock, surrounded by the sea, there is a large black bird sitting. He is too far off to be seen distinctly, but peep at him through this telescope. It is the Cormorant. The rock he is sitting on is a favourite retreat of his, for it is fully exposed to the sun-beams, and this dark-coloured fellow loves the bright rays to fall on his sable plumage, as Virgil tells us, in referring to the rocks, delightful to the sun-loving cormorant. But he is too intent on his indefatigable task to remain long out of the water. He turns his head from side to side, eagerly glancing over the waves. He is evidently impatient to be at work, keeping up the character of Æsacus who, when transformed by Tethys into this bird, never ceased throwing himself into the sea, provoked that he could not die after the loss of Hesperia. See! he springs from the rock and flies rapidly but heavily along, and then settles with a splash upon the surface, floating so deep in the water that his head only appears. The cormorant is a large bird; his

body is thick and heavy, somewhat like that of the goose, and possessing none of the elegance of figure peculiar to the gull. His four toes are webbed, and the middle one is notched like a saw, that he may the more easily retain his slippery prey. His bill is straight, and near the end the upper mandible bends into a hook. The cormorant is a great enemy of the finny tribes, for he has an insatiable appetite. It may be justly called an unclean bird, not only because of its unceasing gluttony, but from its disagreeable figure, its harsh and discordant voice, and its rank and fetid smell. Few, if any, aquatic birds are superior to it in the art of diving and swimming. Disappearing from the surface after his prey, he pursues it with extraordinary velocity, urging himself through the water both with his webbed feet and his short and vigorous wings. His prey seldom escapes, unless by taking shelter among the thick sea-weed at the bottom. Having seized the fish, the greedy destroyer ascends to the surface, and may be seen for a few seconds, swimming about with his struggling captive in his beak, which, however, he speedily swallows, only to commence a new pursuit.

The cormorant is of great use in China, where its indefatigable power and amazing expertness are turned to good account; it is there taught to catch fish for its master's use.

The following account of the Chinese cormorant by Sir George Staunton, is the most authentic of any that has yet been given to us. 'The Embassy,' he says, 'had not proceeded far on the southern branch of the Imperial canal, when they arrived in the vicinity of a place where the Leu-tze, or famed fishing-bird of China, is bred, and instructed in the art of supplying his owner with fish in great abundance. It is a species of the pelican, resembling the common cormorant; but on a specimen being submitted to Dr Shaw, he has distinguished it on the following terms: Brown pelican, or cormorant, with white throat; the body whitish beneath; the tail rounded, the irides blue; the bill yellow. On a large lake close to this part of the canal, and to the eastward of it, are thousands of small boats and rafts built entirely for this species of fishing. On each boat or raft are ten or a dozen birds, which at a signal from the owner plunge into the water; and it is astonishing to see the enormous size of the fish with which they return grasped within their bills. They appear to be so well trained, that it did not require either ring or cord about their throats to prevent them from swallowing any portion of their prey, except what their master was pleased to return to them for encouragement and food. The boat used by these fishermen is of a remarkably light

make, and is often carried to the lake, together with the fishing-birds, by the men who are there to be supported by it.'

'If by accident a large fish sticks in its gullet,' says Professor Rennie, 'it has the power of inflating that part to the utmost; and while in that state, the head and neck are shaken violently, in order to promote its passage. This is a property we never observed in any other bird; but it is probably common to the rest of the tribe, or such as are destitute of nasal apertures. That all birds have a communication between their lungs and the cavity of their body surrounding the viscera, more or less, is well known; but as there is no passage into the œsophagus but by the mouth, to effect this inflation, a violent compression of the body becomes necessary at the same time the bill is closed, and the air is forced back into the mouth and pressed into the gullet. It is observable that, in the act of fishing, this bird always carries its head under water, in order that it may discover its prey at a greater distance, and with more certainty than could be effected by keeping its eyes above the surface, which is agitated by the air, and rendered unfit for visual purposes. If the fish is of the flat kind, it will turn it in the bill, so as to reverse its position, and by this means such could only be got

within the bill: if it succeeds in capturing an eel, which is its favourite food, in an unfavourable position for gorging, it will throw up the fish to a distance, dexterously catching it in a more favourable one as it descends. In thus turning the fish, the dilatable skin under the bill is of great use; but is by no means deserving the name of a pouch, not being capable of more distension than any other part of the œsophagus; nor can it be used as a reservoir for provision, either for its own use, or for the use of its young, as asserted by some authors. Another action which seems peculiar to this bird and its congeners, is violently beating the water with its wings, without moving from the spot, followed by a shake of the whole body, ruffling all its feathers, at the same time covering itself with water. This singular action it will repeat twenty times, with small intervals of rest, when it will retire to an elevated place on shore, and spread and flap its wings till they are dry.'

Let us now turn to another feathered visitor of the sea-shore. See, at no great distance, there are several birds, some on the wing and others walking leisurely on the sand; the back and wings are of a pale bluish-gray, and the breast, throat, and under parts are pure white. On close inspection, we find this pretty bird to have a bill of a pale-yellow colour, tinged with green. The edges

of the eyelids are red, the iris is hazel, and the legs are of a greenish colour, and the toes webbed. The size of the bird is about sixteen inches in length, and about three feet from tip to tip of the extended wings. This is the Common Gull, and he is well known to all frequenters of the sea-shore, affording no small pleasure by the ease and elegance of his motions when on the wing, the rapidity with which he lets himself fall from a height upon the unfortunate little fish which attracts his notice by coming to the surface of the water. The gull is capable of being tamed, and becomes very familiar in a short time.

There are several varieties of gulls, all of which are more or less known to the inhabitants of our sea-shores; but although they delight in frequenting the sandy beach, and even the ploughed fields at a distance from the sea, these birds, whose powerful pinions enable them to defy the storm, build their nests and bring forth their young among the wildest and most inaccessible cliffs. In the breeding-season, they resort in immense multitudes to those rocky shores, where perpendicular cliffs oppose the progress of the surge, which beats continually at their base, and where cavities, far out of the reach of danger, afford a secure retreat. The precipitous cliffs of the western coasts of Scotland and

Norway, which arise many hundred feet above the level of the ocean, form a great breeding-place for all the gull tribe. But although for the most part secure from depredation, their eggs and young often fall a prey to the adventurous inhabitants of those wild shores, who greatly enjoy the perilous sport of descending the cliffs in search of them.

Let us wander further along the beach, toward the low rocks, covered with sea-weed. Beyond these, busily engaged in procuring food, there are several of those gray long-billed birds before mentioned. They are extremely shy and wary; let us therefore approach with the utmost caution, and peep at them from between the rocks. Now we are within some fifty yards of them without being perceived. They are Curlews. Observe that particular bird which is nearest to our hiding-place, how busily he is occupied. He has just been working his bill into the sand, and has drawn forth something which he swallows. Now his suspicions are excited, for his caution keeps him always on the alert to avoid danger. He has ceased to collect his food, and raised his head, evidently listening for some sound that may indicate the proximity of a foe. But his fear is overcome by the appearance of some prey, and he resumes his labour. He has picked a worm out of the sand which

his quick eye detected lurking beneath the surface. Let us have recourse to the description given of the curlew by a very lively and agreeable writer.

'The curlew is extremely shy and suspicious, so that at this season, unless by some stratagem or accident, one can very seldom obtain a shot at it. In Harris I once shot three from a fold. On another occasion, having a musket with large shot, I let fly at one feeding in a field as I was passing along, hit it on the wing, and on measuring the distance, found it to be seventy-five yards. In the Hebrides it is a common saying, that to kill seven curlews is enough for a lifetime; but one, by lying among the rocks on a point frequented by them, might, I doubt not, shoot as many in less than a week. This method, however, I have never tried, it being much more pleasant to be moving about than lying jammed into the crevice of a cliff. When alarmed, they spread out their wings, run rapidly forward some paces, and, springing into the air, uttering their loud cries, fly off at a rapid rate. When looking for food, they generally walk sedately—unlike the redshank, which is continually running, stooping, or vibrating—but sometimes run, and that with great celerity. Dry pastures, moist grounds, and shallow pools, are equally frequented by them, and they may be seen

wading in the water up to the tarsal joint. Towards the end of March they generally leave the shores, where they have resided in flocks from September, and separating in pairs, betake themselves to the interior, where, in the higher and less frequented moors, they deposit their eggs and rear their young. It is now the beginning of May. The sunny banks are covered with primroses, the golden catkins of the willow fringe the brooks, while the spikes of the cotton-grass ornament the moss-clad moor. Let us ascend the long glen, and, wandering on the heathy slopes, listen to the clear but melancholy whistle of the plover, the bleating of the snipe, and the loud scream of the curlew. Here is a bog, interspersed with tufts of heath, among which is a profusion of Myrica Gale. Some lapwings are coming up, gliding and flapping their long broad wings; a black-breasted plover has stationed himself on the top of that mound of green moss, and a ring-ouzel has just sprung from the furze on the brae. See, what is that? A hare has sprung from among our feet! No, a curlew fluttering along the ground, wounded, unable to escape. Run! She has been sitting; here is the nest in a hollow, under shelter of two tufts of heath and a stunted willow. It is composed of dry grass, apparently *Eriophora*, *Eleocharis palustris*, *Scirpus cæspitosus*, some twigs of heath, and,

perhaps, portions of other plants not very neatly disposed. It is very shallow, and internally about a foot in diameter. The eggs are four, pyriform, excessively large, three inches long, an inch and ten-twelfths across, light olive or dull yellowish-brown, or pale greenish-gray, blotched and spotted with umber brown, the markings crowded on the larger end. They vary considerably in size and form, some being only two inches and three-quarters in length. Those in the nest before us are of the largest size, very darkly coloured, and so little contrasting with the surrounding objects, that unless the bird had sprung up among our feet, we should scarcely have observed them. Far up on the hillside you hear the loud cry of the curlew, which is presently responded to from the opposite slope ; in another place, a bird commences a series of modulated cries, and, springing up, performs a curved flight, flapping its wings and screaming as it proceeds. Presently the whole glen is vocal, but not with sweet sounds like those of the mavis and the merle. But it is in vain to pursue the birds, for these are the males, and at this season you will find them fully as shy as they were in winter on the sea-shore. Some weeks hence, when the young are abroad, the females, and even the males, will flutter around you if you approach the spot where their unfledged brood lie

concealed among the herbage, and will attempt, by feigning distress, to lead you into a vain pursuit.

'Like all the other birds of this genus, the young are covered with long, stiffish down, and run about presently after exclusion from the egg, squatting to conceal themselves from their enemies. Up to the age of three weeks they are still unfeathered; their forehead, throat, and under surface, yellowish-gray, their upper parts of the same colour, with patches of dark brown; the bill not longer than the head. That organ gradually elongates as the feathers sprout, and by the end of about seven weeks they are able to fly. At this season, old and young feed on insects, larvæ, and worms. The latter are very fat, but the former are not in good condition until the middle of autumn, about which period the curlews unite into small flocks, gradually disperse, and betake themselves to the shores. Their flesh is delicate and well flavoured, and they are not unfrequently to be seen in our markets. I am not aware of any difference produced in the quality of their flesh as an article of food by their change of residence.

'Montagu has given, in the Supplement of his "Ornithological Dictionary," a very interesting account of a tame bird of this species. "One which was shot on the wing, was turned amongst aquatic birds, and was at first

so extremely shy, that he was obliged to be crammed with meat for a day or two, when he began to eat worms; but as this was precarious food, he was tempted to eat bread and milk like Ruffs. To induce this substitution, worms were put into a mess of bread mixed with milk, and it was curious to observe how cautiously he avoided the mixture, by carrying every worm to the pond, and well washing it previous to swallowing. In the course of a few days this new diet did not appear unpalatable to him; and in a little more than a week he became partial to it, and, from being exceedingly poor and emaciated, got plump and in high health. In the course of a month or six weeks, this bird became excessively tame, and would follow a person across the menagerie for a bit of bread, or a small fish, of which he was remarkably fond. But he became almost omnivorous; fish, water-lizards, small frogs, insects of every kind that were not too large to swallow, and (in defect of other food) barley with the ducks was not rejected. This very great favourite was at last killed by a rat (as it was suspected), after a short life of two years in confinement; but he had in that time fully satisfied our inquiries into his natural habits."

'An adult male curlew measures 25 inches in length, 42 from the tip of one wing to that of the other. The

body is ovate and rather full, the legs long and slender, the neck also long, the head rather small, the bill extremely long, measuring six inches; the tibia bare at its lower end, the tarsus reticulated, the toes rather short and slender; three before, one behind. The throat is very narrow; the œsophagus very long and rather slender; the proventriculus oblong; the stomach a large and powerful gizzard; the intestine long, and moderate width; the cœca rather slender, cylindrical, 4½ inches long. The plumage is moderately full, soft, and blended; the wings very long, narrow, pointed, the first primary longest; the tail rather short and rounded.

'The bill is black, the base of the lower mandible and the basal margins of the upper flesh-coloured. The general colour of the upper parts and neck is light grayish-yellow, tinged with red, each feather with a central blackish-brown streak; the scapulars with serriform yellowish-red spots on the edges; the primaries deep brown, the first five quills unspotted on the outer web, the rest with serriform white spots on the outer, and all with similar large spots on the inner web; the back white, with narrow longitudinal black marks; the upper tail-coverts barred with black; the tail white, with twelve brownish-black bands; the breast, sides, and abdomen, white; the first with lanceolate spots, the

second with spots and bars; the last tail-coverts with narrow lanceolate spots.'

Belonging to the family of gulls are the Petrels, so well known to sailors as Mother Cary's Chickens. 'These birds,' says Bewick, 'are the constant roving adventurous inhabitants of the ocean; one species or another of them is met with by navigators in every climate and at the greatest distances from land.' 'The tempest not only does not affright them, but they are almost necessitated to seek those seas where the agitation of the waves brings to the surface those marine animals which constitute their food. In consequence of this, they are frequently seen in all weathers, in the vortices which are formed by the track of vessels. "It is indeed an interesting sight," says Wilson, "to observe these little birds, in a gale, coursing over the waves, down the declivities and up the ascents of the foaming surf that threatens to burst over their heads, sweeping along the hollow troughs of the sea as in a sheltered valley, and again mounting with the rising billow, and just above its surface, occasionally dropping their feet, which, striking the water, throw them up again with additional force, sometimes leaping, with both legs parallel, on the surface of the roughest waves for several yards at a time. Meanwhile they continue coursing from side to side of

the ship's wake, making excursions far and wide to the right and to the left, now a great way ahead, and now shooting astern for several hundred yards, returning again to the ship as if she were all the while stationary, though perhaps running at the rate of ten knots an hour. But the most singular peculiarity of this bird is its faculty of standing, and even running, on the surface of the water, which it performs with apparent facility. When any greasy matter is thrown overboard, these birds instantly collect around it, facing to windward, with their long wings expanded and their webbed feet patting the water. The lightness of their bodies, and the action of the wind on their wings, enable them with ease to assume this position. In calm weather, they perform the same manœuvre by keeping their wings just so much in action as to prevent their feet from sinking below the surface."'

'"There are," says the same writer in another place, "few persons who have crossed the Atlantic that have not observed these solitary wanderers of the deep, skimming along the surface of the wild and wasteful ocean; flitting past the vessel like swallows, or following in her wake, gleaning their scanty pittance of food from the rough and whirling surges. Habited in mourning, and making their appearance generally in greater numbers

previous to or during a storm, they have long been fearfully regarded by the ignorant and superstitious, not only as the foreboding messengers of tempests and dangers to the hapless mariner, but as wicked agents, connected somehow or other in creating them. 'Nobody,' say they, 'can tell anything of where they come from, or how they breed, though (as sailors sometimes say) it is supposed that they hatch their eggs under their wings as they sit on the water.' This mysterious uncertainty of their origin, and the circumstances above recited, have doubtless given rise to the opinion so prevalent among this class of men, that they are in some way or other connected with the Prince of the power of the air. In every country where they are known, their names have borne some affinity to this belief. They have been called Witches, Stormy Petrels, the Devil's Birds, and Mother Cary's Chickens, probably from some celebrated ideal hag of that name; and their unexpected and numerous appearance has frequently thrown a momentary damp over the mind of the hardiest seaman. It is the business of the naturalist, and the glory of philosophy, to examine into the reality of these things; to dissipate the clouds of error and superstition wherever they darken and bewilder the human understanding, and to illustrate nature with the radiance of truth."'

'When we inquire, accordingly, into the unvarnished history of this ominous bird, we find that it is by no means peculiar in presaging storms, for many others of very different families are evidently endowed with an equally nice perception of a change in the atmosphere. Hence it is that, before rain, swallows are seen more eagerly hawking for flies, and ducks carefully trimming their feathers, and tossing up water over their backs, to try whether it will run off again without wetting them. But it would be as absurd to accuse the swallows and ducks on that account of being the cause of the rain, as to impute a tempest to the spiteful malice of the poor petrels. Seamen ought rather to be thankful to them for the warning which their delicate feelings of aërial change enable them to give of an approaching hurricane. "As well," says Wilson, "might they curse the midnight light-house that, star-like, guides them on their watery way, or the buoy that warns them of the sunken rocks below, as this harmless wanderer, whose manner informs them of the approach of the storm, and thereby enables them to prepare for it." The petrels are nocturnal birds. When, therefore, they are seen flying about and feeding by day, the fact appears to indicate that they have been driven from their usual quarters by a storm; and hence, perhaps, arose the association of the bird

with the tempest. Though the petrels venture to wing their way over the wide ocean, as fearless as our swallows do over a mill-pond, they are not, therefore, the less sensible to danger; and, as if feelingly aware of their own weakness, they make all haste to the nearest shelter. When they cannot then find an island or a rock to shield them from the blast, they fly towards the first ship they can descry, crowd into her wake, and even close under the stern, heedless, it would appear, of the rushing surge, so that they can keep the vessel between them and the unbroken sweep of the wind. It is not to be wondered at, in such cases, that their low wailing note of *weet, weet*, should add something supernatural to the roar of waves and whistling of the wind, and infuse an ominous dread into minds prone to superstition.

'The popular opinion among sailors, that the petrels carry their eggs under their wings in order to hatch them, is no less unfounded than their fancy of their causing storms; it is, indeed, physically impossible. On the contrary, the petrels have been ascertained to breed on rocky shores, in numerous communities, like the bank-swallow, making their nests in the holes and cavities of the rocks above the sea, returning to feed their young only during the night, with the superabundant oily food from their stomachs. The quantity of this

oily matter is so considerable, that, in the Faroe Isles, they use petrels for candles, with no other preparation than drawing a wick through the body of the birds, from the mouth to the rump. While nestling, they make a cluttering or croaking noise, similar to frogs, which may be heard during the whole night on the shores of the Bahama and Bermuda Islands, and the coasts of Cuba and Florida, where they abound. Forster says they bury themselves by thousands in holes under ground, where they rear their young and lodge at night; and at New Zealand, the shores resound with the noise, similar to the clucking of hens, or the croaking of frogs (Pontoppidan, speaking of those of Norway, says like the neighing of a horse), which they send forth from their concealment.'

Terns, or sea-swallows, also belong to the same family. These birds are remarkable for the rapidity of their flight, and in this respect, as well as in their figure and plumage, they resemble swallows.

The terns are continually on the wing, and though web-footed, are not seen to swim; they rest but seldom, and only on the land; their food consists, for the most part, in small fishes and mollusca; they also catch aërial insects. In flying, they send forth sharp and piercing cries, especially during nestling-time. In calm weather,

they sometimes rise very high, and are often seen to come plump down. The young differ from the adult and aged only before the moulting, which is double in the known species, and there is no external difference between the two sexes. The females deposit their eggs, usually two or three in number, in a cavity, and their nests are sometimes so close, that the sitting-birds touch each other. Terns are found in both continents, from the seas, lakes, and rivers of the north, as far as the vast coasts of the Austral ocean, and in almost all the intermediate climates.'

The family of the Guillemots, Auks, Razor-bills, and Puffins, contains many species which pass their lives in swimming and diving after fish, or sitting perched on rocks in retired places of the coast. All these birds are gregarious; that is to say, they associate together in flocks, and are found in their peculiar places of abode in immense multitudes.

The guillemot is about the size of a common duck. The upper parts of the body are of a dark-brown colour, except the tips of some of the wing feathers, which are white, as are also the under parts of the body. They breed in various parts of the coast, on the most inaccessible parts of the rocks, and are found inhabiting the steep cliffs of the Isle of Man, Cornwall, Anglesey, the

Farne Islands, and the cliffs near Scarborough and other localities. The name, Foolish Guillemot, is applied to this bird, from the circumstance that while engaged in hatching they will suffer themselves to be taken by the hand rather than desert their duty. Mr Bewick, moreover, mentions an instance in which this absence of fear was remarkably evinced. He had caught a guillemot at Tynemouth, which the tide had left in a situation surrounded by rocks, upon the flat sand, from which it could not raise itself to take flight. While a drawing was taking of it, 'it sat,' says Bewick, 'under a table trimming its feathers, and appeared perfectly at ease, and not the least alarmed at the peeping curiosity of the children who surrounded it. When this business was finished,' adds the amiable writer, 'it was taken and set down upon an open part of the shore, where it immediately began to waddle toward the water; and as soon as it reached its beloved element, it flapped its wings, darted through the surge, dived, and disappeared.'

The Puffin, or Sea-parrot, frequents the same sort of places as the guillemot. It is a round little bird, with black and white plumage, and a beak not unlike that of the parrot, and ribbed with orange. They burrow like rabbits. 'In the breeding-season,' says Mr Rennie, 'numerous troops of them visit several places on our

coasts, particularly the small island of Priestholm, near Anglesey, which might well be called Puffin-land, as the whole surface appears literally covered with them. Soon after their arrival in May, they prepare for breeding, and it is said the male, contrary to the usual economy of birds, undertakes the hardest part of the labour. He begins by scraping up a hole in the sand not far from the shore; and after having got some depth, he throws himself on his back, and with his powerful bill as a digger, and his broad feet to remove the rubbish, he excavates a burrow with several windings and turnings, from eight to ten feet deep. He prefers, where he can find a stone, to dig under it, in order that his retreat may be more securely fortified. Whilst thus employed, the birds are so intent upon their work that they are easily caught by the hand. This bird, like others which burrow in similar localities, is accused of dispossessing the rabbits, the legitimate proprietors of the soil, and even of killing and devouring their young. But it would require more authentic testimony than we have yet met with to convince us of this alleged robbery; the only apparent evidence being, that they are found burrowing *along with* rabbits in similar holes. We very commonly find, in the same sand-bank, numerous perforations crowded into a small place, the work of various species

of solitary bees, side by side and intermingled with those of sand-wasps; but no naturalist who has accurately observed the proceedings of these insects, would conclude that they were mutual robbers, merely because he observed them going in and out of contiguous holes. In some instances, we are certain that the puffin must form its own burrows. "In one part of the island" (Akaroe), says Professor Hooker, "where there is a considerable quantity of rich loose mould, the puffins breed in vast numbers, forming holes three or four feet below the surface, resembling rabbit-burrows, at the bottom of which they lay a single white egg, about the size of that of a lapwing, upon the bare earth. Our people dug out about twenty of these birds, which they afterwards assured us made an excellent sea-pie." He elsewhere tells us that Iceland contains no indigenous quadrupeds, and he does not enumerate rabbits among those introduced. The climate indeed would probably be too cold for them. If the puffin, however, is really a robber of rabbit-burrows, it is too formidably armed to allow of retaliation with impunity, and few birds or beasts venture to attack it in its retreat. Sometimes, however, as Jacobson tells us, the raven makes bold to offer battle; but as soon as he approaches, the puffin catches him under the throat with her beak, and sticks

her claws into his breast till he screams out with pain and tries to get away; but the puffin keeps fast hold of him, and tumbles him about till both frequently fall into the sea, where the raven is drowned, and the puffin returns in triumph to her nest. But should the raven at the first onset get hold of the puffin's neck, he generally comes off victorious, kills the mother, and feasts on her eggs or her young.'

We have already referred to the curlew as frequenting the level shores of the sea, but there are many other species of birds to be found in such places. Of these a few others may be now noticed.

The Sanderlings.—The sanderlings are found in Europe, in Asia, in North America, and in New South Wales. They inhabit the sea-shores, and abound, in spring and autumn, both on the coasts of Holland and of this country. They are only seen accidentally in countries remote from the sea. There is but one species; but as these birds, which undergo two moultings, are most frequently seen in their summer plumage, in which red or reddish is the predominant colour, while in the winter it is gray, it is not wonderful that naturalists have made a distinct species under the title of *Charadrius rubidus.* The sanderlings traverse, in their periodical migration, a large portion of the globe. But

they are only seen accidentally along rivers, which leads to the presumption that their aliment consists of small marine worms and insects. They breed in the North.

The Sandpipers.—The Sea-larks—a name exceedingly improper, as tending to the confusion of two genera widely remote—never quit the edge of waters, and especially prefer the sea-shore, although they occasionally remove to a considerable distance from it, since they are frequently seen around the lakes and along the rivers of the Vosges and the Pyrenees. They are birds of passage, at least in many countries of Europe. They proceed very far to the north; for they are found in Sweden, on the borders of the Caspian Sea, and throughout the whole of Siberia. During winter they are very common both in France and England. The species is named by Latham, *Purre Sandpiper*. Except during the nestling-time, these birds unite in flocks, often so crowded that a great number of them may be killed by a single shot. 'Nothing,' says Belon, 'is more wonderful concerning this little bird, than to see five or six hundred dozen of them brought, on a single Saturday, in winter, to the Paris market.' They constitute an excellent game, but must be eaten fresh; they are not, however, destitute of that oily taste, which appertains to almost all species of aquatic birds.

The Plovers.—The plovers habitually frequent the sea-coast, the mouths of rivers, and salt-marshes. They feed upon crustacea, and small molluscous animals which they catch in the sand along the line of waters, over which they are seen continually flying, uttering a little cry. Many species live solitarily, or in couples; some others in small flocks. These birds are to be found in almost all the countries of the globe, from the equator to the coldest latitudes of the northern and southern hemispheres. They are all clad in sombre colours, the distribution of which is, however, not unpleasing. Most of them undergo a double moulting, and are vested in various liveries, according to age and sex. Some species have spines, which serve as defensive weapons, attached to their wings; some others have fleshy appendages at the base of the bill. The plovers emigrate every year, in flocks of greater or less numbers, and this principally takes place in autumn. during the rainy season, whence their French name (*pluviers*) is derived, and of which our word plover is an obvious corruption. At this time they are seen in the greatest abundance. They do not remain quiet when on the ground, but are seen in incessant motion. They fly in an extended file, or in transverse zones, very narrow and of a great length. They

are frequently taken, in great quantities, in the countries where they are common, by means of nets variously fabricated.

Of these, the first and most common is the *Golden Plover*. This bird frequents humid and marshy grounds. In winter it is very common on the coasts of France and Holland. It is found in England during the entire year; it is also very abundant in the Highlands of Scotland, in the Western Islands, and in the Isle of Man. It is again found in America, in Asia, and in the islands of the South Sea. Throughout the north of Europe it is common, and in all parts of Germany, Italy, and Spain. From the latter country we trace it into Barbary, and other parts of Africa; and it is to be found as far to the south-east of Asia, as India, China, and the Archipelago of the Eastern Ocean. These birds lay from three to five eggs, of rather an olive-green colour, with black spots. They live on worms, insects, and larvæ. There is very little difference in appearance between the male and female. These plovers strike the earth with their feet to cause the worms, &c., to issue from their retreat. In the morning, like the lapwings and the snipes, they visit the water-side to wash their bills and feet. They are rarely seen longer than twenty-four hours in the same place, which doubtless proceeds from their numbers,

which cause a rapid exhaustion of their means of subsistence in any given spot. They migrate from the districts which they inhabit when the snow falls and the frost begins to be intense, as their resources of provision are then cut off, and they are deprived of the water, which their constitution renders indispensable to them. It is very rare to see a golden plover alone, and Belon tells us that the smallest flocks in which they fly amount at least to fifty each. When they are seeking their food, several of them act as sentinels, and on the appearance of any danger, set up a shrill cry, as a warning to the others, and a signal for flight. These flocks disperse in the evening, and each individual passes the night apart; but at the dawn of day, the first that awakes gives a cry of appeal to the rest, which immediately reassemble on this call. This cry is imitated by the fowlers, to draw these birds into their nets. The flesh of these plovers is in high estimation in general, though the peculiarity of its flavour does not equally please every palate. It is best when the birds are rather fat than otherwise.

The Dotterel Plover is about nine inches in length. Its bill is black; the cheeks and throat are white; the back and wings are of a light brown, inclining to olive; the breast is of a dull orange: the belly, thighs, and vent are of a reddish white; the tail is of an olive brown, and

tipped with white; the legs are of a dark olive colour. The dotterel is common in various parts of Great Britain, though in some places it is scarcely known. They are supposed to breed in the mountains of Cumberland and Westmoreland, where they are sometimes seen in the month of May, during the breeding-season; they likewise breed on several of the Highland hills. They are very common in Cambridgeshire, Lincolnshire, and Derbyshire, appearing in small flocks on the heaths and moors of these counties during the months of May and June; and are then very fat, and much esteemed for the table. This bird is remarkable for its stupidity.

The Redshank.—This bird weighs about five ounces and a half; its length is twelve inches, and the breadth twenty-one. The bill, from the tip to the corners of the mouth, is more than one inch and three quarters long, black at the point, and red towards the base; the feathers on the crown of the head are dark brown, edged with pale rufous; a light or whitish line passes over, and encircles each eye, from the corners of which a dark-brown spot is extended to the beak; irides hazel; the hinder part of the neck is obscurely spotted with dark brown, or a rusty ash-coloured ground; the throat and forepart are more distinctly marked in streaks of the same colour; on the breast and belly, which are white,

tinged with ash, the spots are thinly distributed, and are shaped something like the heads of arrows or darts.

The Spotted Redshank.—The length of this bird, from the tip of the bill to the end of the tail, is twelve inches, and to the end of the toes fourteen inches and a half; its breadth twenty-one inches and a quarter; and its weight above five ounces avoirdupois. The bill is slender, measures two inches and a half from the corners of the mouth to the tip, and is, for half its length nearest the base, red; the other part black; irides hazel; the head, neck, breast, and belly, are spotted in streaks, mottled and barred with dingy ash-brown and dull white, darker on the crown and hinder part of the neck; the throat is white, and lines of the same colour pass from the upper sides of the beak over each eye, from the corners of which two brown ones are extended to the nostrils. The ground colour of the shoulders, scapulars, lesser coverts, and tail, is a glossy olive brown; the feathers on all these parts are indented on the edges, more or less, with triangular-shaped white spots. The back is white; the rump barred with waved lines of ash-coloured brown, and dingy white; the vent feathers are marked nearly in the same manner, but with a greater portion of white; the tail and coverts are also barred with narrow waved lines of a dull ash-colour, and, in

some specimens, are nearly black and white. Five of the primary quills are dark brown, tinged with olive; the shaft of the first quill is white, the next six are, in the male, rather deeply tipped with white, and slightly spotted and barred with brown; the secondaries, as far as they are uncovered when the wings are extended, are of the same snowy whiteness as the back. The feathers which cover the upper part of the thighs, and those near them, are blushed with a reddish or vinous colour; the legs are of a deep orange red, and measure, from the end of the middle toe-nail to the upper bare part of the thigh, five inches and a half.

The Green Sandpiper.—This bird measures about ten inches in length, to the end of the toes nearly twelve, and weighs about three ounces and a half. The bill is black, and an inch and a half long; a pale streak extends from it over each eye, between which, and the corners of the mouth, there is a dusky patch. The crown of the head and the hinder part of the neck are of a dingy, brownish-ash colour; in some specimens narrowly streaked with white. The throat is white; forepart of the neck mottled or streaked with brown spots on a white or pale ash-coloured ground. The whole upper part of the plumage is of a glossy bronze, or olive brown, elegantly marked on the edge of each feather with small roundish

white spots; the quills are without spots, and are of a darker brown; the secondaries and tertials are very long; the insides of the wings are dusky, edged with white gray, and the inside coverts next the body are curiously barred, from the shaft of each feather to the edge, with narrow white lines, formed nearly of the shape of two sides of a triangle. The belly, vent, tail-coverts, and tail are white; the last broadly barred with black, the middle feathers having four bars, and those next to them decreasing in the number of bars towards the outside feathers, which are quite plain; the legs are green.

The Dunlin.—This is the size of a jack-snipe. The upper parts of the plumage are ferruginous, marked with large spots of black and a little white; the lower parts are white, with dusky streaks. It is found in all the northern parts of Europe.

The Lapwing or Peewit.—This bird is about the size of a common pigeon, and is covered with very thick plumes, which are black at the roots, but of a different colour on the outward part. The feathers on the belly, thighs, and under the wings, are most of them white as snow; and the under part on the outside of the wings white, but black lower. It has a great liver, divided into two parts; and, as some authors affirm, no

gall. Lapwings are found in most parts of Europe, as far northward as Iceland. In the winter, they are met with in Persia and Egypt. Their chief food is worms; and sometimes they may be seen in flocks nearly covering the low marshy grounds in search of these, which they draw with great dexterity from their holes. When the bird meets with one of these little clusters of pellets, or rolls of earth that are thrown out by the worm's perforations, it first gently removes the mud from the mouth of the hole, then strikes the ground at the side with its foot, and steadily and attentively awaits the issue; the reptile, alarmed by the shock, emerges from its retreat, and is instantly seized. These birds make a great noise with their wings when flying; and are called *peewits*, in Scotland and the north of England, from their particular cry. In other parts of the island they are called green plovers. They remain here the whole year. The female lays two eggs on the dry ground, near some marsh, upon a little bed which it prepares of dry grass; these are olive-coloured, and spotted with black. She sits about three weeks; and the young, who are covered with a thick down, are able to run two or three days after they are hatched.

The Turnstone.—This bird is about the size of a thrush; the bill is nearly an inch long, and turns a little

upwards. The head, throat, and belly, are white; the breast black, and the neck encircled with a black colour. The upper parts of the plumage are of a pale reddish brown. These birds take their name from the method of finding their food, which is by turning up small stones with their bills to get the insects that lurk under them.

The Whimbrel.—The whimbrel is only about half the size of the curlew, which it very nearly resembles in shape, the colours of its plumage, and manner of its living. It is about seventeen inches in length. and twenty-nine in breadth; and weighs about fourteen ounces. The bill is about three inches long; the upper part of the head is black, divided in the middle of the crown by a white line from the brow to the hinder part; between the bill and the eyes there is a darkish oblong spot; the sides of the head, the neck, and breast, are o a pale brown, marked with narrow dark streaks pointing downwards; the belly is of the same colour, but the dark streaks upon it are larger; about the vent it is quite white; the lower part of the back is also white. The rump and tail feathers are barred with black and white; the shafts of the quills are white, the outer webs totally black, but the inner ones marked with large white spots; the secondary quills are spotted in the same

manner on both the outer and the inner webs. The legs and feet are of the same shape and colour as those of the curlew.

The Common Heron is well known as a frequent visitor of the sea-shore. This bird is about three feet four inches in length, measuring from the end of the anterior toes to the extremity of the bill; from the bill to the tail it measures nearly three feet, of which the tail forms about eight inches; and the expanse of its wings exceeds five feet. It does not, however, weigh more than three pounds and a half, and its buoyancy in flight is consequently very considerable. The general colour of the whole upper surface of the bird is an ashy gray, with somewhat of a bluish tinge. This is deeper on the back of the head, which is likewise ornamented with a dependent crest of narrow blackish feathers, three inches or more in length, overshadowing the back of the neck; upper part and sides of the neck are of a light gray, running into the pure ash-colour of the back, and the latter passing into a deeper shade of ashy gray upon the tail. The wing-coverts are nearly of the same colour, with a slight tinge of reddish; and the quill-feathers black, with a bluish gloss. On the under parts the ground-colour of the plumage is a pure white, marked on the forepart of the neck and breast with large longitu-

dinal black drops. The abdomen, upper part of the throat, and legs, are pure white. The naked space between the bill and the eyes is of a grayish yellow ; the iris is yellow ; the bill bluish above and yellow beneath ; the legs, which are bare of feathers for two or three inches above the knees, are somewhat flesh-coloured in their upper part, and grayish brown below, and the claws black. The middle toe, with the addition of its claw, does not measure more than four inches ; and is consequently much shorter than the tarsus, which exceeds six inches in length. Beneath the anterior half of the bill, which is about five inches long, the skin is capable of considerable distension. There is little difference in the colours of the female ; but the young bird has no crest on the head, and its back and wings are of a darker gray.

The herons may be regarded as birds of passage, but their stay or departure seems everywhere to be regulated by their means of procuring food. They are nowhere very abundant, although they are met with in almost every part of the northern and temperate regions of the old continent, and perhaps also in the new. In Europe they migrate as far northward as Drontheim, and are found even in Russia and Poland ; but they are most common in England, France, and Holland.

They build their nests, in numerous companies, on lofty trees, and more especially oaks, in the immediate neighbourhood of streams and marshes. The nest is of large dimensions, constructed externally of twigs, dry herbs, and reeds, and lined internally with feathers and wood. In this the female deposits her eggs, three or four in number, about the size of those of the common hen, but more elongated, and of a greenish-brown colour, without spots. The male does not share in the task of incubation; but flies abroad in search of food, while the female tends her charge at home. They are particularly fond of the society of ravens, but the latter often carry off their eggs; and the falcons, weasels, and martens, are dangerous enemies to their young. When the young are hatched, both parents assist in providing them with food until they are able to fly, and bring them abundance of fish for their support. But as soon as they become capable of a continued flight, they are driven from the nest, and proceed each in a separate direction to seek its own subsistence wherever it may be most plentifully procured.

The old birds quit their nests about the middle of August, and wander from stream to stream, and from lake to lake, forming themselves into gradually increasing bands as the colder season approaches. Towards the

beginning of September they are often met with in companies of from twenty to thirty in a spot; but as soon as the frost sets in, they begin their migration to the southward, taking their flight by moonlight, like the cranes, but not with the same order and regularity. They return about the latter end of March, when the severity of the season is no longer to be dreaded. Some few, however, remain throughout the winter, especially when the weather is variable, and are occasionally seen, in company with the wild-duck, at the commencement of a sudden thaw. They usually disappear with the return of frost.

Their food consists principally, like that of most of the birds of the wading order, of fresh-water fishes, but more particularly of the young fry of carp and trout. In pursuit of these they wade gently into the water, where the fish abound, and stand in it up to their knees (or rather to their knee, for they rest only on one foot), with their heads drawn in by the folding of their long necks upon the breast, quietly watching the approach of their prey. It has been remarked, not merely by the vulgar, but by observers deserving of implicit confidence, that the fish generally swarm around them in sufficient numbers to afford them a plentiful supply; and this has been commonly accounted for on the supposition that

their legs communicate a peculiar odour to the water which entices the fish to their destruction. But M. Bechstein, who vouches for the fact as one which he had seen innumerable times, suspects that the source of attraction is in the excrements of the bird, which it lets fall into the water, and which the fish, as is proved by experiment, devour with the utmost avidity. The time of fishing is usually before sunrise or after sunset. They generally swallow their prey entire, and many stories are current of eels escaping alive through their intestines, and being a second time devoured by the voracious birds. Besides fishes, frogs form a considerable portion of their food, and in winter they are frequently compelled to content themselves with snails and worms, or, according to M. de Salerne, even with the duck-weed that floats upon the stagnant waters. At such times they occasionally become so emaciated as to appear to consist of little else than feathers and bones.

Herons are taken in various ways. Sometimes they are shot while fishing, or sweeping leisurely along the banks ; but they are so shy that the sportsman can rarely get within gunshot of them. Occasionally a living fish is attached to a hook at the end of a line, and left to swim in the waters which they are known to frequent ; and they are thus caught as it were by angling. When

falconry was in fashion, hawking at the heron was regarded as the most noble of its branches; the powerful wings of the heron, unequalled by any bird of its size, enabling it to mount in the air to an almost incredible height, and thus to put the powers of the falcon to proof. For this purpose it was customary to establish the herons in a proper situation, to which they were attached by precautions taken for providing them with necessaries. These heronries, as they were called, have now become extremely rare in Scotland; but one of them may still be seen in the parish of Craigie, near Kilmarnock, in Ayrshire. Mr Rennie says that the heronries recorded to be existing at present in England, are at Penhurst-place, Kent; at Hutton, the seat of Mr Bethel, near Beverly, in Yorkshire; at Pixton, the seat of Lord Caernarvon; in Gobay Park, on the road to Penrith, near a rocky pass called Yew-crag, on the north side of the romantic lake of Ulswater; at Cressie Hall, six miles from Spalding, in Lincolnshire; at Downington-in-Holland, in the same county; at Brackley Woods, near Bristol; at Brownsea Island, near Poole, in Dorsetshire; and at Windsor.

'I went lately to see a fine heronry at Sir Henry Fletcher's park, Walton-on-Thames,' says Mr Jesse. 'The nests are built on the top of some of the finest fir

trees in the kingdom, and appear somewhat larger than those of the rooks. These birds must go an amazing distance to provide for their young, as I have been assured that the bones of sea-fish have been found under their nests. A young bird from this heronry, having fallen out of the nest, was taken away in the evening by a gentleman, who carried it to his house at some miles' distance, and turned it into a walled garden that night. The next morning one of the old birds was seen to feed it, and continued to do so till the young one made its escape. This bird must have gone over a very considerable space of ground in search of the young heron.

'A large assembly of herons takes place at certain times of the year in Richmond Park, where I have counted from fifty to sixty at a time. Sometimes they may be seen on the tops of trees, and at others on the ground at a distance from the ponds, appearing perfectly motionless till they are disturbed. This assemblage is very curious. The nearest heronry from Richmond Park is the one near Walton-on-Thames, and the other in Windsor great park, both of which would scarcely furnish the number above mentioned. There seems to be no reason why they should congregate and remain for so long a time in the listless manner in which I have seen them; nor can one give a probable reason why the

birds from two heronries should meet at the same time in a place so far distant from their usual haunts. It is seldom that one sees more than two or three herons together in the same place, and this only when they are watching their prey.

'Belon mentions it as one of the extraordinary feats performed by the divine king, Francis the First, that he formed two artificial heronries at Fontainebleau—"the very elements themselves," says he "obeying the commands of this divine king (whom God absolve!) for to force nature is a work partaking of divinity." In order to enhance the merits of these French heronries, he undertakes to assert, that they were unknown to the ancients, because they are not mentioned in any of their writings; and for the same reason he concludes there are none in Britain. Before Belon's time, or the contrary, and before the "divine" constructer of heronries in France was born, there were express laws enacted in England for the protection of herons, it being a fine of ten shillings to take the young out of the nest, and six shillings and eightpence for a person, without his own grounds, killing a heron, except by hawking, or by the long-bow; while in subsequent enactments, the latter penalty was increased to twenty shillings, or three months' imprisonment. At present, however, in consequence of the discontinuance

of hawking, little attention is paid to the protection of heronries, though, I believe, none of the old statutes respecting them have been repealed. Not to know a hawk from a *heronshaw* (the former name of the heron), was an old adage, which arose when the diversion of heron-hawking was in high fashion: it has since been corrupted into the absurd vulgar proverb, "not to know a hawk from a hand-saw."'

The heron, when taken young, readily becomes habituated to captivity; but the old birds generally refuse all sustenance, and perish of inanition. In former days, when it was necessary to procure such for the training of the hawks, it was usual, according to Sir J. Sebright, 'to cram them with food, and to tie a piece of mat round their necks to prevent them from throwing it up again.' Sometimes, however, the old birds have been known to become tame and even domesticated; and the same distinguished authority to whom we have just referred, mentions an instance that occurred within his own knowledge, in which, after recourse had been had to the operation of cramming and tying down the food, the bird 'became so tame as to follow its master on the wing to the distance of some miles, to come into the house when called, and to take food from the hand.'

The *Night Heron*, so called from the hoarse croaking

which it utters during the night, is about twenty inches in length. The bill is three inches and three quarters long, slightly arched, strong, and black, inclining to yellow at the base; the skin, from the beak round the eyes, is bare, and of a greenish colour, irides yellow. A white line is extended from the beak over each eye; a black patch, glossed with green, covers the crown of the head and nape of the neck, from which three long narrow white feathers, tipped with brown, hang loose and waving; the hinder part of the neck, coverts of the wings, the sides and tail, are ash-coloured; throat white; forepart of the neck, breast, and belly, yellowish white or buff; the back black; the legs a greenish yellow. The female is nearly of the same size as the male; but she differs considerably in her plumage, which is less bright and distinct, being more blended with clay or dirty white, brown, gray, and rusty ash-colour; and she has not the delicate plumes that flow from the head of the male. The night heron frequents the sea-shores, rivers, and inland marshes; and lives upon insects, slugs, frogs, reptiles, and fish. It remains concealed during the day, and does not roam abroad until the approach of night, when it is heard, and known by its harsh, rough, and disagreeable cry, which is by some compared to the noise made by a person straining to vomit. Some

ornithologists affirm that the female builds her nest in trees; others, that she builds it on rocky cliffs; probably both accounts are right. She lays three or four white eggs.

The *Crested Purple Heron* inhabits Asia, and is two feet ten inches in length. The bill is brown, tipped with dusky brown, and is yellowish beneath; the crest is of a black colour; the orbits naked and yellowish; from the angle of the mouth to the hind-head it has a black streak; the chin is white, upper half of the neck rufous, with three longitudinal black lines; the rest olive behind, and rufous at the sides, and reddish on the fore-part; the feathers are long, narrow, each marked with a black spot; a black band passes from the middle of the breast to the vent; the lower tail-coverts are white, mixed with rufous and tipped with black; angles of the wings rufous; the quil feathers dusky, and the legs greenish; hind-head black, the crest pendant, consisting of two long feathers; the body is of an olive colour, and beneath it is purplish.

The smaller herons with shorter feet have been called *Crab-eaters.* The *Egrets* are herons, whose plumes on the lower part of the back are, at a certain period, long and attenuated. These plumes were formerly used to decorate the helmets of warriors; they are now applied

to a gentler and better purpose, in ornamenting the head-dresses of the European ladies, and the turbans of the Persians and Turks.

The following interesting account of heron-hunting with falcons, is from the *Magazine of Natural History*; and though it might have been more appropriately introduced, perhaps, when we were speaking of birds of prey, it is too good, we think, to be omitted, and incidentally illustrates the character of the species under consideration.

'In June 1825,' says the writer, 'happening to be in Norfolk, I became an eye-witness to that most ancient and now very rare sport of falconry; and I now relate what I actually saw, and which was to me most novel and entertaining. The place fixed upon for the sport was in the intermediate country between the fens and the heronry, and in the afternoon of the day with the wind blowing towards the heronry. There were four couple of casts of the *female* Peregrine falcon carried by a man to the ground, upon an oblong kind of frame padded with leather, upon which the falcons perched, and were fastened to the perch by a thong of leather. Each bird had a small bell on one leg, and a leather hood, with an oblong piece of scarlet cloth stitched into it over each eye, sur-

mounted by a plume of various coloured feathers on the top of the hood. The man walked in the centre of the frame, with a strap from each side over each shoulder; and when he arrived at the spot fixed upon for the sport, he set down the frame upon its legs, and took off all the falcons, and tethered them to the ground in a convenient shady place. There were four men who had the immediate care of the falcons (seemingly Dutch or Germans), each having a bag, somewhat like a woman's pocket, tied to his waist, containing a live pigeon, called a lure, to which was fastened a long string; there were also some gentlemen attached to the sport, who likewise carried their bags and lures.

'After waiting awhile, some herons passed, but at too great a distance; at length one appeared to be coming within reach, and preparations were made to attack him. Each falconer was furnished with a brown leather glove on the right hand (I suppose to prevent the talons of the bird from scratching it), on which the falcon perched; and there was a small bit of leather attached to the leg of the bird, and which was held by the falconer between the thumb and finger. Each of the men thus equipped, with a falcon on one fist, and the bag with the lure tied to the waist, and mounted on horseback, proceeding slowly in a direction towards where the heron was seen

approaching. As soon as the heron was nearly opposite, and at what I conceived a great height in the air, the falconers slipped the hoods from off the heads of the falcons, and held each bird on the fist by the bit of leather till the falcons caught sight of the heron, and then a most gallant scene ensued. The instant they were liberated, they made straight for their prey, though at a considerable distance ahead. As they were dashing away towards the heron, a crow happened to cross; and one of them instantly darted at him, but he struck into a plantation and saved himself; the falcon dashed in after him, but did not take him. The other falcon soon overtook the heron (which immediately disgorged its ballast of two or three fishes); and after flying round in circles for some time, at length soared above him, and then struck him on the back, and they both came tumbling down together, from an exceeding great height, to the ground. The other falcon, having lost some time with the crow, was flying very swiftly to assist his comrade, and had just come up at the time the falcon and heron were falling. At this instant a rook happened to fly across; the disappointed falcon struck at him, and they both fell together within twenty yards of the other falcon and the heron. When on the ground, each falcon began to pull to pieces its victim; but, as soon as the falconers

rode up, the lures were thrown out, and the falcons suffered to make a meal (having previously been kept fasting), upon the pigeon, which was laid on the carcass of the heron ; and, after they were satisfied, were again hooded and put up for that day.

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