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THE MOUNTAIN.

The Golden Eagle & Her Prey.

Published by Whittaker & Co, London.
THE

BRITISH NATURALIST;

OR,

SKETCHES OF THE MORE INTERESTING

PRODUCTIONS OF BRITAIN

AND THE SURROUNDING SEA,

IN THE SCENES WHICH THEY INHABIT;

AND WITH RELATION TO

THE GENERAL ECONOMY OF NATURE, AND THE WISDOM

AND POWER OF ITS AUTHOR.

Nature speaks
A parent's language, and, in tones as mild
As e'er hush'd infant on its mother's breast,
Wins us to learn her lore!  Professor Wilson's Poems.

LONDON:
PRINTED FOR WHITTAKER, TREACHER, AND CO.
AVE-MARIA LANE.
MDCCCXXX.
PREFACE.

Some apology may seem to be necessary for the appearance of a new work upon Natural History,—more especially of a work that is sanctioned by no name or authority, and pretends to no systematic arrangement. Now these, which not a few may think imperfections, are intended to enable the British Naturalist to stand up for judgment, to be awarded according to its real merits. The dictum of authority, and the divisions of system, are the bane of study to the people at large. The former never fails to repress the spirit of inquiry; and in the latter, the parts are so many, and so scattered, that one cannot understand the whole: it were as easy to tell the hour from the disjointed movements of a number of watches jumbled together in a box, as to find "how nature goes," from the mere dissection of her works.

I do not want to hear the harangue of the exhibitor; I want to see the exhibition itself, and
that he shall be quiet, and let me study and understand that in my own way. If I meet with any object that arrests my attention, I do not wish to run over the roll of all objects of a similar kind; I want to know something about the next one, and why they should be in juxtaposition. If, for instance, I meet with an eagle on a mountain cliff, I have no desire to be lectured about all the birds that have clutching talons and crooked beaks. That would take me from the book of nature, which is before me,—rob me of spectacle, and give me only the story of the exhibitor, which I have no wish either to hear or to remember. I want to know why the eagle is on that cliff, where there is not a thing for her to eat, rather than down in the plain, where prey is abundant; I want also to know what good the mountain itself does,—that great lump of sterility and cold; and if I find out, that the cliff is the very place from which the eagle can sally forth with the greatest ease and success, and that the mountain is the parent of all those streams that gladden the valleys and plains,—I am informed. Nay, more, I see a purpose in it,—the working of a Power mightier than that of man. My thoughts ascend from mountains to masses wheeling freely in absolute space. I look for the boundary: I dare not even imagine it: I cannot resist the conclusion—"This is the building of God."
Wherever I go, or whatever I meet, I cannot be satisfied with the mere knowledge that it is there, or that its form, texture, and composition are thus or thus; I want to find out how it came there, and what purpose it serves; because, as all the practical knowledge upon which the arts of civilization are founded has come in this way, I too may haply glean a little. Nor is that all: wonderful as man’s inventions are, I connect myself with something more wonderful and more lasting; and thus I have a hope and stay, whether the world goes well or ill; and the very feeling of that, makes me better able to bear its ills. When I find that the barren mountain is a source of fertility, that the cold snow is a protecting mantle, and that the all-devouring sea is a fabricator of new lands, and an easy pathway round the globe, I cannot help thinking that that, which first seems only an annoyance to myself, must ultimately involve a greater good.

This was the application given to Natural History in the good old days of the Derhams and the Rays; and they were the men that breathed the spirit of natural science over the country. But the science and the spirit have been separated; and though the learned have gone on with perhaps more vigour than ever, the people have fallen back. They see the very entrance of knowledge guarded by a hostile language, which must be vanquished in single combat before they can
enter; and they turn away in despair. I admit the merit of the systems and subdivisions: for those who devote themselves to a single science, they are admirable; but to the great body of the people they are worse than useless.

With many works that profess to be popular, the case is not better. They are in general collections of scraps, put together by persons of no observation,—the illustrations of a system without the system itself, and therefore of little use to any body. The facts that they set forth may be true; but when one puts the *cui bono*, there is no answer; and when one seeks for the connexion by which all the parts are united into a whole, it is not to be found.

Some part of this may be owing to the mischief of authority; and of the authority of one of the greatest men that ever lived. Bacon, forgetting for once the difference between matter of fact and matter of inference, said, rather inconsiderately, that "final causes produce nothing." The sentence is a mere opinion, and, what is more, it is a contradiction!—as, if the causes be *final*, what can they produce? But the sentence has become a maxim; final causes are but seldom attended to, and the history of nature, thus disjointed, becomes uninteresting. Yet final causes are, in the study of organic being, what the laws of matter are in the study of mere material existence, or what the principles of arithmetic and geometry are in the
study of number and figure. They are the laws of growth and life; and those who do not keep them constantly in view, study nature as if it were dead; and, of course, fall into the same blunders and absurdities as those who attempted to study the heavens without the laws of physics, or properties of substances without those of chemistry. The laws of physics and chemistry are nothing but the ultimate facts, to which we always arrive when we pursue the same course, and beyond which we can never go; and the ultimate facts in the economy of organized bodies, or the laws of life, as we may term them, are to be found in the same way—by observation. Sometimes they act contrary to those of physics or chemistry, and sometimes not; but when the former is the case, we always find that there is an organization, the very best adapted for producing the effect. There is not one violation of this,—not one production of nature doing anything at any time, but just that which, if we had studied it properly before, we should have expected it to do; and when we find this adaptation universal and perfect, can we doubt that it is the result of infinite wisdom? and believing it in our hearts, shall we be ashamed to confess it? Shall we deny the wisdom of our Maker, because he is all-wise; or his power, because he is all-powerful? With all our failings, we do not deal so by our fellow-men; and shall we respect the works and contemn the Maker?
In the following pages the subjects have been viewed in those masses into which we find them grouped in nature; and the plant or the animal has been taken in conjunction with the scenery, and the general and particular use; and, when that arose naturally, the lesson of morality or natural religion. The subjects for a first volume have been chosen more for their breadth than for their number, leaving those that are more minute, and stand in greater need of pictorial illustration, to future volumes, in the course of which the same kind of scenes will be visited, though in other aspects and for other purposes.

Throughout the work, the best authorities, at least those which appeared to the author to be the best, have been consulted, as well for the collection of facts, as for the verification of original observations; but no man's labours have been appropriated without express acknowledgement in the text, and generally speaking, with inverted commas in the analytic table.

The plan, of which the present volume forms a part, has been long under consideration; and materials are in preparation for extending it, not only to a Series of Volumes of The British Naturalist, but to follow, or alternate those, with The Foreign Naturalist, as may be most accordant with the successful preparation of the work and the wishes of the public.

Several facts and inferences will be found in
the present volume, which have not been previously published. But the author has not put them forward as his. His object is not to appear a naturalist himself, but to show how delightful, and how profitable, it would be, if all would be their own naturalists, and go to the living fountain instead of the stagnant pool.

Bank of the Thames,
Nov. 1829.
The Wood Cuts of the various Animals and Insects are
designed and executed by Mr. W. H. Brooke; and those of
the Lake and the Brook, by Mr. Bonner, from Drawings
by Harry Willson, Esq., who has recently published some
interesting Views of Foreign Cities.
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THE BRITISH NATURALIST.

CHAPTER I.

INTRODUCTION.

It may be a trite observation, but it is at the same time a true one, that "there is neither waste nor ruin in nature." When the productions of human art fall into decay, they are gone; and if the artist does not replace them by new formations, the species is gone also; but the works of nature are their own repairers and continuers, and that which we are accustomed to look upon as destruction and putrefaction, is a step in the progress of new being and life. This is the grand distinction between the productions of nature and those of art; those in which the same power finds both the materials and the form, and those in which the form is merely impressed upon previously existing materials.

The substances in nature are in themselves endowed with faculties, unseen and inscrutable by man in any thing but their results, which produce all the varied
forms of inorganic and organic being, of which the solid earth, the liquid sea, and the fluid air, are formed, and by which they are inhabited. The fabrications of man are, on the other hand, in a state of commenced decay the instant that they are made; and without the constant labour of repair and replacing, they would perish altogether. The most extensive cities, and the strongest fortifications, after man abandons them to their fate, fade and moulder away, so that the people of after-ages dispute, not merely about the places where they were situated, but about the very fact of their existence. It is true that, when man takes any of nature's productions out of the place or circumstances for which nature has fitted them, and supports them by artificial means, they cannot continue to exist after those means are withdrawn, any more than a roof can remain suspended in the air after the walls or parts that supported it are withdrawn; or, a cork will remain at the bottom of a basin of water, after the weight that kept it from rising to the surface has been removed. If man will have artificial shelter and food, he must keep in repair the house that he has built, trim the garden he has planted, and plough and sow the field from which he is to obtain his artificial crop; but if he would content himself with that which is produced without importation, and artificial culture, no planting, sowing, or culture is necessary; for whether it be in the warm regions or in the cold, in the sheltered valley or upon the storm-beaten hill, in the close forest or upon the open down, nature does her part without intermission or error; and while the results are so many and so beautiful, the causes are those qualities
with which the fiat of the Almighty endowed the elements, when it was his pleasure to speak the whole into existence.

Over the whole of this extensive, fair, and varied creation, dominion was, by its Almighty and All-bountiful Creator, given to man. When our first parents were formed, and ere yet Eden had been prepared for their abode, "God blessed them, and said, 'Replenish the earth, and subdue it; and have dominion over the fish of the sea, and over the fowl of the air, and over every living thing that moveth upon the earth. And behold, I have given you every herb bearing seed which is upon the face of all the earth, and every tree upon which is the fruit of a tree yielding seed.'" Thus the commandment is ample, and it is circumstantial. There is the dominion to man, as a rational and an intelligent creature—the study and knowledge, as an exercise and improvement of the mind; and the use, for the support and comfort of the body, as the proper consequence and reward of the study and knowledge.

It is this "knowledge" of the productions of nature, their habits, and the laws of their being, which, in the emphatic language of Lord Bacon, "is power;" and, abundant as are the works, possessions, and comforts, of civilized man—extensive as is his learning, numerous as are his arts and his sciences, and disposed as he too often is to neglect nature for art, or even for indolence, the study of the nature and properties of those objects and substances around him, in the production of which he had originally no concern, is the source and fountain of them all.

It is true that the dominion given to man is not an
idle dominion, a mere consumption of that which he finds spontaneously around him, in the state in which it is found. It is a dominion of improvement and for the exercise of the mind, as well as for the satisfaction of the mere animal wants. These latter are common to the whole creation: the meanest animal, the most lowly vegetable finds its food, and protects itself from the weather, in a manner far more certain and successful than man, if he, not elevating himself above the brutes of the field, do not exercise his higher and nobler powers. In those countries where man improves nothing, and cultivates nothing, he is the most abject creature to be found, and suffers more privation and misery than the plants and the animals. In those cases he is without his power; therefore, has not taken upon him his dominion; and, instead of being, as he ought to be, the ruler and governor of the rest of the creation, he is the slave of the laws and instincts of these: and he is so, just because, by being ignorant of those laws and instincts, he is incapable of turning them to his use.

To improve that which he uses is the characteristic of man, the image of the Creator which is stamped upon him; and he is the only inhabitant of the world to whom this power has been given; and though one grand means of effecting this important end, be the treasuring up of knowledge, so that every succeeding generation may turn to account the collected wisdom of all the generations that went before it; yet the rapidity with which discoveries have been made, and inventions founded upon them, since the art of printing diffused knowledge among all ranks of the people, abundantly
INTRODUCTION.

proves that the treasure of nature is yet far from exhausted.

But numerous and splendid as those inventions of modern art are, and much as they have changed the habits, and added to the possessions and comforts of mankind, it is but too apparent that some sacrifice has been made to them. Their number and their novelty, the desire that people have to possess themselves of them, and the labour which must be undergone in the gratification of that desire, have drawn the attention of a very large portion of the people from the objects that are around them. The very splendour that has rewarded the knowledge of the few, has tempted the many from the path of original knowledge, just in the same manner that the splendour of a pageant attracts the populace to the neglect of their more useful avocations. The world of man's making has become so great and so imposing, that it has tempted people to forget the world of God's making, without which, and the careful study and knowledge of it, the other could not have existed.

Perhaps that may have acted as a stimulus to the few, though the tendency of it must have been to make them seek after that which was novel, rather than after that which was true; and hence, though, during the last half century, there have been many more successful inventions than during any other period of the same length, it is certainly not too much to say that the failures have increased in a much greater proportion. The reason is a very plain one: the people do not see the scientific induction—the observation of nature, which must precede the suc-
cessful application of a new substance or a new combination to the arts; they see only the result; and therefore, when even a commendable feeling prompts them to become imitators, they fix upon a result to be arrived at, in total ignorance of the means that ought to be used. Hence they labour for nought, and vex themselves in the pursuit of vanity.

The necessary consequence is, an artificial state of society, in pursuits, in manners, in the very structure of the mind, and in every thing, whether of occupation or engagement; nay, even in that most important of all considerations, religion itself. The raw material passes from the hand of the producer without much change, or any knowledge of the process by which it is to be made fit for use; the manufacturer receives it he knows not whence, or from what; the merchant thinks only of the sale and the profit; the consumer, of the supply of his necessity, or the gratification of his vanity; and the gratification is so very evanescent, that hardly has one novelty been received, when another becomes necessary. Thus, all is one round of bustle and turmoil, in which, amid a dazzling succession of splendours, there is very little time for thought, and less for engagement, than any one who has not been a careful observer of the state of things would be apt to suppose. In proof of this, it may be stated with confidence, that the community have not got substantially wiser, even in the matter of their pecuniary interests; for there have been more wild and ruinous speculations, unfounded upon a single well-established fact, within the last ten years, than within any other recorded period of double the duration. All these
failures proceeded from an ignorance of facts, which any body could have known, had they taken the trouble of inquiring,—of facts that stand boldly out, and make themselves be felt the moment that the parties come within the sphere of their operation.

But while in business there has been no very perceptible accession of general wisdom, there has not been much improvement in what are supposed to constitute the pleasures of the world. The theatre has lost its intellectual character. The delineation of human nature, even in its most ordinary aspects, is abandoned; genius pens not one line for even the great national houses; the fashionable, when they are attracted, are attracted by sight and sound, without meaning or moral; the crowd are drawn by buffoonery and grimace; and the calm part of the community, they who ought to impart to it its character, must attend to their vocations. The other public amusements are all little better than mere sights; for be it a collection of pictures, or plants, or animals, one can only have an observation beyond the mere external beauty or deformity of the show. There is no allusion to use; not a word about nature or properties; not even a knocking at that door of information, by the opening of which so wide a vista of instructive associations might be seen. The eye is gratified for a moment; but the show stands insulated, suggesting nothing, and leading to nothing; except, perhaps, the craving for another show, from the restlessness of that mind, which fain would break out of the prison and be free as thought, but is not permitted.

In religion the case is perhaps still worse, as that is
altogether an intellectual matter. The most attentive study of the wonders of creation, (and all its works are wonders, from the animalcule which the eye cannot discern without a microscope, to planets and suns and systems, and those yet more incomprehensible powers of mind by which these can be contemplated and known,) —the most attentive study of these, can impart but a faint and shadowy notion of that Being, who, by a simple will, imparted to them those principles which regulate their changes and preserve their existence through countless ages. This being the case, (and the wisest men that have lived have felt and admitted it,) it is not possible that without any knowledge of his works there can be a proper knowledge of God. If the only world with which we are acquainted be of man's making, the only God with which we can be acquainted must be of man's imagining; and whatever may be the forms or the words of the religion, it can be nothing but superstition. A belief in that of which the believer knows nothing, is a contradiction in terms—a delusion and a cheat; and, if there be but the very slightest stirring of reflection, one who is just beginning to think must feel that infidelity, which ignorance itself imparts, but which it veils in its own darkness when only a shade deeper.

That God, the Creator, can be known only from the works of creation, is manifest from the whole tenor of Holy Writ; for, even in those parts of it that relate to the Christian scheme of redemption, which requires an immediate revelation by the Deity, the whole of the illustrations are taken from the works of Nature; and though, unaided by any human science, the grand
truths of Revelation may be understood by man,—though man may know what God has done, in order that man may enjoy everlasting happiness, yet, without a careful study of the works of God, man cannot be so impressed with the exalted nature of that Being, as to estimate the astonishing goodness which condescended to notice one so low.

Were it at all necessary, it would be easy to multiply proofs of the neglect of the study of Nature, and illustrations of the loss, both in pleasure and profit, which society suffers through that neglect; but it is always a much easier matter to point out a fault, than to show how that fault is to be corrected. It does not appear that the fault is altogether in society,—at least not directly; for whenever a work on natural subjects appears in a form intelligible to the public, it is sought after and read with more avidity than any other publication,—so strong is the bias to know something of the phenomena around us, that we restrain it with reluctance even under the most untoward circumstances.

One discouragement, and that of a very inveterate nature, arises from the form and nomenclature of the modern systems. Nature herself does not speak in an unknown tongue; and therefore a plain man pauses when he finds the objects with which he is most familiar, named and described in a language different from that which he himself speaks. On the other hand, as these names and descriptions are familiar to the learned of all countries, they save a little trouble to them. But while, by this means, the progress of a few of the more profound and systematic
students is accelerated, an incalculably greater number are prevented from making any progress at all. The professional students ought to be to society, what pioneers are to an army on its march,—they should go before it and clear the way, so that it may advance the faster. But if the pioneers were to block up the way behind them, just in order to make their own progress the more rapid, it would be difficult to point out the advantage that they would be to the army.

The celebrity that has been won by system and nomenclature, and the disposition which has been shown to make new divisions and alter old ones, though probably sanctioned by the progress of discovery, has further given the science of nature, as it is found in books, a formidable appearance to the unscientific; and that again has been increased by the multiplicity of works and systems through which one is compelled to wade, before the facts that are interesting for the picture of nature that they exhibit, can be collected together. This, too, in England at least, is in some measure unavoidable. Works on science will not pay for the labour and expense. Thus there cannot be a revision of the whole subject; and the new facts come out, in the transactions of societies and in periodical journals, in essays and notices, which do not always state them with accuracy, and which seldom point out how they are to be joined to the information already before the public. Farther, publicity is announced by the authority of names; an influence which is always mischievous, but against which there is no means or possibility of guarding, but by the diffusion of knowledge among the public generally,—as they who have not the demonstrated
truth to believe, must place their faith somewhere, and necessarily, or at least naturally, place it in the idol that is most in vogue at the time.

Out of these circumstances, and many other analogous ones which might be enumerated, there arises a farther evil, which, in its effects, is probably the most baneful of all: the wonders, that is, the novelties and rarities in nature, are those that are shown and written about. They who avoid the mouse or the spider, whose characters and habits they might be studying during many an hour which is spent in idleness and gossipping, throng to the exhibitions of learned cats and sapient pigs. A calf with two heads, or an ox of double the ordinary obesity, will attract the gaze of hundreds, who care nothing for either animal in its natural form and condition. Curiosity is a valuable feeling, and ought not to be repressed; but there is no feeling that stands more in need of being guided; for if it ever be debauched by following after rarities that are of no use, it can hardly be brought to regard common objects, however valuable they may be.

There is a pretty strong natural tendency to this love of marvels, and to pay much more attention to the deviations of nature from her ordinary mode of working, than to study the laws of common occurrences; as if there were more both of pleasure and of wisdom in criticising the supposed faults and blunders of nature, than in contemplating her beauties. Even when attempts are made to render the study of natural objects amusing and attractive, the attention is not directed to the general course, but to the deviations. If it is a plant, its common habits, by the study of which alone
its uses can be discovered, are passed over, and the attention is directed to some freak or accidental circumstance; and if an animal, any trick that it may have been taught by man, is far more attractive than its natural habits, and the more that it is contrary to those habits, the more is it admired and wondered at. Even a stone of fanciful shape and unusual colour is picked up, kept, shown, and talked about as a curiosity, by those who would think their time unprofitably and painfully spent, were they to study the strata of which the globe is composed, with a view either to the knowledge of its present state, or the elucidation of its past history: just as if that which can communicate no knowledge and lead to no use, were more valuable than that which is fraught with the profoundest wisdom, and leads to the greatest practical utility.

These are formidable barriers; but the case is not in itself so bad as, from the mere contemplation of them, it would appear. They are, no doubt, obstacles in the path to knowledge, but fortunately they are in the by-path only. They render access to the copy a good deal more difficult and uninviting than it otherwise would be, but the original is as open to the public as ever. The best system that man can invent, and the best descriptions that he can give, with all the helps of painting, engraving, or prepared specimens, are nothing to nature itself. The form may be fine, and the colouring beautiful; and we may admire the mould of the one and the tints of the other; but the charm is not there—life, that mysterious impulse, which moulded the form, painted the colours, and caused that which runs in all to assume certain characters and perform
certain functions is gone, and all that is left is a piece of dead matter, which can remind us of nothing but the size, shape, and consistency of the parts of which it is made up. "A living dog," says Solomon, "is better than a dead lion;" and the saying is true as respects both the power of the animal, and the lesson which the study of it is calculated to impart.

Now man cannot be shut out from this means of study, either by the situation in which he is placed, or by want of education. If he shall have the range but of one field, or even of one pathway, be that ever so limited, there is still enough of nature to engage his attention, afford him pleasure, and lead him to the contemplation of that Being, "in the knowledge of whom stands everlasting life." Nay, even in confinement, in the gloomy solitude of the dungeon, cut off from all intercourse with his kind, separated from those animals which have been domesticated for use or for pleasure, and forbidden to look upon the fair sky and the fertile earth, there are well-authenticated instances, in which the mouse and even the spider have owned his dominion, and come at his call, to amuse his solitude. These instances show that, if we had time and patience for finding out their instincts and perfections, there are none of the works of nature that might not have their use; and that the whole range of the works of creation is so given to man, as that the link by which his enjoyment is bound to them can be separated only by the stroke of dissolution.

When indeed our information extends only to our own kind, we are, though we know all their habits and all their history, in every age and country, in a state of
very great ignorance and helplessness as regards even the advancement of our own comfort as individuals. Creation is so linked together as one whole, both in space and in time, that we cannot know the nature and learn the use of any one part without a knowledge of the whole. For the want of this information, people have often done very foolish things,—such as wantonly killing those rooks, that are of so much use in destroying the larvae and eggs of insects, which, but for rooks and other birds that feed upon insects, would render the labour of the husbandman unavailing. In like manner the garden spider is often destroyed, though it be one of the grand preservers of the buds, the blossoms, and the fruit of the coming season. At the time when these spiders become most abundant, the flies are very numerous, most of the generations for the passing summer having been produced; and if all that appear in the autumnal days were to live till they had deposited their eggs, the different sorts of grubs and caterpillars would be so abundant in the spring, that, instead of fruit, hardly a green leaf would be left undestroyed.

One of the most valuable consequences of the study of nature is, the removal of prejudices, under the influence of which we are apt to act very foolishly. Instead of looking at plants and animals as forming a part of nature as one whole, we are apt to make our own ignorance the rule of our action, and persecute one and foster another, from dislike and regard founded on nothing but our own caprice. Thus, instead of being, as we ought to be, the wise and skilful rulers of the world, improving its beauty at the same time that we add to
our own enjoyment, we become mere capricious tyrants, and, like all other members of that class, feel in return the miseries that we inflict.

Because, according to our limited notions, certain classes of animals prey upon other classes, we call them cruel; and, not contenting ourselves with restraining them from injuring us, or that on which we set a value, we, from mere wantonness, wage against them a war of extermination. Now we ought to bear in mind that the same Creator who formed us, formed them also; and that, therefore, even those which, in our estimation, are the most formidable or the most vile, have a use, and an important use, in His sight; that only our ignorance prevents us from finding out and admiring that use; and that the wanton destruction of any one being, is in truth a crime. Before we can have any title to accuse any animal of cruelty, we must first suppose it to be, which it is not, endowed with reason, capable of judging of right and wrong—a human being and not an animal. "Do the young lions roar when they have food?" asks the inspired penman; and the same question may be put with regard to every animal in the creation. Certain propensities, which we call instincts, lead each animal to pursue the course that it does, and the lion and the wolf are no more guilty of cruelty than the lamb and the turtle. Admitting that neither of the latter feeds upon animal substances, which in the case of the turtle is not the fact, they cannot subsist without destroying vegetables; neither can they consume their vegetable food without destroying those myriads of minute animals with which every leaf is peopled. Every kind of life is supported
by the destruction of some other kind; and the same power which confers the means of continuing the different races, prepares for such the means by which it is to be destroyed. Hence, if we are to look upon creation with eyes of wisdom, we must look upon it as a whole, and as the harmony with which all the parts are balanced. If we find any race or tribe that has a great number of enemies, we invariably find that that tribe is prolific in proportion to the number of its destroyers; so much so, that it would increase to its own destruction, from the want of the proper kind and quantity of food.

This holds in every region of the world, and among vegetables as well as among animals. In countries where the influence and operations of man have had but little effect, we can trace the most beautiful adaptation in the structure and habits to the nature of the country. If that is a plain of great extent, and affording pasturage at all times, the larger quadrupeds are usually some of the ox or buffalo tribe, as we find in the plains of India and the Savannahs of North America. Those animals, from their unwieldy gait and their great weight, are not adapted for leaping or for taking long journeys in quest of food. If the plains be subject to seasonal parching, we find the race different; and lighter animals that can migrate in quest of food, and bound across ravines, or from rock to rock upon the mountains, are the most abundant,—as may be observed in the Llanos of South America, and the plains of Southern Africa. If the land be inclined to permanent sterility, or if it be stony, alternating with swamps and marshes, either
constantly, or at certain seasons of the year, we find the animals undergo another change,—they are calculated for leaping or wading, as is the case with the ostrich on the borders of the great African desert, and the emu and the kangaroo in New Holland.

This adaptation is not confined to any one race, or to any one instinct of the race: it applies to them all, and to all their habits. Some of them are not a little singular. On the continuous plains, whether these be adapted for occasional or for constant residence, the young animals are left to use their own legs from the time of their birth; but when the country consists of patches, and there must be, as it were, daily marches, the mother is provided with a marsupium, or pouch, in which she can carry her young until they have acquired size and strength adapted to the nature of the ground upon which they are to find their food. This is the case with the kangaroo; and indeed with most of the quadrupeds of Australia,—with all of them that can be considered as native, peculiar to that country, and as singular as it is in its geography.

Where there is herbage, whether permanent or seasonal, we find animals that browse herbage; where there are many native fruits, we find animals that can live upon trees; and where there is a tendency in hard and prickly plants to overrun the ground, we find elephants, and other animals that consume these. Thus every vegetable-consuming animal, by consuming one kind of vegetable, gives scope for other kinds; and thus yields food for other animals. Each has its destroyer; each has also that which it fattens; and these are so balanced, that the whole conduce to good. While
they do so, they remain; and where there ceases to be a necessity and an office for them in the economy of nature, they cease to exist, and new races, adapted to the change and circumstances of the place, occupy their room.

The means of production and destroying are also balanced in a very wonderful manner. When man takes possession, he becomes the grand destroyer,—his arts and arms, and especially the use of fire, of which he is the only creature that can take advantage, are superior to the strength of lions, the wings of eagles, and the coilings and fangs of serpents; and accordingly, the wild beasts vanish before him, and return again when he retires. The lion, which for many ages had not been found in Bengal, is said to have, of late years, reappeared in some parts of that country, which have been depopulated and are degenerating into desarts.

But, independently of any reference to man, there is an admirable balance between the destroyer and the prey; both races thrive equally, and thus show that, in the general purpose of creation, the one has been made for the other. In the warmer parts of Asia and Africa, where not burnt up and converted into sand, large quadrupeds breed very fast, and are of numerous kinds, and it is there that we find the most formidable of the beasts of prey. In tropical America, large quadrupeds are not so numerous; and the beasts of prey are not so powerful,—the puma is much inferior to the lion, and so is the jaguar to the tiger. In New Holland, where, from the sterile nature of the country, there never could be many large animals,
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there is no native beast of prey worth naming. The
dog is, probably, not a native, and he is not a very
powerful animal at any rate; and the dasyurus, which
has been found on that island, is very rare, and is in
size not superior to a cat. In the adjoining island of
Van Dieman's Land, where the herbage is naturally
better, the animals of prey are a little larger; but
neither of the two species of dasyuri that are found
there, is more powerful than the fox.

Thus, if we leave our own notions out of the case,
and take nature just as we find it, there is perfection
in all its parts and all its forms; and from the smallest
moss that consumes the damp upon a wall up to the
king of the forest, at whose roaring all the other
inhabitants quake, all is beauty; and the same exqui-
site wisdom and astonishing powers are everywhere to
be found.

But this lesson is not confined in time any more than
in space. According to those laws of inorganic matter,
which have been proved beyond the possibility of con-
tradiction, or even doubt, the surfaces of countries
must in time undergo changes, unless when these are
prevented by the exercise of human industry. When
the summer heat partially melts the snow upon high
mountains, the water thus produced must insinuate
itself into the seams and fissures of the rock, upon
even the highest peaks where there is no soil to be
washed down; and when the frost comes in winter,
the water which has thus lodged itself must crystallize
into ice. In doing that it expands, or occupies a larger
space,—not very much larger, but it expands with a
force greater than any known resistance; and the frag-
ments that are thus loosened, must ultimately be separated, and fall by their own weight. In like manner, the rain that falls upon lofty places must wash down the softer and less compact soils; and thus it may be asserted, that, from the necessary action of the weather, there is a continual tendency to flatten the general surface of the earth. The process is, no doubt, a slow one, but it is sure; and there is no part of the world without some traces of its effects. In the champaign counties of England, the pavements, altars, and other remains of the Romans, are invariably found below ground. In the soft lands near the mouths of the large rivers, and also under the peat-bogs, the ruins of former forests and former animals are abundant, and diffused over all parts of the country. It is true that some of the surfaces (those of the peat-bogs in particular) have the power of elevating themselves, as the mosses with which they are covered decay at the root while they are growing at the top; and they powerfully retain humidity, by the presence of which both operations are so much facilitated, that a depth of many feet has been found in the memory of one individual. Other instances occur, however, where no such assistance could be obtained. In cutting the Caledonian canal, from the Moray Firth on the east side of Scotland, to Fort William on the west, the implements and weapons of a former people were found at the depth of more than twelve feet, beneath a covering of loose stones, intermixed with very little even of sand, and exhibiting hardly a trace of vegetation, except the scanty covering upon the surface.

Another class of revolutions, of which there are traces
in all countries, and which must change both the plants and the animals, is the destruction of lakes and pools. In mountainous countries, that arises from the rivers which are discharged by the lakes. The beaches which had once been the margins of the water, can often be traced along the sides of valleys that are now dry, or which, at most, contain but a small rivulet; and in other cases the river, after having mined its way through the softer strata, is arrested by hard rock near the lake. Scotland, Wales, Switzerland, the slopes of the Andes, all mountainous countries in fact, abound with instances of this description; and those countries which at one time were nearly covered with water, are so completely drained by those natural changes, as at another to contain hardly a drop, and thus become deserts: in which state both their plants and their animals must undergo a change.

Sometimes, again, the land becomes parched through the want of rain, to such a degree that the plants are all withered, and the rain, when it does come, does not penetrate into the soil. When that is the case the quality of the vegetation changes, and in extreme cases, wholly disappears. In the progress of this change, as plants become fewer in number, they become strongly impregnated with salt. The oil and water which they contain are dried up by the heat, and the charcoal, alkalis, and acids unite into new combinations, which are unfavourable to ordinary vegetation. The acridity augments, and at last nothing is left but a barren sand covered with a crust of salt.

We have one of the most remarkable instances of this kind of change on the northern parts of all the con-
tinents. There there are traces of many animals that do not now exist, but which have certainly existed along with the races that now inhabit the same regions, because their remains are found together in collections of matter that have not been subjected to any other change than that produced by ordinary accumulation. Besides those animal remains that are imbedded in the different strata of rocks, and among which, though care must be taken not to confound skeletons that are more changed and mutilated with animals originally less perfect, there is a sort of progressive character from simpler to more complex. There are animals which, from the situations in which their remains are found, cannot have been extinct anterior to any great or general revolution of the globe. Of these, the most remarkable are a species of elephant, one of rhinoceros, and one of hippopotamus, which appear to have been pretty generally diffused over the cold, or at least the temperate parts of the northern hemisphere. The tusks, teeth, and other bones of an elephant, are found in soft deposits, such as clay, mud, and marle, or under peat-bogs. They have been found in many parts of England, in Scotland, and in Ireland; and the remains of the rhinoceros and hippopotamus are found in the same kind of situations. In the clay formation at Brentford, in Middlesex, at no very great depth below the surface, we believe the remains of all the three have been met with; and from their being found near situations which are frequented by the living species of accompanying fossil animals, and also in many stages of their growth, there remains not a doubt that they subsisted in the districts that now contain their bones.
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When attention was first directed to those great bones, the opinion was taken up, probably a little too hastily, that they belonged to the identical species that are now found existing in the tropical regions; and the conclusion was, that they must have existed anterior to some mighty convulsion of the globe, which had blended in one mass of ruin the productions of all its zones. The nearness to the surface at which these remains were found, and the soft substances in which they were imbedded, rendered it impossible to refer them to any very remote period, or their covering to any thing else than the accumulation of clay or mud by water, or the growth of peat. The vulgar opinion referred them to the deluge; but that did not agree with the facts. The bones themselves showed that the species were not quite the same with the existing ones; and there was an inconsistency in supposing that the elephant of the warm countries should have escaped that catastrophe, while that of the temperate was lost. Besides, wherever the bones occurred, the debris over them appeared to have been accumulated gradually, by deposits from rivers, or in caves, or by the growth of mosses and other plants.

These circumstances led the more observant and reasoning naturalists to conclude, that, without any necessary intervention of a deluge to drown them, or to waft them from the regions of the equator, these animals had, at one time, lived in the same countries in which their bones are found; and this conclusion was further corroborated by the fact, that, though these remains are found in North America, there is no trace of an Elephant in the tropical part of that continent. In
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the year 1799, actual observation established the truth of these conjectures, by the discovery of an entire northern elephant imbedded in ice at the mouth of the river Lena, in Siberia. It would have been easy to argue that an entire elephant, from the warmer parts of Asia, could not possibly have been conveyed to the mouth of the Lena by any deluge; because, whether it had come across the lofty mountains and the Table-land, or by the more circuitous way of the sea, it must have been dashed to pieces, and the soft parts decomposed by maceration in water, before half the journey was accomplished. But there was no need of arguing; for the covering of the animal was not a defence against heat, like the naked dark skin of the tropical elephant, but a defence against cold. It was covered with three kinds of hair: one, black bristles, about eighteen inches long; another, brown hair, about four inches in length; and the third, close, reddish wool, not above an inch long. This being the very winter-clothing of animals of the cold countries, left not a doubt that this individual kind inhabited Siberia; and if that was the case, those of England, North America, and all the other countries where their remains are found, must have done the same. The elephant of the Lena was a large animal,—sixteen feet four inches long, and nine feet four inches high; the tusks measured nine feet and a half along the curve, and weighed three hundred and sixty pounds. The head and tusks together weighed nearly eight hundred pounds. From this we can see that nature needs no violence, no general suspension of her operations or order, to effect the extermination even of the most powerful of her productions, when their pur-
pose is accomplished, and their existence in any particular place is no longer required; but that wherever any one is needed, there it is found, and where there is no longer necessity for it, it vanishes from the catalogue.

These, and a number of other changes, produced gradually, or instantly—as in the case of earthquakes, volcanoes, or inundations—alter the appearance of the country, either upon a large scale, as respects long periods, or upon a small scale, as respects short ones; but amid them all we find nature true to her general principle, that "in like circumstances the results will be similar;" and the more extensive that our information is, the more are we convinced that nothing is the production of chance, but that the whole is governed by laws which evince wisdom that we may admire, but dare not imitate; and that so universal and uniform are those laws, that what we in our ignorance consider to be breaches of them, are proofs that they are always obeyed.

It is in this way that we are enabled to look up from nature to the Author of nature; and if our information be of sufficient extent, nay, if it be but sound as far as it goes, we can no more doubt or deny the existence of a creating and preserving God, than we can doubt or deny the fact of our own existence. Nature is infinitely diversified, and yet each production makes its appearance at the time, and under the circumstances, which we would be led to expect. A plan which is so perfect and so harmonious, of which the parts are so diversified, and yet which so mutually promote the existence of each other,—which blend the sea,
the land, and the air, into one whole,—and which, though always perishing, are always being produced,—offers a field of contemplation which the longest life and the most active mind cannot exhaust; and it has the advantage over every other subject of study, as it presents or awakens none of those bad passions and imperfections which always present themselves when man and his works are the objects of our inquiry.

It has this farther advantage, that the details are just as interesting as the whole; that the subject which is too small to be seen by the naked eye, is just as perfect in all its parts, and as wonderful in the use of them, as that which is of the most ample dimensions. The little green moss that is as a pin's point upon a wall or the bark of a tree, or the fungus that makes a barely visible speck upon a leaf, is as perfect in its structure, and as full of life as the pine or the oak that rises majestically over the forest, and exhibits itself to an entire county at once. The aphis, that hardly crumples the rose leaf, or the animalcula, of which myriads do not render a drop of water turbid, is equally complete, and, in some respects, much more curious than the horse or the elephant. Of the aphis, nine successive generations, all females, succeed each other every summer, and yet each produces a numerous progeny; and some of the animalculæ increase in number by a spontaneous division of the little bodies of those previously existing.

In order to understand any thing of the subject, we must, indeed, study the small as well as the great, the common as well as the rare. The rarest and the most majestic of animals, cannot tell us more than the worm
that we trample under foot, or the caterpillar that we destroy as a nuisance. Nor does the utility diminish with the size. Silk, the finest substance with which we are clothed—carmine, the finest colour with which we can paint, and the very ink with which we write, are all the productions of little insects.

When we are acquainted only with the larger animals and the cultivated vegetables, (and a very great number of persons, who would be very angry if we were to accuse them of ignorance, know very little about these,)—we may be said to know absolutely nothing about the works of creation. Indeed, the study of the domesticated animals in a state of confinement is not the study of nature at all: it is the study of art, by which nature has been in so far supplanted. To obey the bit and the spur, is no part of the natural disposition of a horse; to fawn, and watch, or catch game for a master, is no part of the natural disposition of a dog; neither is it the natural disposition of the cow to come lowing in order to be drained of that with which nature provided her for the nourishment of her own offspring. These and all the other matters, whether useful properties or idle tricks, which make up nine-tenths of the published biography of animals, are not animal biography at all. They are merely instances of the triumph of human art over the natural propensities of the subjects upon which it has been exercised,—very important as they lead to useful applications, but still mere art, and tending to close rather than to open the door to the proper study of nature; and it is only in proportion as the animals resemble man, by possessing the faculty of teachability, which is the badge and
character of reason, that those things can be said of them.

The unreasoning productions of nature, whether animal or vegetable, need no teaching. Those powers which are given them for the maintenance of their being, are perfect; and the farther they recede from man, the more astonishing is the perfection. We read of old lions teaching young ones to rend their prey, of old eagles teaching their young ones to fly in circles and to stoop on their quarry; and that animals may have been found in situations that would tempt those who look upon every part of animal conduct as if it were human, to come to such conclusions, is very possible. But any such means are unnecessary; for whatever may be the natural habits of the animal, it will assume them with the most unerring certainty, though it has never seen them practised. Nobody ever heard of a cat being complained of as a mouser, because it had been separated from its mother before she had initiated it in that art. Ducklings that have been hatched under a hen, take to the water, in spite of all her warnings to the contrary. The cuckoo, when hatched by the hedge-sparrow, turns all its companions out of the nest; but the sparrow, true to her instinct, feeds and cherishes the unnatural intruder; while it, equally true to its instinct, flies to pass the winter in unknown regions without a guide, and returns the next season to deposit its egg in perhaps the nest of its foster-mother. As we descend in the scale, the instinct becomes still more perfect,—at least still more wonderful. The fly deposits its egg in the substance which is best adapted for nourishing its young, whether that be a leaf, a tree,
a piece of wood, the earth, the water, a putrid substance, the body of a living animal, or that of another insect. The species of tree or of animal is never mistaken. The *pulex penetrans*, or *chigoe* of the West Indies, deposits her progeny in the human body. The *oestrus bovis*, or gadfly of the ox, seeks no nidus for hers, but beneath the skin of that animal; and that of the horse, fastens her eggs to the hair of the animal, and then tickles and irritates the skin in such a manner as that it may, by applying its mouth to the place, take the eggs into the stomach. Even in those cases where the animal, or egg, or whatever else is to be the nidus, and supply the food, is to perish by the operation, the destruction does not take place until the young animal has perfected its growth, and escaped, to pass into another state.

In their mechanical structures, whether for their own habitations, for their young, or as snares to assist them in procuring their food, we have still the same uniformity. In those that form themselves into societies, as the beaver, the bee, and the ant, we find the one assisting the other; but we never find any teaching, or any need of it. Beavers build all in the same way, in similar situations, and, where they can procure them, of the same materials. All bees, of the same species, construct their cells in the same form; and if their wax and their honey be not exactly the same, the difference may always be traced to the plants from which those substances are collected. In all these wonderful habits they are perfectly regular. These form part of the grand system of which the elements and the seasons form a part; and none of them varies
any more than a stone ceases to fall to the earth when unsupported in the air. Man requires the union of favourable circumstances, and the experience of generations, before he can construct a decent dwelling, or find a constant supply of food; and yet he sometimes forgets that Being, at whose single and instantaneous word or pleasure those thousands of creatures, and their millions of instincts, came into existence, in perfect regularity, amid continual change, requiring no new effort and no repair; but passing from life to death, and from death back again to life, in one wonderful succession, until it shall please Him, who in one moment spoke them all into being, to speak them all out of it in another.

But it is not in this view alone that the study of nature is the most pleasing and profitable. In contemplating the structure of any plant or any animal, however common, and however, upon that account, disregarded or overlooked, we may find finer applications of mechanical art, and nicer processes in chemistry, than the collected art of the whole human race can boast of. That the vegetable principle in an acorn should be chemist enough to fabricate oak timber, and bark and leaves and new acorns; and mechanic enough to rear the tree in the air against the natural tendency of gravitation, and in spite of the violence of the winds, and do all this by means of a little portion of matter, that can be kept for a considerable time as if it were dead, is truly astonishing. It is equally demonstrative of power and wisdom in Him who gave the impulse, that out of the same soil and the same atmosphere each plant should elaborate that which properly belongs
to it; that the flower of one plant should be crimson, that of the next yellow; that one should delight us with its perfume, and that the very next one should offend us by its fetor; or that a food, a medicine, or a poison, should be found the closest neighbours. Nor is it less singular that light, which is so necessary to the growth of plants that without it they lose those substances upon which their colours depend, and become pale and sickly, is unfavourable to the germination of seeds. And yet the matter is no prodigy, but depends upon principles which hold true in the animal and the mineral kingdom as well as in the vegetable. The moisture and the exclusion of light bring on a fermentation, in the course of which, the farina of the seed is converted into sugar; the very same process by means of which malt is made out of barley. The colouring matters again are all oxides, or combinations of oxygen, in some way or other, and have a very great resemblance to the artificial colours which chemistry has taught mankind to prepare. The colours of all flowers are more intense in fine sunny weather; the skins of the inhabitants of warm countries become dark; those who are exposed to the sun in summer, become brown.

In this single department of one of the kingdoms of nature, we have thus not only a fund of the most curious information, but of information that is practically useful at every step. Even from the mere form of vegetables, we have some of the choicest of our ornaments, and have taken some of the most useful hints in our architecture. The engineer who first succeeded in fixing upon the dangerous rocks of Eddy-
stone, a lighthouse that resisted the violence of the sea, moulded its contour from the bole of a tree which had withstood the tempests of ages; and the model was found so admirably adapted to the purpose, that it has been copied, in similar cases, ever since. Even in the more slender plants, that climb upon other plants, or upon walls, the apparatus with which they are furnished is the very best adapted for the purpose. They coil round the stem, they lay hold by their spiral tendrils, or they are covered with little knobs which are the rudiments of roots, that insert themselves into the smallest crevices, and, when once there, so swell and expand, that they break before they can be removed.

The means that they take to secure the succession are equally wonderful in themselves, and in the way in which they harmonize with the rest of creation. The honey that is contained in the nectaries of so many flowers, and which finds so many insects in food, is one certain means of preventing the loss and degeneracy of the plants. The perfecting of the seed depends upon the application to the pistil, or little tube that stands on the rudiment of the seed-vessel, of the pollen, or powder, generally of a yellowish colour, that is contained in the anthers, or little knobs upon the top of the filaments. That powder, in many cases, consists of little hollow balls, which are filled with an air or gas, similar to that with which balloons are inflated; and which enables them to float in the air until they alight upon the pistils. Sometimes those two parts are in the same flower, sometimes in different flowers upon the same plant, and sometimes upon different
plants. Wheat is an instance of the former, on the ears of which the anthers may be seen, in the summer, like pieces of yellow dust. The farmer calls these the bloom, and when heavy rains fall at the time they are upon the ears, they are washed to the ground, and in consequence, many of the grains never come to maturity, but remain empty husks. Fine sunny weather appears to be the best for this operation of nature, as it expands the grains of pollen, and causes them to float, and also to burst when they come in contact with the pistils, which is also a necessary part of their economy. The filbert or hazel is an instance of two sets of flowers upon the same plant. Those that are to produce the pollen make their appearance in the latter part of the season, while those from which the nuts are to be produced, do not appear till the spring following. The willow, the hop, and the juniper, are instances of the two on different plants.

The volatile or floating nature of the pollen performs among plants an operation which, from experience, mankind have found to be very advantageous, not only with cultivated vegetables, but with domestic animals. It has been found that if the same vegetable be cultivated on the same field, or the same flock continued on the same pasture, for a number of successive crops or generations, their quality degenerates; and if continued long enough, they would die out. Something of the same kind happens to the human race; for there are many well-authenticated instances where, in consequence of a few families intermarrying only with each other, both the bodies and minds of
their progeny have degenerated, age after age, till at last they have become extinct.

Now by the floating of the pollen, and the carrying it from flower to flower by insects, the pollen of one plant is often applied to the pistil of another, and the race prevented from degenerating. In some instances this produces a little confusion. Thus, if cabbages and turnips, and greens and cauliflowers, all blossom together in the same field, the seeds are apt to be confounded, and produce different plants from those on which they grow. It is the same with fruits and berries, and also with flowers. The pips of apples, the seeds of gooseberries, and those of the garden-flowers that are sown in beds, produce many sorts, and of those some are altogether new. In gardening this is attended with considerable advantage. Seedling pinks, auriculas, and other flowers, are often obtained of much greater beauty than the parent plants; and some of the best strawberries and apples have been procured by the same means.

But, in the forms and habits of vegetables, curious though they are, we have only what may be called the still life of nature; and it is only when we turn our attention to animals, that we feel it in all its wonders. The plant remains in one place, drawing its nourishment from the earth below, and the atmosphere around; and when these do not afford the proper quantity and quality, the plant languishes and dies. But among animals we find all the instincts and apparatus of locomotion, as well as instruments and arts necessary for the obtaining of that upon which they live. Their motions are of every degree of swiftness,—from that of
the swift, equal to, at least, two hundred and fifty miles in an hour—or to be in England at six in the morning, and in Africa before noon,—to some of the crawling reptiles that cannot pass over half the number of inches in double the space. Then we find them calculated to move through many kinds of media,—through the air, through the water, under the earth, into the substance of timber, and even of stone. Nor does the apparent size or strength appear to signify much; for with the exception of the points of the piercers that enable them to mine their way, the bodies of the animals that work into the hardest substances are generally soft as well as small. Their passages too are made over all sorts of surfaces, whatever may be their texture or position. The water-flea, (*gyrinus natator*), whirls his fairy circles on the pool, with the same ease and the same rapidity as if he were moved by the wind in free space: and when a number of them are gam-bolling upon a glassy pool, they seem, as the exquisite gloss of their black wing-cases glitters in the sun, as if they were sparks of fire rather than living creatures that can move only in consequence of muscular action. The gentle ripple that follows their course, as they wheel and play together, seems to be occasioned rather by their agitating the air than by any action of theirs upon the water, and the glitter of the wing-cases is so constant that in those gyrations, from which they get their specific name, their wings can hardly be used; and yet, small as they are, they must have the means of covering their feet and bodies with an oily coat, to repel the water, in the same manner as ducks and other water fowl preserve their feathers from the same element.
The number of springs and paddings upon the feet of animals, by which their fall is broken, and their bodies prevented from being injured, when they alight on the ground, after rapid motion, with the hooks, and pumps, and suckers, by means of which they are enabled at once to fasten themselves to the smoothest surfaces, though perpendicular, or even the under sides of horizontal ones, are truly wonderful; and no one can examine the structure, or even watch the motions, of a common house-fly, without perceiving that in science of design, and elegance of execution, it is superior to all the engines that ever man invented. The moment that its little feet touch the surface, they adhere, by the action of two small webs or membranes, one on each side of the foot, which touch the surface, first in the middle, and then gradually to the outsides, so as to exclude the air; and as the weight of the fly is connected to the middle of each sucker, they never miss their hold, until it relieves them first at the outsides. Thus we have a series of motions all perfectly explainable upon the established doctrines of matter, as indeed all mechanical contrivances for the motion of matter must be, whether the work of nature or of art. But all this, which in the hands of the most expert mechanic, would require a considerable time, is done by the fly in an instant. In all animals that bound and leap by rapid motion, the padding of the feet, which is formed of a substance not very unlike Indian rubber, is of the utmost importance. The foot of the horse may be taken as an example. When the horse bounds forward, the point from which he takes his spring is the fore-part of the hoof, because that takes a firm
hold of the ground, and also gives him the advantage of the whole power of the foot and leg; but when he alights it is upon the padding at the heel, by means of which the violence of the fall, which if received on the tip of the hoof, and with the bones in one extended line, would sprain the foot, and probably split the hoof, is prevented, and the strain is thrown upon all the joints of the foot. The human body, being composed of matter, as well as the bodies of other animals, has its motions regulated by the same laws. Those who walk well, raise their feet upon the toes, by which means the foot as well as the leg is brought into action; but if one were to alight upon the toes after a leap, a sprain would be the consequence; when alighting, the flexor muscles that draw up the foot, are contracted, and the extensors and tendons in the hind part of the leg made tight by the projection of the heel; and thus the body falls, as it were, upon a spring, which gradually relaxes till the toes touch the ground; and as the heel is more padded than any other part of the foot, the fall is rendered much less violent. So strong is this natural tendency to plant the foot upon the heel, that the majority of people do it even while walking slow, when it fatigues rather than assists; and accordingly one of the hardest lessons that military men have in teaching a recruit to march gracefully, is getting him to "point his toes." The clownish motion of rising much upon the toes at every step, and dodging down upon the heel, besides being ungraceful, is fatiguing, as there is twice as much motion in the joints of the feet, and twice as much raising and letting down of the body, as there is any occasion for.
The motions of flying and swimming, and the means by which an animal can so alter its specific gravity or weight, in proportion to its bulk, as to be able to ascend and descend, and also to float in mediums of different densities, are still more curious than those of progressive motion along the earth. They are performed partly by the muscular power of wings and fins, and partly by the help of air-cells and air-vessels, which the animal can expand or compress at pleasure; but their principles, as they involve a mechanical and pneumatic action at the same time, are rather more difficult to explain. By observing the habits, and examining the structure of the animal, we may however obtain some knowledge of them; but in the most interesting parts of the study, that of the instincts and dispositions of the animal as a living creature, we can infer nothing but that two animals, which are exactly alike in their structure, will be of the same disposition; and though that be a very general rule, as established by experience, it is not universal.

Hence the only sure way to become naturalists, in the most pleasing sense of the term, is to observe the habits of the plants and animals that we see around us, not so much with a view of finding out what is uncommon, as of being well acquainted with that which is of every day occurrence. Nor is this a task of difficulty, or one of dull routine. Every change of elevation or exposure, is accompanied by a variation both in plants and in animals; and every season and week, nay almost every day, brings something new; so that while the book of nature is more accessible and more easily read than the books of the library, it is at the same
time more varied. In whatever place or at whatever time one may be disposed to take a walk,—in the most sublime scenes, or on the bleakest wastes,—on arid downs, or by the margins of rivers or lakes,—inland, or by the sea-shore,—in the wild or on the cultivated ground,—and in all kinds of weather and all seasons of the year,—nature is open to our inquiry. The sky over us, the earth beneath our feet, the scenery around, the animals that gambol in the open spaces, those that hide themselves in coverts, the birds that twitter on the wing, sing in the grove, ride upon the wave, or float along the sky, with the fishes that tenant the waters, the insects that make the summer air alive,—all that God has made, is to us for knowledge and pleasure, and usefulness and health; and when we have studied and known the wonders of his workmanship, we have made one important step toward the adoration of His omnipotence, and obedience to His will.
CHAPTER II.

THE MOUNTAIN.

This mighty and majestic feature of nature inspires the beholder with a feeling of immensity and power, like that which arises when he gazes on an interminable desart or a boundless ocean. No eye, however uninstructed, and no heart, however steeled, can fail to have been impressed by a sense and a feeling of the sublime and the awful, as he beholds those huge and mysterious bulwarks; towering through the air, like pyramids connecting earth with heaven,—their sides girdled with the forests, and their summits crowned with the snows of a thousand years. Whether we look upon them from the plain, rearing their dark and giant forms into the regions of the sky, and flinging down their cataracts with the resistlessness of time and the roar of thunder,—or wander amid their vast solitudes and horrid wastes, listening to the rush of the wind among their pine-organs, startling the eagle from his eyrie, and intruding upon the birth-place of the storm; and glancing down through some cleft in the clouds, far below us, upon the earth, which we seem to have left, with its towns and rivers lying like the painted dots and lines upon a map,—we are alike struck by a revelation of won-
ders, before which the spirit falls prostrate, and acknowledges that, with a presence which there is no doubting, "God is" indeed "here."

But, it is not to be imagined that these mighty evidences of an immortal workmanship are idle and unnecessary excrescences upon the otherwise fair and even surface of the earth which they overlook; or that their wildernesses are set apart as the dwelling-place of desolation, or their caverns as the home in which the "blackness of darkness" abides. It is not to be supposed that nature, (all whose other schemes are so replete with a visible beneficence,) where she has worked upon her mightiest scale, has worked idly or ill; or that she has created a machinery before whose stupendous materials and motions the feeble imitations of man are as the productions of insignificance, but in the service of him to whose good her minutest operations tend. To say nothing of the stones, crystals, and metals which they contain within their womb,—to say nothing of the animals which furnish food or clothing to man, that wander by their torrents, or start amid their echos,—to say nothing of the timber which hardens on their sides, or the fuel which forms in their hearts,—not even to mention the medicinal plants which owe their birth to the chill air of these upland wastes,—nor the thousand other benefits which man, in his civilized and social state, gathers from these great garner-houses,—they are the reservoirs from which the world is watered, and the fertilizing principle shed abroad throughout the earth. By a process infinitely designed and beautifully framed, working with immensity as unerringly as if it were with atoms, the
peaks of the mountains are fitted for the arrest and distillation of the clouds which gather round and overhang them, making half their mystery and horror; and their interior is formed into a thousand basins and canals in which the waters are gathered, and by which they are poured out, in streams of life and with voices of gladness, through the plains. By that beneficent working which, "from seeming evil still educes good," the waste of glacier and the wilderness of snow send forth, upon their triumphant paths, the Rhine, the Danube, and the Nile; and of the apparent desolation of the mountains, are born the beauty, the glory, and the fruitfulness of the earth.

But, to the eye of science, they present yet another source of interest and gratitude, scarcely less important. Piled up as they are, like huge portions of the central earth, flung out by some antediluvian convulsion, and with their sides laid bare by the violence of tempests, and exhibiting the naked strata of which they are constructed,—they enable us to investigate many of the secrets of that earth on which we tread, and which must, otherwise, remain concealed, within its inaccessible depths. They are like vast warehouses, in which nature has congregated samples of her works for the inspection of science;—like libraries, written by no mortal hand, in which may be read her mysteries, by those whom study has made acquainted with her language. By a careful perusal of their construction, and of the materials of which they are composed,—by observation of their various phenomena, and of that of the atmosphere by which they are surrounded, together with the relative influences of each upon the other,—we may, at
length, discover the mechanism of the earth, and the grand problem regarding the formation of the world may be, one day, solved.

Though the wild deer is now the only remarkable animal of the chase among the mountains of Great Britain, yet the bear and the wolf have had their dens in common with other beasts of prey, now only found in other countries. The brown bear (*ursus arctus*) which is still formidable in more northern regions, and even in Germany and France, once infested this country. Those animals were so powerful in the days of the Romans that (as Plutarch informs us) they were transported to Rome; and though the efforts to exterminate them were unceasing, and their destruction was accounted one of the noblest triumphs of the daring, yet they appear to have held their place till a much later period. Tradition says, that in the year 1057, a Gordon vanquished so fierce a bear that he was permitted to wear three bear’s heads in the quarterings of his arms as an achievement of honour. The tradition may not be literally true; but the very existence of the tradition is a proof of that of the animal. It is corroborated too by many circumstances connected with the honours of families in Wales and Scotland, where pedigree and tradition reach much further back, and are much more full and circumstantial in their details, than in England. “Beware the bear,” though allegorical in the case of the “Baron of Braidwardine,” was often a real note of precaution in the forest-hunts of both ends of the island; and, probably, notwithstanding the zeal and ardour with which both the bear and the wolf are said to have been hunted, their extirpation in the remote
parts of the country may have been fully as much promoted by the destruction of the woods which afforded them shelter and prey, as by all the exertions of man.

There is evidence that at one period of its history, the island was inhabited by a bear of much more formidable size than the brown bear which is still found on the continent. That is the Cave Bear, (*ursus speleus,* ) so called, because as a living animal it is now supposed to be every where extinct, though its remains have been discovered in several of those great caves, in which the bones of animals not now met with alive, are often found. Those remains occur in several places of England, and give evidence that the animal of which they are now the only monument, must have been at least the size of an ordinary horse.

The *wolf,* though now extinct, comes down much nearer to the present time; and seems to have been peculiarly abundant in the times of the Saxons. The cold time of the year, when the food of the wolf in his native forest fails, is still the season at which he most boldly attacks domestic animals, and sometimes man himself. The Saxons called January, *Wolfen moneth;* but whether they invented the name after they came to England, or imported it from Germany, does not appear; though from the number of names in Germany that are compounded of *wolf,* the probability is that they brought the name from that country. In the tenth century, the number of wolves in England is supposed to have been very much thinned, in consequence of a law of Edgar, which commuted certain punishments for a fine of so many wolf's tongues. In
1680, Sir Ewen Cameron, of Lochiel, is said to have killed the last wolf in Scotland; that in Ireland fell within thirty years after; but neither the time nor the final extirpator for England is mentioned. The remains of the wolf, in England, have not, so far as we know, been met with, except in the monumental caves to which allusion has been made; and along with them sleep the remains of other two extinct species, a tiger about the size of the Bengal tiger, and a hyæna about the size, and resembling in the skeleton that of Southern Africa. These two belong to extinct species, and, with the larger bear, appear to have inhabited the northern parts of the old continent about the same time with the extinct elephant, rhinoceros, and hippopotamus. But though all these are gone, there is still in many parts of the country an animal which is very destructive of birds and small quadrupeds, and which, when it can find no means of retreat, sometimes springs at man. That animal is

THE WOOD-CAT.

The Wood-Cat, (*felis catus sylvestris,* ) in the largest specimens that have been met with in places where they have abundance of food, and have not been hunted, is, including the tail, about four feet in length, of which that appendage occupies about a foot and a half. It stands about a foot and a half in height, and measures, in a powerful specimen, nearly two feet round the body. The head is larger, the gape wider, the eyes more fiery and sparkling, and the whole air of the animal more agile, bold, and fierce, than that of
the domestic cat,—though the wood-cat is never considered as any thing but a different variety, and often represented as being the original race from which the domestic cat has been taken.

The habits of the wood-cat are against that opinion; and, so far as we know, there is not any evidence in support of it, farther than the similarity of colour which is found between the wild one and some of the domestic. Among domesticated animals, colour proves nothing; and though it be more to be depended on in those that are in a state of nature, it is not conclusive even there. The wood-cat is a remarkably solitary animal, unless when it comes abroad in the night to prowl. It used to be one of the beasts of chase, and that, with its solitary habits, has now nearly driven it to the fastnesses and wild parts of the country.

The colour of the wood-cat is a ground of yellowish brown, lighter towards the belly; and the head, back, sides, and tail are marked with transverse bars of deep brown and black, in the form of those of the tiger, or rather of the tiger-cat, but more blended together, and consequently less perfectly defined in their outlines. The tail is thicker than that of the domestic cat, and the end of it is blunt, whereas that of the other tapers to a point.

Besides the evidence of form, superior size, and habits, there is some corroboration that the domestic cat is another species, most likely an imported one,—Asiatic in most of the varieties, and certainly so in the Cyprus, or spotted. The wild cat was always a native of Wales; and had the domestic cat been the wild one tamed, it would not have had to be enumerated
among subjects that were worthy of having a price set on them. Yet such was the case. In the tariff of values set down in the Statute of Howel Dda, about the beginning of the tenth century, a cat is reckoned equal in value to every tree after a thorn-tree, among which the oak and the elm, (the native or wych elm, which is excellent timber, and one of the trees of which bows were made,) are included. The Statute runs to this effect:

"A kitten before it can see, its value is one penny;
"After it can see, and till it has caught a mouse, two-pence.
"After it has caught a mouse, four-pence."

The wood-cat does not confine its depredations to mousing, but in places that are near its haunts, kills poultry and lambs and kids, and is even said to destroy sheep, when they are in a weakly condition. As it keeps to the woods and rocky places, the grouse and mountain hares are safe from it; but it makes great havoc among the coppice birds. It is rather a dangerous animal to catch in a trap, as it is very tenacious of life; and the moment it is loosened, it springs, and fastens with great fury. For the same reason it is dangerous to wound or even to irritate it; and if it cannot be killed outright, the safest way is to let it alone.

There is one season at which the wood-cat becomes a determined mouser, more especially on the lower slopes, and in the coppices among the Scottish mountains. When the hazel-nuts ripen and begin to drop, they attract great numbers of the field mouse, (mus
\textit{sylvatica};) and an instinct corresponding to that which brings the mice to prey upon the nuts, brings the cats, which have their dwellings in the holes of the adjoining rocks, to prey upon the mice. As the coppices are in general close, and the mice numerous, the hunting is carried on during the day, and the cats are very bold. They are said to combine for the purpose of giving battle to intruders. That, however, is not well authenticated; but we have had personal evidence that they show front when surprised, and that they will follow yelling along at the top of a precipice, at the bottom of which one is walking, for a very considerable distance; and apparently in great wrath, more especially, if it be twilight. In places where they abound, they are much more dangerous plunderers of poultry-houses than foxes are; as they can climb where foxes cannot reach, enter by a smaller opening, and if they be taken in the fact, instead of making their escape by stealth or stratagem, as reynard does upon such occasions, they spring in the face of those who open the door; and though there is no great danger of their attack being mortal, it is alarming, because unexpected, and the lacerations which they inflict, are not easily healed.

The Highlanders of Scotland, with whom the wood-cat is anything but a favourite, call it \textit{chat phaidhiach}, the raven-cat. The wood-cat, like the rest of the genus to which it belongs, is understood to eat only what it kills, unless when pressed by the greatest necessity. Its range of food is, however, very considerable, as it catches insects as well as birds and small quadrupeds. Its fondness for fish is very great, and notwithstanding the dislike that it has to the water,
because that impairs the action of its retractile claws, it is said sometimes to catch them in their native element. We have never seen it in the act of pouncing upon them in the water; but at a waterfall (that of Kilmorac) in the north of Scotland, where, in the season of the fish ascending the river, we once observed a wild cat for more than an hour, crouching and watching the finny adventurers, though certainly without once making a dart into the foaming stream, which, indeed, from the height of the fall, the volume of water, and the narrowness of the gorge in which it is confined, would have been a daring attempt even for an animal that could swim. In the domestic cat, water sooner injures the fur than in almost any other animal, as its fur is dry, and free from that oily matter by which the skins of many other animals are protected. It is understood to be chiefly owing to this dryness of the fur, that electricity is so easily excited in the back of a cat. Whether the wild one has the same peculiarity has not been mentioned; though, as we have seen the animal exposed to rain, without appearing to feel the same inconvenience as the domestic cat, we should therefore conclude, that the fur has some water-proof quality; and we have observed, that when the skin of the wild-cat was used as a fur, it did not suffer so much from rain as that of the domestic one. A good deal of the difference may, however, be owing to the differences of atmosphere to which the two animals are exposed.

Formidable as the wood-cat is, it is, however, often attacked, and sometimes foiled, by an inhabitant of the same kind of situations,—the Marten.
There are supposed to be two kinds of marten in this country, the common marten and the pine-marten. Of these, one is found chiefly on the south part of the island. That is,

THE COMMON MARTEN.—(*Martes fagorum*).

This species, if indeed it be a different species from the other, and not a mere variety produced by difference of situation, is found in the woods of England, and in the rocky parts of the Welch mountains, especially where they are covered with brushwood. It lodges in hollow trees, and is said to eject other small quadrupeds, and even birds of prey from their nests. Of those it takes possession for its own brood, which are generally about four in number. In its form and appearance, the marten is by far the most elegant of the British beasts of prey; it is also the boldest, the most agile in its motions, and the most powerful in proportion to its size. Its head and body are about a foot and a half long, and the tail about half as much more. It is rather low on the legs, and the form of
the hind ones is strongest; by this structure the animal is admirably adapted for leaping; and there is also great power of motion in the back-bone, by which means it can throw the whole energy of its body into a leap. When moving freely and without any excitement, it is so lithe, that one would imagine there was hardly a bone in its body; but when it is excited, as in the chase, (for it is understood to course hares and rabbits, both by sight and scent,) it shoots along in leaps like the successive discharges of a dart.

The colour of the marten is a brownish black on the upper part, tawny on the under, the throat and breast white, and the head with a reddish tinge. The fur is close and rather soft; but in both respects it is inferior to that which comes from colder climates. The marten is a great slaughterer of game, poultry, and birds; perpetually in motion while awake, and coiled up into a ball and perfectly still when asleep. It climbs trees with great facility; and though it falls even in the middle of a pack of hounds, such is its agility, that it will be in the tree again before they be scarcely aware of its fall. Instead of that offensive smell which some of the analogous animals, such as the polecat, have, the scent of the marten is musky and agreeable, and on that account dogs run very readily at it. Though the instinct of the marten leads it to a very general destruction of animal life, and though in the practice of that it shows great courage and determination, it cannot be regarded as a savage animal. When taken young it can be easily tamed, and in that state it is very frisky and playful; but when any of the animals that are its natural prey come within its reach, its playfulness is instantly sus-
pered, and it springs upon them and dispatches them in a moment.

The art with which many of the wild animals dispatch their prey, without injuring or tearing the flesh, is very surprising, and in none is it more so than in the marten. If the animal be small, or of feeble structure, it is understood by one crush of its jaws to dislocate the neck, and divide the spinal marrow; but if the animal be too large, or the articulation of the neck too strong for that purpose, it fastens on the side of the neck behind the ear, and divides the blood-vessels with as much neatness and certainty, as if it had studied anatomy.

The Pine Marten (*Martes abietum*) differs from the common marten in appearance only by being a little smaller, and having the throat and breast yellowish instead of white; though the latter is said not to be always the case, and is by some supposed to be the effect of age. The pine-marten is most abundant in Scotland, in the wild, wooded ravines of the mountains, where it either builds a nest for itself on the tops of trees, or finds one ready made by dislodging or destroying a bird. This animal is more secluded than the former, and unless at lonely huts near its native woods, it seldom approaches the habitation of man, or interferes with his property. Their habits, as well as the superior thickness and softness of the fur, may be the result of the more rigid climate, as it is found that the marten of countries that are still colder, has finer fur than the pine-marten of Scotland.

But if those circumstances soften the fur, they do
not appear to soften the courage of the animal, for the pine-marten is just as bold to attack, and as stanch as the common marten, if indeed it be not more so. In mountain situations, it not only attacks and vanquishes the wood-cat, but is said, by its stratagem, to bring down the pride of the mountain—the eagle herself, if the first and formidable clutch of her talons does not transfix its vitals. With the cat, it is in a state of open hostility; and often when she is crouching, with her eyes intent only on her prey, and just ready to pounce, the pine-marten will spring upon her, fasten on the vessels of her neck, pin her to the spot, and put an end to her hunting. It is also said that the cat, though ever so much pressed with hunger, will not venture to spring upon the marten. The pounce of the cat is not a death-stroke, like that of the eagle—indeed, death at one blow is not the practice of any of the feline race, from the lion downwards. Catching, crippling, and then torturing to death, is the cat system; and catching a marten, without killing it, by any animal whose throat it can reach, is "catching a tartar." Thus the cat does not willingly attack, but still she knows her enemy, and as she knows that it will attack if she do not, and as she is rather a brave animal, she generally offers battle. The onset is one of some skill on both sides. The aim of the cat is to pounce with her paws upon the head of the marten, in such a way as that the claws may destroy or wound its eyes, while her teeth are embedded in its neck; and if she can accomplish that, the fate of the marten is decided. That, however, if done at all, must be done in a moment, and if it be lost, there is no repairing the mistake. The spring of the
wood-cat is larger than that of her opponent, and the cat takes up her position so that she shall, if possible, alight upon his head with her full spring and impetus. To distract her attention, he keeps moving his head from side to side, and if he succeeds in his object, he rushes to close quarters by a side movement. If the spring of the cat takes proper effect, there is a struggle, but not of long duration; and it is the same with the opposite result, if the cat miss and the marten fasten, during the short pause of exhaustion after the spring. Here we may notice another curious feature in the economy of all the feline race. It has been remarked even of the most powerful of them, that if they miss their object when they spring, they sneak cowardly away, and do not return to the attack for some time, if, indeed, they return at all. Now the fact is, that it is not cowardice, but exhaustion. The gnashing with the teeth and the talons seems to be the reaction by which the motion of the spring is balanced, and the tone of the animal kept up; and if it fail in that, it takes a while to recover the use of its springing muscles. Probably the violence both of the spring and the exhaustion are connected in some way or other with the electric state of the body; but that is a point not easily to be settled. Should both miss, the contest is renewed, and seldom, in the observed cases, (which are not indeed very numerous,) given up until the one be killed; and in a protracted contest, the marten is always the victor, as the cat is first exhausted by the greater weight of her body, and the violence of her leaps. In the year 1805, a gentleman, on whose veracity we can depend, witnessed one of those com-
bats in the Morven district of Argyllshire. In crossing the mountains from Loch Sunart southward, he passed along the bank of a very deep wooded dell, the hollow of which, though it occasionally showed green patches through the trees and coppice, was one hundred and fifty, or about two hundred feet from the top. The dell is difficult of access, and contains nothing that would compensate for the labour; and thus it is abandoned to wild animals, and among others to the marten, which, though the skin fetches a high price, is not so much hunted there as in more open places; because, though they might succeed in shooting it from the heights above, they could not be sure of removing the body. Thus it is left to contend with the mountain cat for the sovereignty of that particular dell, and both are safe, except when they approach the farmhouse at the bottom of the hill. The contest there lasted for more than half an hour, and both combatants were too intent on each other's destruction, to shun or fear observation. At last, however, the marten succeeded in falling upon the right side of the cat's neck, and jerking his long body over her, so as to be out of the reach of her claws; when, after a good deal of squeaking and struggling, by which the enemy could not be shaken off, the martial achievements of puss were ended in the field of glory.

The victories of the marten over the golden eagle, though there be a tale of one of them at every place where eagles and martens are common, are not quite so well authenticated; and wood-cats, pole-cats, and even weasels, which, though lithe and active enough in their way, are certainly nothing to the martens, are often the
heroes of the tale. It runs uniformly in the same manner:—Down comes the eagle in the pride of her strength, slash goes her talons into the limb of the marten, and with a flap of her wings she is soaring toward the zenith. The prey, however, is only scotched; and the marten or the weasel, or whatever else it may be, jerks round its head into the throat of the eagle, and both fall lifeless to the earth. These accounts may be true; but they belong to that class, of which there is a separate edition for every district, and therefore they would need verification by an eye-witness.

But upon the little open glades, and in the shelves of the rocks, by those dashing streams that descend and cut their way in the lower slopes of mountains, there is a fruit more cooling and agreeable than the nut, and it may be obtained without a fear of wood-cats and martens. That is the mountain strawberry, (Fragaria collina,) one of the finest fruits that grow, and one of those that remain longest in season. If the soil of a mountain ravine is good, the aspect warm, and plenty of shelter, it begins to ripen in August, produces abundantly, and continues till it is killed by the winter frost. There are two varieties of it,—the white, which is nearly round, and has the one side tinged with delicate scarlet; and the red, which is of an oblong form, and nearly as dark in the colour as a mulberry. The white is a very delicious luxury; and the red, though a little austere, (all red fruits are mostly so,) has a high flavour. Both may be cultivated, but the red is the most hardy; and they who choose to pay it proper attention may, in mild seasons, have fresh-gathered strawberries to their Christmas desserts. By cultivation, the size increases,
and, some say, the flavour; but those who cull it in its native wilds have the advantage of health and pleasure, in addition to a keenly-whetted appetite, to enjoy it.

This is not the only berry to be met with in such places; for after the coppice is cleared, and the heath arrived at, if it be dry, and the soil tolerable, there is the beautiful myrtle-leaved bilberry, (*vaccinium montanum*) with its fine round berries, of the brightest lustre, and the most intense, though very deep, purple. This delicate berry can bear the keenest blast of the mountains, and where the plant is the most stunted the flavour is the richest. If the soil be inclined to moisture without any admixture of peat, and especially if it be under the shade of a pine forest, which often occurs in such situations, sheltering the bilberry and destroying the heath-plant, the bilberry assumes a more lofty character. The plants are continuous, with leaves the size of those of an ordinary myrtle, and the berries are as large as the black currants of the garden; they are also very abundant, and more juicy than in the exposed situations, though perhaps they have not so rich a flavour. These berries are often considered as a different species from the others, but they are probably only a variety produced by difference of situation. In lonely situations they afford a welcome harvest to the mountain birds. The bilberry is produced so abundantly in some places that, in passing through the bushes, one may gather handsful without stopping; but it is tender, and soon becomes sour. Where it is abundant, it might probably be made into wine. Upon the lofty parts of the heath, the cow-berry (*vitis idaea*) is now to be found; the bush is low and hard, and so is the berry, which, notwith-
standing its fine red colour, is generally left to the birds. In the bogs, at about the same elevation, the cranberry, or crowberry, (*oxyccocus palustris,* is very frequently met with, but it is harsh and austere.

On the margin of those pools that occur in the courses of the streams, as one approaches a mountain, especially if the pool be surrounded with foliage, and also on the sides of the little tarns or lakes, when they are in sheltered situations, one meets with what would hardly be looked for, a perfect inundation of gnats. It is true that, during the very warm summers, the sides of the rivers and lakes in Lapland are much more infested with those troublesome and noisy insects than countries that lie farther to the south, and have a much milder winter. From this it would appear that the severity of the weather does not injure the eggs of the gnat; and indeed the instinct of the little creature guards against any such injury, as the young continue in the water till they assume the winged form, under which they buzz and bite during their short aerial existence. The water, even in that state, cannot acquire a very low temperature; and as, generally speaking, the pools and lakes in those countries are of sufficient depth to prevent the whole from freezing down to the bottom, even in the most rigorous winters, myriads are reserved for each year.

The common gnat, (*culex pipiens,*) which disturbs the silence of night with its shrill pipe, and covers with blotches or blisters the skins of such as have that part of their person delicate and irritable, is a very singular though a very small creature. Of the vast number that are ever sporting over the water any fine evening,
perhaps the greater part may have left that element only the same day. The female gnat is a regular boat-builder. How the last race of the summer, that are to people the air during the following year, dispose of their eggs, is not completely known; but no sooner is the surface of the water loosened from the fetters of the winter’s ice, than the larvae, or young of the gnat make their appearance in every piece of stagnant water, with their tails at the surface, and reclining their bodies below. If they be disturbed they naturally sink, and thus one would be led to conclude that they are hatched at the bottom; and yet as the eggs which are produced in the warm season cannot be hatched except upon the surface of the water, it is not easy to see how those that are produced in the cold season can be hatched under the water either. That they are hatched in some way or other is clear, and they find their way to the surface with the first gleam of heat. In this state, though they can dive, they must come to the surface to breathe, which they do through the tail as long as they are in the larvae state. When they change to the chrysalis, the body turns and acquires two breathing apertures, which stand up and are open above the surface of the water. After they have remained about ten days in this state, the upper part of the case of the chrysalis begins to open, and the perfect gnat to protrude the fore part of its body. As it works away at its extrication, the case, which though empty does not collapse, answers the purpose of a little boat, as the perfect insect is not adapted for living in, or even on, the water. The body serves as a mast to the tiny vessel, the wings for sails, and the
fringed feelers, with which the head is provided, for streamers, while the tail remains in the case as ballast. This bark, though ingenious, is frail; and when even a smart ripple of the water happens before the gnats be wholly disentangled, the number which perishes is quite incredible. When no such disaster happens, they escape from the case, and play and buzz in countless myriads.

Of those that come to maturity, the natural life is not supposed to exceed a month, and probably the female begins to deposit her eggs before she has attained the half of that age. We admire the art which many birds show in the building of their nests; and the untaught geometry of the bees, that so construct their cells as to combine the greatest possible strength and economy; but small and common as the gnat is, and little as we heed her, she perhaps evinces more art and science than any of them. The water is the only element in which her young can subsist in the early stages of their growth; and yet the heat of the sun and the action of the atmosphere are necessary to the hatching of her eggs. Instinctively she knows this—or which, when speaking of instinct, which is not a matter of reasoning at all, but one of pure observation, is the same—she deposits her eggs on the water, and in such a way as that they shall neither sink nor attract the notice of enemies, by being attached to any bulky substance. She alights upon a floating leaf, a bit of grass, or any of those light substances which are found upon the still water, which she chooses. Projecting her hindmost pair of legs backwards, and bringing them into contact, she with her tail places one egg where they
meet, with the end where the breathing aperture of the larva is to be uppermost. To this egg she cements another, to that a third, and so on till the number amounts to between two and three hundred. Nor does she build at random, but fashions the whole into a little boat, hollow, elevated and narrow at each end, and broad and depressed at the middle, the very model of those fishing-boats that are found to live in the roughest water. When she has completed her little vessel, it is launched, and committed to the water, where, if no accident happen, the whole boat is converted into detached and living larvae in the course of three or four days. The success of this mode of nidification is best proved by the countless swarms of gnats that appear at all periods of the summer, notwithstanding the number of enemies by which they are beset. Indeed, such a power of production do the little creatures set in opposition to those of destruction, that, were their destroyers fewer, they would fill the air in marshy places almost to solidity.

These phenomena are not, however, altogether confined to the mountain; its peculiar traits are of a more elevated character, though they do not, and cannot, exceed in wonder, the smallest that nature produces.

As we gain the ascent, and bid farewell to the region of phænogamous, or flowering plants, and reach the families that are nourished by the cold stone, it may not be amiss to pause, and take a little breathing. Even there, upon its very verge as it were, the vegetable kingdom does not forget its bounty. The dwarf crimson bramble, (rubus arcticus,) and more frequently
the luscious cloudberry, \textit{(rubus chamaemorus,)} are found fast by the margin of the snow, as the limit of vegetation. The first of these is a very pleasant fruit; but even in the bleakest parts of Scotland it is rare, and it is not very plentiful even in Lapland; but the cloudberry is more abundant, and it is much better. The fruit is single, upon the top of a footstalk, and in form, size, and colour, it is not unlike the mulberry, after which it is partly named; but in flavour, taking the place where it is found into consideration, it is superior to all the mulberries that ever grew.

At this elevation, the amphitheatre around the base of the mountain begins to appear:—its woods and its pools, its green dells and its brown heaths, come out with a very graphic and pleasant effect; and as one toils along the remainder of the ascent, one is glad occasionally to turn and remark its changes.

The summit is gained at last.—It is midsummer, and yet the stones are frozen to the ground, in every place where they do not feel the influence of the sun. Here, an atmospheric load to a considerable amount is removed. It is usually estimated, that when a man of the ordinary size stands at the level of the sea, the pressure of the atmosphere upon the surface of his body, is about fourteen tons and a half; and that when he gains an elevation of little more than four thousand feet, about two tons of this pressure is taken off. It is true that, generally speaking, the pressure is internal as well as external, and that where it is not, the external pressure gives tone to the system; for one feels relaxed in warm weather before rain, when the barometer is low. But when one ascends a mountain,
there is no such feeling; the increase of cold more than counterbalances the removal; and as the bearing thus produced, is an energy of the living system, instead of a dead weight, exhilaration and pleasure are the consequences.

On the summits of those cliffy mountains, there are generally large masses of loose stone, and it is no uncommon feat, to send these booming and bounding down the slope, or thundering over the precipice. In the former case, how they dance, dash, and loosen others, till the whole mountain side is in motion! In the latter, the stone is not seen, but the peals, as it dashes from one projecting point to another, are loud; they are caught up in echoes, and reverberated from cliff to cliff, till the whole wilderness is in thunder,—rendered the more awfully solemn, that there is not a living thing visible, save one small, pale butterfly, and the wind has carried it away before the species could be known.

Ha! the sound of wings in the abyss, together with a cherup, which again awakens the echoes, and mocks the thundering of the stone. The bird appears more than a thousand feet distant, and yet she is gigantic. What grace of attitude, what strength of pinion, and with what rapidity, yet with what ease, she wheels sunward; till, far above the summit of the mountain, she leans motionless like a brown speck on the bosom of the sky! From its size, it must be twelve pounds weight at the least, and yet it absolutely rises, and that rapidly, as if it were of less specific gravity than the medium in which it floats, rarified as it is by a height of nearly a mile. The muscular energy by which that
is effected, must be immense: to sustain itself without motion of the wings is astonishing enough, but it is nothing to a rapid motion upward, from no fulcrum but the thin air. It is

THE GOLDEN EAGLE.

For many years she has had her eyrie in those cliffs. She has laid the surrounding heaths and valleys under contribution, for the support of those successive broods, for which, while they were young, she was so attentive in rending the prey; but which, when they grew up, she drove far from her own immediate haunt, to become the monarchs of other mountains.

In symmetry, in strength, in the vigour of her wing, the acuteness of her vision, and the terrible clutch of her talons, the golden eagle is superior to every other bird; and as her habitation is always in those time-built palaces, the most lofty and inaccessible precipices, there is sublimity in her dwelling; and though in reality a long-lived bird, she has popularly gained a sort of immortality, from the durable nature of her abode. It appears to be one of the general provisions of nature, that the most powerful destroyers of living animals should have their favourite haunts in the most lonely places; and in this, the lion, the most powerful of quadrupeds, and the golden eagle, the most vigorous of birds, completely agree. There is, however, a wonderful difference in the distances at which they can discover their prey: the lion springs only a few yards, while the eagle darts down from the mid-heaven, in one perpendicular and accelerating stoop.
The Golden Eagle (*Falco Chrysaetos*) is among the largest as well as the most powerful of birds. Specimens have been found, measuring nearly four feet in length, and about nine feet across the wings, when they were fully extended. Specimens of much larger dimensions have also been seen, one of which was shot at Warkworth, measured eleven feet three inches from the tip of the one wing to that of the other, and weighed eighteen pounds. Probably large specimens were more abundant formerly, when the wild countries were left freer to their range than they are now. The average dimensions may be taken at three feet long, and seven feet and a half in expanse, in the male; and three feet and a half long, and eight feet in expanse, in the female. This great extent of wings, makes these when folded as long as the tail. Considering its breadth and strength, the golden eagle is not a very heavy animal, the average weight being about twelve pounds for the male, and fifteen for the female. The figure is, however, compact, and the parts admirably balanced; and both the individual parts and the general arrangement and symmetry, are indicative of great strength. In order that the powerful muscles and tendons by which the talons are moved may be protected from the weather, the *tarsi*, or feet-bones of the eagle are closely feathered, down to the very division of the toes. The general colour of the toes, is yellow; they are defended above by horny plates, or scales, of which there are only three on the last joint of each toe, and they are furnished with talons, which are strong, black, sharp, and very much hooked. So admirable is the mechanism by which the toes and talons of the
eagle are moved, that a dried foot may be made to act powerfully by pulling the tendons, long after it has been dead; and the tendons themselves are among the toughest of natural substances. There is considerable dignity in the repose of the eagle; she usually sits upon a pinnacle of rock, where she can command an extensive view; and the head is often recurvated, so that one eye is directed to the front, and the other to the rear. The knobs on the under part of the toes prevent any injury from the roughest rock, and take a firm hold of the most slippery: so that the eagle on her two feet seems as firmly based as most quadrupeds do on four. The hold which she thus takes of the surface, and the powerful action of the muscles that move the toes, give her another advantage; for by those combined powers, she can throw herself with a bound into the air, at the same time that she expands her wings, and thus, contrary to the vulgar belief, rear usually from level ground. When, however, the eagle has been feeding in any other place than near her abode, she shows an unwillingness to rise. As she is so constituted as to be able to bear hunger four or five weeks, her feeding is voracious in proportion; and as, notwithstanding that she shows considerable adroitness in plucking birds, and skinning quadrupeds, she always swallows, more or less, of the indigestible exuviae, as well as the bones of the smaller prey, her meal is heavy. This, in all probability, has given rise to the vulgar opinion.

The following description of the adult female, given in Selby's admirable work on "British Ornithology," is accurate:—Bill bluish at the base, the tip black.
Cere, (the naked skin at the base of the bill,) lemon-yellow. Irides, orange-brown. Primary quills, black; the secondary ones, clouded with hair-brown, broccoli-brown, and umber-brown. Crown of the head, and nape of the neck, pale orange-brown; the feathers occasionally margined with white, narrow, elongated, and distinct. Chin and throat, dark umber-brown. Vent, pale reddish brown. Tail, pale broccoli-brown, barred with blackish brown, and ending in a broad band of the same colour. Tarsi, clothed with pale reddish-brown feathers. Toes naked, yellow. Claws black, very strong, and much hooked.

In the young bird, the irides of the eyes are not so yellow; the back and coverts of the wings are of a deeper brown; there are some white feathers on the breast and belly; the inside of the thighs are white;
the feathers on the tarsi, white; the feathers of the wings, white at their bases; and the tail, white, for a part of its length from the root, which becomes less at each successive moulting. These distinctions diminish till the fourth year, when the bird arrives at its full size; they are then lost, and the age cannot be known for a number of years. The story that is usually told about the eagle renewing her age, is of course without foundation, though it probably relates to the moulting or change of the feathers, which happens to the eagle as well as to other birds.

Though the golden eagle, as found in this country, be perfectly untameable, there is a constant sexual attachment in the race. The greater number of other birds pair only during the breeding season, and become indifferent to each other after the young can subsist by themselves; but the nuptials of the eagle are for life. After a male and female have paired, they never separate, or change their abode, and rear all their successive broods in the same nest, which being made of strong twigs five or six feet long, firmly wattled and placed in some fissure or hollow of an abrupt rock, is supposed to last for centuries with only additional repairs. The pair, though they drive off their young, and, indeed, every creature but man, whose haunts they shun, are closely associated together: when the one is seen for any length of time, the other is sure not to be far distant; and the one may often be seen flying low and beating the bushes, while the other floats high in air, in order to pounce upon the frightened prey.

The time that they live, has not been accurately ascertained; but their longevity must be very great.
In their strength they are proof against the elements, for the strongest gale does not much impede their motion; and their powers of endurance enable them to sustain very great casualties in respect of food. In many parts of Scotland, where they are much more numerous than in England, there are pairs that have nested in the same cliffs, beyond the memory of the inhabitants. One of these places is Lochlee, at the head of the North Esk in Forfarshire. That lake lies in a singular basin, between perpendicular cliffs on the north, and high and precipitous mountains on the south. A pair of eagles inhabit each side, so that three may sometimes be seen floating in the air at once; but those that have their abode in the inaccessible cliffs on the north, seem to be lords of the place, as the south ones do not venture to beat the valley while these are on the wing. Nor is it in their native freedom only that eagles attain a great age; for there was one kept in a state of confinement at Vienna for one hundred and four years.

The female lays usually two eggs, which are supposed to produce a male and a female; sometimes she lays only one, and very rarely three. The eggs are of a dirty-white colour with reddish spots. The young are produced after thirty days' incubation. When they come out of the shell, they are covered with a white down; and their first feathers are of a pale yellow. They are exceedingly voracious; and the old ones, though they drive them from the eyrie as soon as they are able to shift for themselves, are, up to that period, equally assiduous in finding them food, and bold in defending them from attack. The vicinity of an eagle's
nest is usually indeed a scene of blood, as the prey, if not killed by the blow of the wing or the clutch of the talons, is carried to the ledge that contains the nest, and despatched there.

Of the boldness of the eagles at that time, many stories are told; and they are so universal, that there must be some foundation for them. When the old ones are at the nest, the boldest fowler dares not approach it, as one flap of the wing will strike a man dead to the ground. Even when they are absent, an attack on their brood is far from safe, as they see so far, and can come so rapidly. An Irish peasant had discovered the eyrie of a pair of eagles on one of the islands in the Lake of Killarney; and watching the absence of the parents, he swam to the island, climbed the rocks, made prize of the eaglets, and dashing into the lake, made for the shore; but before he had reached it, and while only his head was above water, the eagles came, killed him on the spot, and bore off their rescued brood in triumph. In the northern islands, where cormorants, gulls, and other aquatic birds breed in immense numbers, the eagles commit terrible devastation among the young; though in these places the sea eagle is often mistaken for the golden eagle. They also attack full-grown deer, and even foxes, wolves, and bears; they generally fasten on the heads of the larger quadrupeds, tear out their eyes, and then beat them to death with their wings.

There are accounts of their carrying off infants in Britain; and in places farther to the north, they have carried off children a little more advanced. Instances of this are mentioned in Iceland, in the Faroe islands,
and in Norway. In the parish of Nooder-hangs in the last country, a boy two years of age was carried off in 1737, though his parents were close at hand, and made all the exertions in their power to scare the spoiler; nor were they able to follow her to the place of her retreat. In Tinkalen (Faroe islands) a child was carried off, and the mother climbed the hitherto unascended precipice, but the child was dead. Ray mentions a case in the Orkneys, where the mother was more fortunate; and it probably is the foundation of the following tale, which appeared in Blackwood's Magazine for November, 1826, and which bears the exquisitely graphic stamp of Professor Wilson.

THE STORY OF HANNAH LAMOND.

"Almost all the people in the parish were leading in their meadow-hay on the same day of Midsummer, so drying was the sunshine and the wind,—and huge heaped-up wains, that almost hid from view the horses that drew them along the sward, beginning to get green with second growth, were moving in all directions toward the snug farm-yards. Never had the parish seemed before so populous. Jocund was the balmy air with laughter, whistle, and song. But the tree-gnomens threw the shadow of 'one o'clock' on the green dial-face of the earth—the horses were unyoked, and took instantly to grazing—groups of men, women, lads, lasses, and children, collected under grove and bush, and hedge-row,—graces were pronounced, and the great Being who gave them that day their daily bread, looked down from his eternal throne, well-pleased with
the piety of his thankful creatures. The great Golden Eagle, the pride and the pest of the parish, stooped down, and away with something in his talons. One single, sudden female shriek—and then shouts and outcries as if a church-spire had tumbled down on a congregation at a sacrament! 'Hannah Lamond's bairn! Hannah Lamond's bairn!' was the loud, fast-spreading cry. 'The eagle's ta'en aff Hannah Lamond's bairn!' and many hundred feet were in another instant hurrying towards the mountain. Two miles of hill, and dale, and copse, and shingle, and many intersecting brooks lay between; but in an incredibly short time, the foot of the mountain was alive with people. The eyrie was well-known, and both old birds were visible on the rock-ledge. But who shall scale that dizzy cliff, which Mark Steuart the sailor, who had been at the storming of many a fort, attempted in vain? All kept gazing, weeping, wringing of hands in vain, rooted to the ground, or running back and forwards, like so many ants essaying their new wings in discomfiture. 'What's the use—what's the use o' ony puir human means? We have no power but in prayer!' and many knelt down—fathers and mothers, thinking of their own babies, as if they would force the deaf heavens to hear!

"Hannah Lamond had all this while been sitting on a rock, with a face perfectly white, and eyes like those of a mad person, fixed on the eyrie. Nobody had noticed her; for strong as all sympathies with her had been at the swoop of the eagle, they were now swallowed up in the agony of eyesight. 'Only last Sabbath was my sweet wee wean baptized:' and on uttering these
words, she flew off through the brakes and over the huge stones, up—up—up—faster than ever huntsman ran in to the death,—fearless as a goat playing among precipices. No one doubted, no one could doubt, that she would soon be dashed to pieces. But have not people who walk in their sleep, obedient to the mysterious guidance of dreams, clomb the walls of old ruins, and found footing, even in decrepitude, along the edge of unguarded battlements and down dilapidated stair-cases, deep as draw-wells or coal-pits, and returned with open, fixed, and unseeing eyes, unharmed to their beds, at midnight? It is all the work of the soul, to whom the body is a slave; and shall not the agony of a mother's passion—who sees her baby, whose warm mouth has just left her breast, hurried off by a demon to a hideous death—bear her limbs aloft wherever there is dust to dust, till she reach that devouring den, and fiercer and more furious far, in the passion of love, than any bird of prey that ever bathed its beak in blood, throttle the fiends, that with their heavy wings would fain flap her down the cliffs, and hold up her child in deliverance before the eye of the all-seeing God?

"No stop—no stay—she knew not that she drew her breath. Beneath her feet Providence fastened every loose stone, and to her hands strengthened every root. How was she ever to descend? That fear, then, but once crossed her heart, as up—up—up to the little image made of her own flesh and blood. 'The God who holds me now from perishing—will not the same God save me when my child is on my bosom?' Down came the fierce rushing of the eagles' wings—each
savage bird dashing close to her head, so that she saw the yellow of their wrathful eyes. All at once they quailed, and were cowed. Yelling, they flew off to the stump of an ash jutting out of a cliff, a thousand feet above the cataract, and the Christian mother falling across the eyrie, in the midst of bones and blood, clasped her child—dead—dead—dead, no doubt,—but unmangled and untorn, and swaddled up just as it was when she laid it down asleep among the fresh hay, in a nook of the harvest field. Oh! what pang of perfect blessedness transfixed her heart from that faint feeble cry—'It lives—it lives—it lives!' and baring her bosom, with loud laughter and eyes dry as stones, she felt the lips of the unconscious innocent once more murmuring at the fount of life and love!

"Where, all this while, was Mark Steuart, the sailor? Half way up the cliffs. But his eye had got dim, and his head dizzy, and his heart sick; and he who had so often reefed the top-gallant-sail, when at midnight the coming of the gale was heard afar, covered his face with his hands, and dared look no longer on the swimming heights. 'And who will take care of my poor bed-ridden mother,' thought Hannah, whose soul, through the exhaustion of so many passions, could no more retain in its grasp that hope which it had clutched in despair. A voice whispered 'God.' She looked round expecting to see an angel, but nothing moved except a rotten branch, that under its own weight, broke off from the crumbling rock. Her eye, by some secret sympathy of her soul with the inanimate object, watched its fall; and it seemed to stop, not far off on a small platform. Her child was bound
within her bosom—she remembered not how or when—but it was safe—and scarcely daring to open her eyes, she slid down the shelving rocks, and found herself on a small piece of firm root-bound soil, with the tops of bushes appearing below. With fingers suddenly strengthened into the power of iron, she swung herself down by briar and broom, and heather, and dwarf birch. There a loosened stone leapt over a ledge, and no sound was heard, so profound was its fall. There, the shingle rattled down the screes, and she hesitated not to follow. Her feet bounded against the huge stone that stopped them, but she felt no pain. Her body was callous as the cliff. Steep as the wall of a house was now the side of the precipice. But it was matted with ivy, centuries old—long ago dead, and without a single green leaf—but with thousands of arm-thick stems petrified into the rock, and covering it as with a trellise. She bound her baby to her neck, and with hands and feet clung to that fearful ladder. Turning round her head, and looking down, lo! the whole population of the parish, so great was the multitude, on their knees! and hush, the voice of psalms—a hymn, breathing the spirit of one united prayer! Sad and solemn was the strain—but nothing dirge-like—breathing not of death, but deliverance. Often had she sung that tune, perhaps the very words, but them she heard not, in her own hut—she and her mother—or in the kirk, along with all the congregation. An unseen hand seemed fastening her fingers to the ribs of ivy, and in sudden inspiration, believing that her life was to be saved, she became almost as fearless as if she had been changed into a winged creature. Again her feet touched
stones and earth—the psalm was hushed—but a tremulous sobbing voice was close beside her, and lo! a she-goat, with two little kids at her feet! 'Wild heights,' thought she, 'do these creatures climb, but the dam will lead down her kid by the easiest paths; for O, even in the brute creatures, what is the holy power of a mother's love!' and turning round her head, she kissed her sleeping baby, and for the first time she wept.

"Overhead frowned the front of the precipice, never touched before by human hand or foot. No one had ever dreamt of scaling it; and the golden eagles knew that well in their instinct, as, before they built their eyrie, they had brushed it with their wings. But all the rest of this part of the mountain side, though scarred, and seamed, and chasmed, was yet accessible—and more than one person in the parish had reached the bottom of the Glead's Cliff. Many were now attempting it, and ere the cautious mother had followed her dumb guides a hundred yards through, among dangers that, although enough to terrify the stoutest heart, were traversed by her without a shudder, the head of one man appeared, and then the head of another, and she knew that God had delivered her and her child in safety, into the care of their fellow-creatures. Not a word was spoken—eyes said enough—she hushed her friends with her hands, and with uplifted eyes pointed to the guides sent to her by heaven. Small green plats, where those creatures nibble the wild flowers, became now more frequent trodden lines, almost as easy as sheep-paths, showed that the dam had not led her young into danger; and now the brushwood dwindled
away into straggling shrubs, and the party stood on a little eminence above the stream, and forming part of the strath. There had been trouble and agitation, much sobbing and many tears among the multitude, while the mother was scaling the cliffs,—sublime was the shout that echoed afar the moment she reached the eyrie,—and now that her salvation was sure, the great crowd rustled like a wind-swept wood.

"And for whose sake was all this alternation of agony? A poor humble creature, unknown to many even by name—one who had had but few friends, nor wished for more—contented to work all day, here—there—anywhere—that she might be able to support her aged mother and her little child—and who on sabbath took her seat in an obscure pew, set apart for paupers, in the kirk!

"'Fall back, and give her fresh air,' said the old minister of the parish; and the circle of close faces widened round her, lying as in death. 'Gie me the bonny bit bairn into my arms,' cried first one mother, and then another, and it was tenderly handed round the circle of kisses, many of the snooded maidens bathing its face in tears. 'There's no a single scratch about the puir innocent, for the eagle, you see, maun hae stuck its talons into the long claes and the shawl. Blin! blin! maun they be who see not the finger o' God in this thing!'

"Hannah started up from her swoon, looking wildly round, and cried, 'O! the bird, the bird!—the eagle, the eagle! The eagle has carried off my bonny wee Walter—is there nane to pursue?" A neighbour put
her baby into her breast,—and shutting her eyes, and
smiting her forehead, the sorely bewildered creature
said in a low voice, 'Am I wauken—O tell me if I'm
wauken, or if a' this be the wark o' a fever, and the
delirium o' a dream?"'

The strength of wing and muscular vigour of the
eagle are truly astonishing. The flesh has not, as some
have alleged, any offensive smell or taste, but it re-
sembles a bundle of cords, and cannot be eaten. Some
notion of its power may be formed from the statement
of Ramond, when he had ascended Mont Perdu, the
loftiest of the Pyrenees, and nearly three miles above
the level of the sea. He had for a considerable distance
bid adieu to every living thing, animal or vegetable;
but right over the summit there was a golden eagle far
above him, dashing rapidly to windward against a
strong gale, and apparently in her element and at her
ease.

In the regions which she inhabits, the golden eagle,
like the lion, owns no superior but man, and she owns
him as such only on account of his intellectual re-
sources. When taken ever so young, there is no very
well authenticated account of the taming of an eagle.
The wandering hordes to the eastward of the Caspian
sea, do, indeed, train eagles to hunt both game and
wild beasts; and Marco Polo, the father of modern
travellers, who, in the early part of the thirteenth cen-
tury, spent six and twenty years in a pilgrimage over
the east, and revealed the wonders of the whole, as far
as Cathay or China itself, records the eagle hunts at
the court of the Great Khan of Tartary, as among the
greatest marvels with which he met. It is probable that the eagle thus trained to falconry, may have been the imperial eagle, which is much more common in the south and east, and which, though a powerful bird, is not quite so savage as the golden eagle. That the eagle was never used in European falconry, is certain. It is invariably classed with the "ignoble falcons," or those that keep as well as kill their prey. One bird is said to give the eagle more trouble than any other, and that is the heron, rather a light and feeble bird. The heron gets under the shelter of a stone, or the stump of a tree, where neither the wing nor the talons of the eagle can be effective; and from that position it twists round its long neck, and bites and gnaws the legs of its enemy. Several years ago, a heron was put into the cage of a powerful eagle, at the Duke of Athol's, at Blair. It immediately betook itself to the shelter of a block of wood, which the eagle had for a perch, and began to nibble and bite; nor did the eagle vanquish it till after a contest of twenty-four hours. It is not very often, however, that the golden eagle frequents the haunts of the heron; her favourite ranges are the open moors and uplands, where the prey can be seen from a great distance, and there is little cover to shelter it. In this country they do not often come to the woods, though they do so in the mountainous parts of France, where the winter is proportionally more severe, and the animals, upon which they prey at other times, are passing the cold season dormant in their holes.

In Scotland, the eagle finds winter food in the very fastnesses of the mountains. Of that food one favourite article is
THE ALPINE HARE.

The Alpine or White Hare (*lepus variabilis*) is, in point of size, generally intermediate between the common hare and the rabbit, though we have seen a specimen as large as the former. It is a timid, gentle creature, inhabiting the wild and lonely mountains, and seldom found at a lower elevation than 1500 feet above the level of the sea. They bring forth their young in situations more lofty than this; generally so much so, as to be out of the reach of the wild cat and pine marten. They live in holes, and under stones; and as their safety from the eagle is in concealment, and not in flight, they are not easily raised. The following account of their seasonal appearance, from the Edinburgh Philosophical Journal, vol. ii., is accurate; though we have observed, that their whiteness is more complete in long and severe winters:—

"The varying hare becomes white in winter. This remarkable change takes place in the following manner: About the middle of September the grey feet begin to be white; and, before the month ends, all the four feet are white; and the ears and muzzle are of a brighter colour. The white colour gradually ascends the legs and thighs, and we may observe, under the grey hairs, whitish spots, which continue to increase till about the middle of October; but still the back continues of a grey colour, while the eye-brows and ears are nearly white. From this period the change proceeds very rapidly, and by the middle of November the whole fur, with the exception of the tips of the ears, which remain black, is of a shining white. The back becomes white
within eight days. During the whole of this remarkable change in the fur, no hair falls from the animal; hence it appears that the hair actually changes its colour, and that there is no removal of it. The fur retains its white colour until the month of March, or even later, depending on the temperature of the atmosphere; and, by the middle of May, it has again a grey colour. But the spring change is different from the winter, as the hair is completely shed."

This seasonal change of the fur of the alpine hare (and it is not confined to that animal) answers several important purposes. One of these is safety from enemies. The summer colour approaches that of the grey stones and lichen among which it lives, while its winter hair is that of the snow, which then completely covers the mountains. Another advantage of the change of colour is even more important:—it tempers them to the weather. White is much more difficult both to heat and to cool than black, and thus the white colour preserves the natural heat of the animal in winter; and the dark colour in summer raises the temperature of the surface, and makes the animal perspire, the evaporation of which is a source of cold. The adaptation of the colour to the temperature is much more obvious than the protection. The animals that prey upon the alpine hares are a part of creation as well as they, and their preservation is just as essential; so that we may suppose that the increased mode of concealment on the part of the one, is counteracted by an increased vigilance on the part of the other. But the protection of the animal from the weather counteracts no part of the economy of nature, and there we
find it pretty generally extended; birds and rapacious animals become lighter in winter; and so does the old hair upon cattle, and other quadrupeds, that are left out for the winter in exposed situations. The ermine, which does not need much protection, except from man, becomes white in winter; and many animals that are dark on the upper part of the body, are light, or were white on the under, that an equal temperature of the vital parts may be preserved.

This curious seasonal change has not been very carefully investigated; and, therefore, the precise way in which it is brought about cannot be ascertained. Attempts have been made to explain it, by urging that, when animals are exposed to strong light and heat, the deoxydising rays of the sun decompose carbonic acid, and as that is given out at the surface, the carbon is precipitated upon the rete mucosum, and produces the black colour; but the lips and tips of the ears in the alpine hare retain their blackness in winter; and therefore the several parts of the skin would require to be endowed with different powers; and in the grouse of Labrador, the feathers of the tail remain black during the winter, as do some feathers on the breast of

THE PTARMIGAN.

The Ptarmigan, rock grouse, or white partridge, (Tetrao lagopus,) which is another inhabitant of the most elevated parts of mountains; and, except in lofty and lonely places, it is rather a rare bird. It resembles the common red grouse in form, only it is, perhaps, a little less, the length being about fifteen inches, the breadth two feet, and the weight nineteen ounces.
From the still and lonely places in which it is found, the ptarmigan is a very interesting bird; very gentle in its manners, and apparently courting the society of man; as if, when it is met with on the mountain-top, a stone be thrown so as to light on the other side of it, it will run among one's feet, and may be almost caught with the hand. On this account, the ptarmigan has been called a stupid bird; but stupidity cannot, with any thing like propriety, be attributed to any animal in a state of nature. Their habits, and means of subsistence and defence, vary; but they are all equally wise. In summer, the ptarmigan is mottled grey and white, so that, when it is in motion, it is not easily distinguished from the stones among which it is found. The quills of the wings are white, and so are the two middle feathers of the tail, but the other tail feathers are black, with white tips. In winter, the whole plumage, except a feather or two on the breast, is white, the change beginning in September, and being usually finished in October. The moulting, or annual change of feathers in those birds, has not been very accurately described; but there are some reasons for concluding that the feathers alter in colour only in the autumn. The young birds are mottled like the old ones, but change their colour at the same season with these: and if they shed their feathers then, they would have to produce two complete coats in the course of a few months, a degree of exhaustion of which, we believe, there is no instance among the feathered tribes. Neither are there any well-authenticated instances of changes from lighter, either in feathers or in hair, without a reproduction; while there are many of the
opposite change. The whitening seems always to be the result of a diminished action in the hair or feather, which may be produced either by heat or cold, or natural decay. Thus we find that the children of peasants have the points and upper parts of the hair bleached almost white by the sun, while the roots are brown: those alpine animals turn white in winter; and men and other animals become grey with age. It seems that the bleaching process takes place in the hair itself, and has no connexion with a temporary change of colour in the skin, as the rete mucosum; for we often find that the same summer sun which darkens the skins of those who are much exposed to it, bleaches and whitens the hair upon the hands and eye-brows. Thus it remains doubtful, whether the action of the sun in summer, even by drying the hair and feathers of those beasts and birds which turn white in the winter, may not assist in producing the change of colour. That these are material causes for all those changes, we may rest assured; and that these have some connexion with chemical action, is highly probable; but we must be careful not to confound the chemical action of living bodies with that chemistry of dead matter which alone we can study in the laboratory.

The common residences of the ptarmigans are in the most elevated parts of the mountains, where they hide themselves in crevices, and often in holes in the snow, which, till the temperature rises as high as that at which snow begins to melt, are both warm and dry; so that a ptarmigan at the top of Ben Nevis has really a more comfortable winter abode than a pheasant in one
of the low and rainy counties of England. They of
course feed within the range of vegetation, buds and
young shoots of heath and other alpine plants, with
mountain berries and insects, being their food; but
they re-ascend during the night. In winter and spring,
they live in parties; but during the breeding season,
they separate in pairs, descend lower, and spread over
a greater range of surface.

The season for their pairing is as late as June,
which offers another argument in favour of their
moult ing in the spring. The nest is a circular hole,
scratched at the root of a bush, or at the foot of a rock,
with hardly any other preparation. Each female lays
from six to twelve eggs, larger than those of a partridge,
and of a reddish colour, mottled with black. The
young are produced in three weeks, and are of a
reddish mottled colour. The male is very attentive to
the defence and feeding of the female while she is
sitting; and both birds defend their young with great
boldness; but the eagles and larger hawks are too
powerful for them, and commit great havoc. As their
chief safety is in concealment on the earth rather than
in flight, they are much better adapted for running than
for flying; and that their legs may not get numbed by
the cold, they are thickly feathered. Ptarmigans are
rarely found in England, except upon some of the
highest mountains in the north, and they are not very
frequently met with in Wales; the part of Scotland
where they are most abundant, is the great ridge of
the Grampians, on the confines of Perth, Aberdeen, and
Inverness shires.

It is generally supposed, that the animals upon
which the eagle preys, are well acquainted with its shadow; and that, to prevent that from being seen, the eagle floats at such a height as to make it indistinguishable. Certainly, we have always discovered the eagle flying lower in cloudy weather than when the sun was bright, but, whether on account of its answering her vision better, or for some wise purpose, as that of the shadow, has not been ascertained.

From the summit of the mountain, if one be provided with Dollond's best three-feet achromatic telescope, an instrument that no traveller in these lands of long views should be without, the golden eagle can be followed, and her motions watched, with the same accuracy as if one were a companion in her flight. In this we have a very apt and striking instance of the superiority of reason over even the surest instinct, and the finest apparatus with which it can be furnished. The eye of the eagle is so formed, that, while the bird floats in the air at such an elevation as that its size is reduced to a single speck, it can command miles of surface with such precision as to perceive at once in what part of the wide field of view there is prey—even though nature, equally attentive to the prey and the preyer, has coloured the former so like the surface on which it is found, that no eye, but that of an eagle, could distinguish it at even half the distance.

But wonderful as that faculty is, it is less surprising than human vision aided by the telescope, by means of which man has been enabled not only to connect mountain with mountain, but planet with planet; and, while he has his home localised in some little spot of the earth, to become a dweller, as it were, in the whole
solar system, and a rational speculator into the nature and laws of that universe, of which the solar system forms a part. Thus, while in the study of nature we find every thing to admire, we find nothing to envy; and the more that we trace the power and wisdom of God in his works, the more apparent becomes the great goodness which he has manifested toward us. This is one of the most important lessons that we derive from the study of nature; and we derive it from that study alone. It teaches us gratitude to our Maker, and contentment with our condition; for the greatest distinctions in the social distribution and arrangement of men, are nothing when compared with those distinctions with which our Maker has endowed us above the other productions of creation.

And yet an eye is a most curious instrument. In a merely mechanical point of view, and without any reference to the power that it has of conveying to the sensation of animals the presence and qualities of objects, it embraces the principles of many sciences; and, in so far as the resemblance can be traced, it is a beautiful instance of the universality of the laws of nature. The different parts of the eye have so complete a resemblance to those optical contrivances by which we aid it, in the observation of distant or minute objects, or renovate its powers when they have begun to decay, that the careful study of the eye itself might have led to the construction of telescopes, microscopes, and spectacles.

In the eyes of different animals there are remarkable differences, according to the nature and habits of the animal, the medium in which it lives, or the time at which it finds its food. The eyes of the more perfect
animals are two, and they are, generally speaking, moveable; so that the animal may turn them in various directions without moving its body, or even its head. In the insect tribes the eyes are often compound, consisting of a great number of sights or lenses, each of them adapted for receiving and transmitting light, but all of them, even in the most compound eye, communicating with one single retina, or organ of perception. Animals that are liable to be chased, have the eyes further back in the head, and so prominent that they can see laterally, or even behind. The eye of the hare is an instance of this, and that of the giraffe is still more remarkable. The eyes of pursuing-animals are more directed to the front; and those that spring on their prey have them deeply enfonced, so that they may take a more steady view, both in direction and distance. In the eyes of animals that have to seek their ways and their food in the direction of the perpendicular—as in cats that climb trees—the eyes have the pupil elongated in that direction, so that they may contract the opening, and exclude light from other objects at the sides of the one principally looked to, and yet have a considerable range in the direction of that. Animals, on the other hand, that have to find their food upon the ground, as those that graze, have the pupil contracted above and below, with the opening elongated in the horizontal direction. There is a considerable difference in the eyes of day and night animals, as they are called,—as between those of an eagle and those of an owl. The day animal has the interior of the eye lined with a dark membrane or pigment, the surface of which is without gloss; and
which, therefore, does not allow any reflection of light from one part of the interior of the eye to another. The eyes of night animals are, on the other hand, without this, or have it light-coloured, by which means lights are reflected within the eye. Each of these adapts the animal to the time at which it is abroad: the owl cannot see in the bright sun, because the image of the object, to which its eye is turned, is confused by the reflection, from the inner surface of the eye, of all the images of surrounding objects; and the eagle cannot see in the dark, because of the deficiency of light, in consequence of none of the side lights being reflected. Each, however, can see more perfectly in its own element than if it had the opposite contrivance. Between animals that live in the air, and those that live in the water, there are differences equally curious. The contrivance, by which the light that enters at the forepart of the eye is so managed as to produce vision, is similar to that by which the sight is improved when we use spectacles or telescopes. There are certain transparent parts of the eye which are thinned off toward the sides, and left thick in the middle, as is the case with those glasses or lenses, of which telescopes and other optical instruments are composed. Those natural lenses, by making the rays or points of light that come from the outsides of objects more rapidly approach each other within the eye, make the object appear to occupy a much greater space than it otherwise would. Thus they magnify it, and of course make all the parts more distinct;—as, if in looking at any surface, that of the moon, for instance, the rays from the extremities be made to contract twice as much, the surface will
appear to be doubled in both its dimensions, and seem consequently four times as large—or it will have the same appearance as if brought to half the distance. There are three of those humours, as they are called, in the eye of the more perfect animals. The aqueous humour, which fills the foremost part of the eye, displays the iris or coloured portion that opens and shuts, with the pupil or passage of the sight in the centre, and it is supposed also to occupy a small portion behind the iris. Behind the aqueous humour there is situated the crystalline lens, which is equally transparent as the aqueous humour, but of a firmer consistency, and has both its sides convex or thickest at the middle. The remaining part of the cavity is filled by the vitreous humour, which is of a consistency between the two; and behind that, the retina or nervous tissue is spread out, and supposed to be the most delicately sensible part of the animal structure.

Now it is in consequence of these lenses being of a more dense structure than the substance to which their convex sides are turned, that they cause the rays to approach each other, magnifying the object, and rendering it more distinct. The front surface of the aqueous humour refracts the rays that come through the less dense air, and they are further refracted by both surfaces of the crystalline lens. But animals, that live in water, and receive the rays of light through that medium, would not have them brought together by an aqueous humour: and, therefore, the external eye in fishes is nearly flat, while the convexity of the crystalline is increased till it be almost a little globe, like one of the most powerful single-lens microscopes.
The combination of lenses, or humours in the eye, is supposed to take off those prismatic colours that are produced when rays of light are strongly and differently refracted—much in the same way that a similar effect is produced by the compound object-glass in an achromatic telescope; and thus the eye, taken even as a piece of mechanism, and without any reference to life, or the faculty of sight, is equal, nay superior, to the utmost effort of human contrivance. When we come to add to it those natural powers of perception and adjustment by which it acts and adapts itself, it would become, were it not so common, and in the midst of a world as wondrous, a great and constant wonder. The refraction of rays that come from objects at different distances, are different, and those which come from a near one, approach each other more rapidly, and, therefore, meet sooner than those that come from a remote object. Light from objects at different distances, therefore, must meet in points at different distances, behind the pupil of the eye. But vision is not distinct, unless the point where the rays meet be the very surface of the retina; and, therefore, there must be in the eye a power of altering its form,—by the motion of the retina backwards and forwards, by an alteration in the convexity, or otherwise, of the refractive power of the lenses, or by both; and one can easily feel such a power, by habituating the eyes to look at objects at different distances. Looking closely, together with the straining of the eye-lids, which usually accompanies such an effort, seems to increase the convexity of the lenses; for, when the sight has begun to dazzle and fail at the usual reading
or writing distance, one can, by gazing intently for some time at small objects very near to the eye, recover its tone, though after such an effort, distant objects will be dim for some time.

It is probable that the eyes of birds, more especially eagles that soar high, and depend wholly upon their sight, have this power much more vigorously than the eyes of men; and it is not unlikely that the third eye-lid, or nictitating membrane which they possess, and the apparatus with which that embraces the ball of the eye, may compress and stimulate the lenses, as well as lubricate, cleanse, and protect the front of the eye. In the eagle, the power of this organ is wonderful; for even when she soars so high above the mountains, that you can mark her large form with difficulty, down she drops with unerring certainty, even upon the smallest of her prey, to a depth considerably below. When one is near enough, the sound of her descent is like the rustle of a whirlwind; and even as one sees her through the telescope, if the prey be worthy of her, the descent is grand. Those wings, upon which she the moment before floated with so much grace and ease, are dashed behind her, as if they were a useless impediment; but these formidable weapons are, all the while, kept in readiness, if they should be needed, to aid the talons in the work of death. If she mistakes or misses, and it is not often that she does the one or the other, for her eye is keen and her aim is true, she shoots away at a distance, as if she had been unworthy of herself: but when her aim is sure; when the ptarmigan or the mountain hare is transfixed; and, while she exults for a moment over
her victim, before she rends it, there is a terrible majesty in her air;—and when all this is among the grandeur of mountain scenery, while the spectator is elevated above the whole;—when the dark eminence and the dusky eagle are projected against a mountain glen, with its bright stream, its green bosom, its scattered trees, its abrupt hills, and its wild and rocky precipices, here veiled with mist, and there glancing in the sun,—it is a scene which fails not to make a vivid and a lasting impression.
CHAPTER III.

THE LAKE.

The consideration of this division of the more striking features of the earth's surface, properly follows the
last—inasmuch as lakes are usual accompaniments of mountain scenery, and form part of the machinery by which nature works for the transmission of those waters which are distilled by, and gathered into the hills; as well as for the provision of those vapours with which the air feeds these huge alembics of the earth. In what is, unscientifically enough, called the new world, and particularly in Canada, these inland waters have a character somewhat different from that which they assume in the portion of the globe of which our island forms a part;—extending to the magnitude, and exhibiting most of the phenomena of seas, and standing in less immediate and visible connexion with mountain ranges, to which they owe their birth. In Europe, the principal lakes are those of Switzerland; to which, with their surrounding scenery, those in the northern parts of our own island bear, in all respects, a close resemblance.

Here, they present to the eye an appearance which at once indicates their origin; and exhibits, in immediate connexion with each other, the various parts of that eternal process by which the vivifying principle is preserved from stagnation, and the spirit of fruitfulness poured over the earth. Embosomed in deep valleys, and shut in by circling hills,—fed by the streams and torrents that pour from the uplands, opening chasms in the mountains, and wearing fissures in the cliffs; or by the countless streams that penetrate towards the earth's centre, till, turned by some stratum of rock, they burst upward, in springs, amid the hidden depths,—and presenting a surface from which, in turn, the air may gather exhalations, and
send up to the mountain peaks volumes of clouds, laden with fresh materials for the action of their appointed part in the beautiful design,—they afford to the naturalist a field of never-wearying interest, and to rational man a theme for gratitude, adoration, and love.

To the enthusiast in the picturesque, nature nowhere presents an aspect of such varied beauty as amid these combinations of hill and water and glade. That monotony which characterizes a wide expanse of unbroken plain, even when clothed in a mantle of uniform hue, and that unrelieved sense of awe and loneliness which a mountain range, without this soothing accompaniment, is apt to suggest, are, alike, absent here. All that is most sublime is softened by all that is most beautiful; and all that is most beautiful, is elevated by all that is most sublime. The pervading and perpetual presence of water clothes the earth in its richest robe of verdure; and there is a spirit of life and motion over all, which prevents that feeling of oppression and melancholy with which man finds himself bowed down in the immediate presence of nature, in her mightier agencies. The air is full of soothing sounds, poured from a thousand natural sources,—the ripple of the mimic wave upon the mimic beach; the murmur of the cascade; the roaring of the cataract; the sighing of the breeze, or the rushing of the blast among the rocking woods; all blend into one wild, but enchanting harmony,—repeated by a thousand voices, from hill and grove and glade,—that it might well suggest a mythology like that of the Greeks of old, and lead the imagination to people every cliff and stream and tree with a dryad or a faun.
The atmospheric phenomena of these regions too, owing to the broken surface and that motion of which we have spoken, give a character of universal variety and endless change to their scenery. The light of familiarity, which in time deadens the enjoyment of mere level landscape, however fair, comes not here; because here the landscape is never for any length of time the same. The minutest alteration of the sun’s place in the heavens, or the passage of the lightest cloud, produces a change upon the earth, and invests it with a novel charm. This scene is ever changing, like a succession of creations; and every change is repeated with the rich distinctness of truth, yet with the softened beauty of a fiction or a dream, in the unstained mirror of the lake. Whether we gaze upon these jewels of nature, lying like giant gems in their rich green setting of wood and hill, or lashed into foam and tumult by the wing of the tempest from the mountains,—whether we view them with their surface turned into plaits of gold by the alchemy of sunset and the touch of the breeze, or with their crystal floors paved with mimic stars and a mimic moon,—nature nowhere else presents herself to the eye in forms in which the presence of power is so intimately associated with the presence of beauty—the feeling of loneliness with the feeling of life—the sense of motion with the suggestions of repose—the evidences of unyielding winter with something like the aspect of an ever-budding spring, and the spirit of hoar antiquity with that of continual youth.

The deep lake never very much alters its temperature, even though situated in a northern region; more—
especially if it be but little elevated above the sea, and the land around it be high. The latter circumstance is a certain indication of depth; and when that extends to a hundred fathoms or so, the water, instead of being covered with ice, even in the longest and most severe winters, does not cool nearly to the freezing-point. Strange stories have been told of lakes that have this property: their waters have been said to be impregnated with substances, which, at the same time that they defy the frost, act upon those who drink them. These have been alleged of some of the Scottish lakes that pour their limpid waters iceless into the sea; while all the shallow parts of them are frozen to a considerable thickness. But there is no need for any admixture to prevent the congealation; that is the necessary result of the depth, and of a well-known property of water. The greatest density of that fluid is at about forty-two degrees of Fahrenheit; and until this degree of cold is imparted to the whole volume of the water, of course no ice can be formed on the surface. The cooling process is, in deep water, a very slow one; as the instant that a pellicle on the surface becomes heavier than the rest, it sinks and exposes a new one. When the water has cooled so far as to become stationary, the action of wind upon the surface furthers the cooling; but even with that assistance the very deep lakes are never frozen. The winter of 1807-8 was one of uncommon length and severity; and yet instead of any ice forming upon Loch Ness, (probably the deepest lake, and most uniformly deep, in the United Kingdom,) the river that flows from it was several degrees above freezing, and only a few slight
traces of ice were discernible in some of the shallows near to its confluence with the sea, at the distance of seven miles from the lake.

But the same circumstances which render those deep lakes difficult to be cooled, render them just as difficult to be heated; and thus the presence of a lake takes the vicinity of it out of the extremes of chilling winter and burning summer, which characterize northern countries, equalizes the temperature of the year, lengthens the period of active vegetation, and clothes its banks with a verdure unknown to any other places in the same latitudes. Even the evaporation that takes place from the surface of a lake which is surrounded by high mountains, does not produce any thing like the same degree of cold that is produced by evaporation from a lake in a flat country. The air descends from the mountains, is condensed in proportion to the depth to which it descends, and being so, it is warmed. Another thing: there is not the same difference of temperature between the night and the day; and thus there is less dew and blight. In spring or autumn, the vegetation around a marsh, or even a moist surface, is often found destroyed, while on the banks of a lake not a leaf is touched.

But lakes in mountainous countries have another advantage: they prevent those floods of the rivers, which are so destructive where there are no lakes; and if they be in warm latitudes, they prevent the soil from being burnt up and becoming desart. Rains fall with greater violence upon varied surfaces than upon plains, because there the atmosphere is subject to more frequent and rapid changes; the slopes of the surfaces
precipitate the water sooner into the rivers; and thus the rain passes off in an overwhelming flood. By the interposition of lakes, this is prevented. They act as regulating dams; the discharging river cannot rise higher than the lake; and thus, when the lake is large, a flood which otherwise would flow off in a day, and destroy as it flowed, is made to discharge itself peaceably for weeks. Besides the preventing of devastation, this is of advantage to the country. When the flood passes off, while the rain is falling, and the air is moist and not in a state for evaporation, the land derives but a small and temporary advantage from the rain; but when the water is confined till the state of the atmosphere changes, a considerable portion of it is taken up by the process of evaporation, and descends in fertilizing showers.

A decisive proof of the advantage of lakes, and the casualties that result from the want of lakes to regulate the discharge of mountain rivers, was unfortunately given in the floods in Scotland, in the summer of 1829. The whole of the rivers that flow eastward from the Grampians have steep courses, but no lakes to regulate their flow; and the consequence was, that they threw down the bridges, flooded the fields, washed away the soil and crops, and did other damage; while those streams farther to the north, that roll an equal or a greater mass of water, but which are expanded into lakes, did no harm. Mountainous countries, in which there are no lakes, are usually barren, or in the progress of becoming so. The Andes in America, the ridges in Southern Africa, and many other lakeless elevations, are utterly sterile. The mountains of Scot-
land, and even those of the north of England, have little beauty where there are no lakes;—they are covered with brown heather, unbroken by any admixture save dingy stone and red gravelly banks, where the rains have torn them to pieces. There are none of those sweet grassy dells and glades, and none of those delightful thickets, coppices, and clumps of trees, that spot the watered regions. No one seeks for beauty or sublimity in the mountains of Northumberland and Yorkshire; or in that dull part of the Grampians where the Ila, the Esk, and the Dee have their remotest sources. When the low lands are approached, there will of course be sublimity, because the rivers have gained force, and will cleave the earth and form precipices and cascades. But the upper regions, whatever may be their elevation, are cursed with more than Babylonian infliction. "The bittern will not dwell there:"

"The bittern will not dwell there:"
the dusky raven, with his revolt ing *crocq*, hollow and horrible, as if it came from the chambers of the grave, is almost the sole inhabitant; and even he does not make these places his home, but merely visits them for the purpose of devouring the remains of those animals that have perished in their desolation. If the surface be dry, it presents nothing but miserable stunted heather, and white lichen, which crackles under the foot, and is the shroud of all useful vegetation. If it be moist, then it is a peat-bog, which offers no safe place for the foot; or, which is more unsightly still, a dead peat-bank, over the whole black surface of which there is not one living thing, animal or vegetable. The water that creeps away from this miserable surface has the appearance of unpurified
train oil, often has a film of iron on the surface, and is always so cold and astringent that the very stones seem to be shrunken by its touch.

Turning to the other parts of the very same ridges of mountains, how different is the scene, and how different the emotions! The lakes of Cumberland and Westmoreland, now contrasting their silvery surfaces with the swell of green hills, and the shade of dark woods; and now giving back the reflection of rugged cliffs and frowning precipices;—there is music in the name, and at the thought of them all the wealth of the plains is forgotten. The gem of every country is a lake. England has her Ulswater, Ireland her Killarney, Scotland her Katrine, and Wales her Bala, which, though designated by the humble name of a pool, is capable of softening down the fiery spirit of the Cambrian, as he gazes on it from the mountain's ridge,—and the waters are so limpid, that "the lasses of Bala," by laving their beauties in it on May-morn, excel in brightness all the other daughters of the principality.

There is even a deeper feeling in the contemplation of a lake than in that of a mountain. It is a moving, almost a living thing; and a focus for the concentration of other life than you meet with upon land. In the secluded tarn, or in those coppice-encircled bays where the wind is excluded, the creatures are assembled. The trees are full of birds, the bushes swarm with quadrupeds, the air is alive with insects, and ever and anon, as they touch with tiny foot the surface of the water, the dancing circles convince one that the water has its inhabitants likewise. Numerous visitors have their banqueting house here. One grand spoiler is
The Heron (*Ardea cinerea*) is, in appearance and habits, one of the most singular birds to be found in Britain. It is longer than the golden eagle, and the expanse of its wings is not much less than that of the ordinary specimens of that bird. It measures about forty inches in length, and sixty-four in breadth; and yet, with all this vast spread, it does not weigh above three pounds. The fact is, that it is all legs, wings, neck and bill, and this gives it, when seen from a distance, a very formidable appearance. In its way, it is a formidable bird; and though shy and retiring in its nature, and not disposed to attack any thing but its finny prey, its structure is admirably united to its modes of life. Its legs are of great length and strength. The scaly coverings of the legs, and the nature of the cuticle on the naked parts and
between the plates, enable it to bear the water for a great length of time without injury. Its toes are long, with claws well adapted for clutching, and one toe is toothed, so that eels, and other slippery prey, may not wriggle out of its clutches. The muscular power of the long neck is wonderful, and by it the point of the bill can be jerked to the distance of three feet in an instant. No bird indeed can, with its feet at rest, "strike out" so far or so instantly as the heron; and the articulations of the neck are a sort of universal joints, for it can, with the same ease, and in the same brief space, jerk out the head in any direction or in any position; nay, the bill can act, and that powerfully, when the neck is twisted backwards and the head under the wing. The bill, too, is formidable; the points pierce like spears, and toward the extremity there are sharp and strong barbs turned backwards; so that when once it strikes, it never quits that which it can lift, and it makes a terribly lacerated wound in that which it cannot. The bill is about six inches long, and the gape still longer, as it extends backward as far as the eyes. The gullet and craw are exceedingly elastic, so that it can swallow large fish, and a number of them. Seventeen carp have been found at once in the maw of a heron. The neck of the heron is indeed one of the most singular pieces of animal mechanism, and proves how nicely the maximum of activity and strength can be combined in the smallest possible quantity of materials. The wings are also admirably fitted for enabling it to float itself with its weighty prey, or to lean upon on the air in its long and elevated flights. They are concave on their under sides, and thus act like para-
chutes. This formation of the wings also enables it to alight in such a way as not to disturb the water, or in any manner alarm its prey. By exerting the parachute power, it not only prevents that accelerated motion in descent, which makes the stoop of the eagle so terrible, but it gradually softens the motion, and alights so gently as not to occasion a rustle in the grass, or a ripple of the water.

This structure of the wings is of great use to the heron in one of its modes of feeding. Its usual mode is to wade and wait for the prey; but it sometimes fishes upon the wing. It seldom does that, however, except in shallow water, the depth of which does not exceed the length of its neck or legs; and its vision must be very acute, to enable it at once to see the fish and estimate the depth of the water. It comes to the surface with a gradually diminished motion; and then, suspended by the hollow wings, whose action does not in the least ruffle the surface, it plunges its bill, grapples the fish to the bottom, and, after perhaps a minute spent in making its hold sure, rises with a fish struggling in its bill. The prey is sometimes borne to the land and there swallowed, and sometimes it is swallowed in the air. Eels are generally carried to the land, because their coiling and wriggling do not admit of their being easily swallowed when the bird is on the wing; but other fishes, especially when small, are swallowed almost instantly, and the fishing as speedily resumed. We once had an opportunity of seeing four or five small trout caught in this way in about as many minutes; and we know not how long the fishing might have been continued, as the bird did
not appear to be in the least exhausted; but a gos-hawk came in sight, and at her appearance the heron escaped, screaming, to the upper regions of the sky.

That is not, however, its usual mode of fishing. Wading is the general method, and in it the hooked and serrated toes are often used in aid of the bill. Small streams and ponds are its most favourite places, and the success, especially in the latter, is often very great. Nor is the actual catching the only injury that the heron does to fish-ponds, for it lacerates a great many that it does not secure, and often in so severe a manner that they will hardly recover, though fish suffer far less, either in pain or injury, from wounds, than land animals. The heron does not much frequent the larger and deeper lakes, and seldom (perhaps never) fishes in water deeper than the length of its neck and legs. Its time of fishing is the dusk of the morning and evening, cloudy days, and moon-light nights. We remember seeing only one instance of a heron fishing when the sun was bright. That was on a rivulet, in the hills of Perthshire, the banks of which, at some places, nearly closed over the water; and there the heron appeared, like a skilful angler, to take the side opposite to the sun.

The most apparently trivial habits of organized bodies are just as demonstrative of infinite wisdom, as those that attract the vulgar by their novelty, or by some real or fancied resemblance to the marvellous among mankind: the times at which the heron resorts to the water to fish, are those at which the fish come to the shores and shallows to feed upon insects, and when, as they are themselves splashing and dimpling the water,
they are the least apt to be disturbed by the motions of the heron. The bird alights in the quiet way that has been mentioned, then wades into the water to its depth, folds its long neck partially over its back, and forward again, and with watchful eye awaits till a fish comes within the range of its beak. Instantaneously it darts, and the prey is secured. That it should fish only in the absence of the sun, is also a wonderful instinct. Every one who is an angler, or is otherwise acquainted with the habits of fish in their native element, knows how acute their vision is, and how much they dislike shadows in motion, or even at rest, projected from the bank. It is not necessary that the shadow should be produced by the bright sun. Full day-light will do it; and we have seen a successful fly-fishing instantly suspended, and kept so for a considerable time, by the accidental passage of a person along the opposite bank of the stream, nay, we once had our sport interrupted by a cow coming to drink; so alarmed are fish, especially the trout and salmon tribe, at the motion of small shadows upon the water; though shadow, generally speaking, be essential to their surface operations. They do not feed, and therefore we may conclude that they do not so well discern small bodies upon the surface, when the sun is bright. Fishes are in fact, in part, nocturnal animals; and the heron, that lives upon them, and catches them only in their feeding places, is partially, also, a nocturnal animal.

There is one case in which we have observed herons feeding indiscriminately in sun and shade; and that is when a river has been flooded to a great extent, and the flood has passed off, leaving the fish in small pools
over the meadows. How the herons find out these occasions, it is difficult to say; but we have seen several pairs come, after a flood, to a river which they never visited upon any other occasion; and within many miles of which a heronry, or even the nest of a single pair, was never observed.

Few birds are more generally diffused than the common heron. It is found in all latitudes and all longitudes. In some places they migrate, in others they merely spread themselves, or shift their quarters in the same latitude, and in others again they remain quite stationary. The power of changing their abode is necessary for their comfort, and even for their existence. They are exceedingly voracious; and their powers of digestion are equal to their powers of swallowing. The seventeen carp mentioned by Willoughby, were only a meal for six or seven hours. The absolute necessity of food for the preservation of the life of the animal is not, however, quite so great as its rapacity; for it can not only subsist for a long time without food; but when old ones are taken alive, they prefer freedom to luxury, and starve themselves to death, even though food be placed within their reach, and kept there till they could eat it unobserved.

Herons appear, like many other animals, to have some instinctive perception of the approach of rain; as their favourite time for flying, and at which they take their loftiest flights, is just before a fall of rain. Their elevation then is greater than that of the eagle; and their flights are also longer at those times than when they are merely in search of food. It is possible that their elevation may be chosen as an instinctive
means of defence against their enemies,—as when they are assailed by eagles and hawks, their first means of escape is usually ascent; and if they can sufficiently attain that, they are understood to be safe.

In cases of extremity, they can shake off their natural timidity, and show both courage and skill. When a hawk gets higher on the wing than a heron, (the whole of that tribe can kill their prey only by stooping upon it when it is below them,) the heron is said—though it is very difficult to verify the saying by actual observation—to assume rather an ingenious system of tactics. The neck of the heron is the part usually struck at, as when that is successfully hit, he is finished without harm to the assailant. To prevent this, he is said to double the neck backward under the wing, and turn the bill upward like a spear or bayonet, over the centre of his body. This bill is, as has been mentioned, six inches in length, so that, if it be well aimed, and the heron can avoid the stroke of the wing, the enemy is sure to be transfixed before the talons can take effect. We have heard of instances in which not hawks merely, but eagles (not the golden eagle, but the sea-eagle, *falco albicilla*, or the osprey) have been thus transfixed by the heron, and have fallen to the ground pierced through the vitals, while their intended prey has soared untouched, and made the air shiver with its scream of victory. As these contests must take place at a considerable height above the earth, it is not easy to know the details of them; and indeed the habitual vigilance which the heron observes upon all occasions, necessarily renders the encounters not very frequent. Still, though we have not seen it, the
occurrence may be possible; and the greater the force with which the assailant descends, the greater is the probability of its being fatally pierced by the bill. Even when wounded, the heron is a dangerous bird; and when winged, it cannot be approached but with the utmost caution. The bill is darted out with rapid and unerring aim, at the eyes of whatever animal comes within its range; and powerful dogs have been struck blind in rushing too hastily upon a wounded heron.

Under almost any circumstances the herons are found in pairs; and in the breeding season they congregate in flocks, like rooks. The female heron lays four or five eggs of a bluish green colour, and about the size of those of the duck. Their nests are usually built upon lofty trees; but so fond are they of the society of each other, that rather than separate, part of them will build on the ground. Montague mentions a heronry upon a little island in a lake in the north of Scotland, where, there being but one stunted tree for a great number of herons, as many as it could support made their nests on it, and the rest congregated round it on the earth. Twenty nests upon one tree is not an unusual number in cases where they are pinched for room. The nests are large and flat; the frame-work being made of twigs; and the inner coating of wool, feathers, moss, or rushes, according as there may happen to be a supply. While the period of incubation lasts, the male fishes with assiduity, and provides his mate with a supply of food; but after the young are hatched, both parents assist in providing for them. In situations that are well adapted for the construction of heronries, the birds have great reluctance to leave them, even
after the trees are cut down; and a case is mentioned by Dr. Heysham, in which, when their own habitations had been destroyed, they made an attempt to possess themselves of those of their neighbours. A heronry and rookery had been for many years near each other, and the one party had never offered to give the other the least disturbance. At length, however, the trees which had been the habitations of the herons were cut down, while those that belonged to the rooks were spared. When the pairing time came, the herons made a general attack upon the habitations of their swarthy neighbours; and after a considerable time spent in fighting, and a number of killed and wounded on both sides, the herons remained in possession of the trees. Next year, however, the rooks renewed the contest with the same determination as before; but they were again worsted, and the herons were again in possession. After the second brood had been hatched, there was not a suspension merely, but a termination of hostilites; and afterwards the two societies occupied the same trees, and lived in harmony together. The labour which the herons take in fishing for their broods, as well as the success with which that labour is attended, is very considerable; so much so that the spaces between the trees on which the nests are constructed, are often strewed with fish; even eels of large size have been brought in this way; from a distance of several miles.

The heron has fallen off very much in estimation, both as an article of food and as a means of sport. In former times it was accounted a suitable dish for kings; and so highly was the hunting of it with hawks
prized, that the destroying of a heron’s nest, or the capture of its eggs, subjected the party to a penalty of twenty shillings. At present it is little heeded in places where fish-ponds are not in use; and where they are, it is looked upon as a destroyer and a nuisance. When the peasants succeed in killing it, they do not send it off as a present to royalty, or even eat it themselves; they nail it up upon the barn wall or the stable door—those common museums of rustic natural history, along with owls and kites, and other birds that are refused a place in the culinary catalogue.

It is difficult to generalize the natural history of a lake, as it depends much upon situation. This applies to the plants upon its shores, the fish in its waters, the birds that frequent its surface, and even the insects that sport in the air over it. Sometimes those differences appear to be perfectly capricious. Thus in the lower part of Strathmoor, in Scotland, there is one small lake (the Loch of the Stormouth,) which, in the breeding season, is literally covered with the common gull, while on other lakes in the immediate neighbourhood, which are to all appearance as well, if not better adapted for the purpose, there is not one to be seen. But in the distribution of animals, whether for temporary or permanent residence, there can be no caprice, their preference of any place to another must depend upon some instinct, which, if known, would be another point in their history; and it is only by the careful observation of their peculiarities that that history can be made either general or true so far as it goes. There is, however, one bird, which is pretty generally found visiting all the British lakes that are
surrounded with high rocks or eminences, and not at any very great distance from the sea; characters that belong to most of the larger lakes in the islands. That bird is

THE SEA-EAGLE.

In the history of the sea-eagle there is some confusion; first, because it has been confounded with the osprey, or fishing buzzard; and secondly, because the old and the young have been described as two distinct species. Indeed, some naturalists are of opinion that the osprey is only the eagle at a different stage of its growth. The two, however, are essentially different in their size, their habits, and even of the divisions of the hawk tribe to which they properly belong. The male of the osprey is only about one foot nine inches in length, and the female about two feet; and the breadth of the male about five feet, and of the female about five feet and a half. The male of the sea-eagle is about four feet in length, and the female about two feet ten inches; and the breadth of the female is about seven feet. The tarsi of the osprey are naked and scaly; those of the sea-eagle are feathered at least half way to the toes. The osprey has in former times been trained to catch fish for its keeper, while the sea-eagle, like the golden-eagle, will not fish but for itself or its young.

The Osprey (falco haliaëtus) of Linnaeus, though in his time the distinctions of eagles were very imperfectly understood, and which used to be called the bald buzzard, or the fishing hawk, is in fact not an
eagle at all, though a very fierce and powerful bird. It is common in England, and perhaps most so in the warmest parts of the country, less frequent in the north, and rather a rare bird in Scotland. On the other hand, the fishing eagle is abundant in Scotland, much more so, and more generally diffused, than the golden eagle. It is most abundant in the north; less so in the south; rather a rare bird in the north of England, and hardly known in the south. This is one of the principal causes of the confounding of the two: they who have described from English specimens, have described the bald buzzard; and they who have done so from Scotch ones, have described the sea-eagle. The other mistake is precisely of the same kind with that which made the old and the young of the golden eagle two different species.

The beak of the osprey is of a bluish black, with the cere at the base, gray, and toward the base is rather straight, but not so much so as in the eagle, and the point is remarkably hooked. The general colour of the upper part is brown, with the feathers a little paler at the margin. Those on the crown of the head are edged with white, and the back of the head and nape of the neck entirely white, on which account it got the name of the bald buzzard, though no part of its head be destitute of feathers. The lower part of the body is spotted with brown in the young birds, but nearly pure in the old. The whole plumage is close and glossy, and resembles that of water-fowl, fully as much as that of the eagle. The legs are short and very strong; the tarsi black, and defended by scales; the lower parts of the toes very much tuberculated, and
the claws black and remarkably strong. The flight is generally rather heavy; but at times it can shoot along with great majesty.

It forms its nest on the tops of tall trees or cliffs near the water, but never on the ground, as is stated by some naturalists. The eggs are four or five, of a pale yellow spotted with brown.

The principal food is fish, in the catching of which it shows very great intrepidity. When looking out for prey, it hovers over the surface of the water, at a considerable height, with its wings continually in motion; and when the prey appears, it darts down with so much force, that it plunges fairly into the water to the depth of a foot or two; and then springs buoyant to the surface, ascends the air, and soars off to a resting place in the woods or on the cliff, according to the situation, dashing the spray from its feathers as it flies. The fact of its being able to plunge into the water, reascend and fly immediately, led some of the earlier naturalists to conclude that one of its feet, at least, must be webbed; that, however, is not the case; and the only natural protection that it has from the effects of the element in which it finds its food, consists in the similarity of its feathers to those of the water-fowl. Even the feathers upon its thighs are different from those of the eagles and hawks; they are short, close, and compact, while those of the latter birds are long and plumy. The osprey, though a powerful bird, is not a handsome one. As both this and the sea-eagle have got the name of the osprey, and some of the more modern writers confine it to the one bird, and some to the other, it is necessary to attend to the specific distinc-
tions, which are, indeed, too marked for occasioning any danger of confounding the one with the other.

The Sea-Eagle (*falco albicilla*) is a powerful bird, second only to the golden eagle, and probably exceeding that in rapacity, as well as in the range of its food. The dimensions of this eagle have already been mentioned. Though approaching in size to the golden eagle, it is not nearly so compact or indicative of strength, neither is it of the same rich colour. The upper part is gray-brown with darker spots, the lower part nearly cinerous, with blackish spots; the tail in the full grown bird is white, which has led some to confound it with the young of the golden eagle; and it has a beard or tuft of feathers at the root of the under mandible.

As fishing is their regular means of subsistence, they are chiefly found near the sea, or the shores of great lakes, where they build their nests in the most inaccessible precipices, and the female lays one egg, or at the most two. The eggs are white, and about the size of those of a goose. Like the other rapacious birds, they can remain a long time without food. Selby mentions one that had existed in a state of want for five weeks, at the end of which time it had begun to gnaw the flesh from its own wings.

Few exhibitions in nature are finer than the fishing of this powerful bird. Not adapted for walking into the shallow water for prey like the heron, the sea-eagle courses over the surface. From her unapproachable haunt in the trees or the crags—the latter is, when she can obtain it, her most admired residence—she
darts forth with the straightness and fleetness of an arrow, and as she glides high in the air, scanning the expanse of miles with her clear and unerring vision, one or two motions of her wings are sufficient to elevate her almost above the reach of human eyes, or bring her down close to the surface of the water. When her prey appears within her reach, she pauses not an instant, but raising her broad wings upward against the air, and thus taking advantage of the elasticity of both, shoots down as if discharged from a bow or an air-gun, makes the cliffs echo to her cherrup, and dashes upon the water with the same thunder and spray as if a lightning-rent fragment had been precipitated from the height. For an instant the column of spray conceals her, but she soon ascends bearing the prey in her talons, and brief space elapses before she is lost in the distance.

In lakes that abound with large fish, if there be lofty trees or rocks near, the eagle is almost sure to be found, more especially if the situation be wild and lonely. Those inlets of the sea to which the name of "lochs" is given, upon the north and west coasts of Scotland, are, from their precipitous shores, their wild and solitary character, and the abundance of fish that they contain, favourite haunts of the eagle; the same may be said of those on the shores of Donegal, Mayo, and Galway, and especially those in the southwest of Kerry, in Ireland; also of the wild and clifffy positions of Orkney and Shetland; and to the very margin of the polar ice. Indeed, it is found in all the northern parts of both continents, and in Asia as far south as the Caspian Sea.
But though it be always found near the waters, it is properly a land bird, and can neither rest nor feed except upon the land; consequently, it is never found upon the ocean, or near low shores, though it is by no means confined to lakes and inlets, but may be observed at every headland which is lofty and lonely enough for its residence. Many tales are told of conflicts between these eagles and the larger inhabitants of the sea. The eagle can strike in the water, and retain in its hooked talons, fishes that it cannot lift into the air, though it can keep them at the surface. The larger cod, which are very abundant on those parts of the coast which the eagle haunts, and the larger salmon, in the bays, or in those lakes which are near the sea, are those of which the tales are usually told; but we have heard similar stories of the basking shark.

If the fish be near the surface,—and cod, especially, swim so near it, that from a promontory, a white "blink" may be seen over the shoal, if numerous,—the eagle dashes down, plunges its crooked talons into the prey, and clutches them with such force, that it cannot disentangle them, even though so disposed. The laceration, the pain, and the encumbrance, prevent the fish from darting off with that activity which it could exert if free; and the exertions of the eagle, though not adequate to lifting the fish into the air, are very capable of keeping it at the surface, as the difference of specific gravity between even the living fish and the water, is but trifling. Thus a struggle ensues; the fish endeavours to dive, and the eagle strives to pull it above the water, so as to be able to strike it behind the head.
with its wing, or tear out it eyes, or open its skull with its beak. If the fish be very large, and the claws of the bird do not, in consequence, very much destroy its muscular power, it is sure to succeed so far as to drown the eagle; after which, the talons relax, the dead body floats off, and the fish recovers. But if the fish be small, it is drowned in the struggle, by the water passing the reverse way into its gills, or it is lifted so far out of the water, as to enable the eagle to beat or tear it to death. When that takes place, the fish has no tendency to sink, and the eagle is said to float with it to the shore, rowing in the air, or occasionally on the surface of the water with its wings.

Upon those lonely islets and rocks in the North Sea, where the nests and young of sea-fowl almost cover the surface in the breeding season, the sea-eagle finds abundant prey, and reigns king of the place, except upon an occasional visit of the golden eagle, or in those wild and lofty places which are selected by the skua gull, for the scenes of its nidification. Though no match for the eagle, single-handed, the Skuas, which are bold and powerful birds, come to the charge in numbers, and so buffet the eagle with their wings, that she is glad to make her escape to the upper regions of the air.

Though both active and successful as a fisher, the sea-eagle has other means of subsistence. She does not scruple to pick up dead fish along the beach, or to attack seals, and land animals. Birds and small quadrupeds, and even lambs, fawns, and grown-up deer, fall a prey to the craving of her appetite; and, as she relishes carrion, on that account, most likely hunts by.
scent, as well as sight. On the coast of Sutherland, where the rocks harbour a number of these eagles, which prey upon the inhabitants of the sea and the flocks of the people indiscriminately, the following is mentioned, as a successful way of capturing the spoiler: "A miniature house, or at least, the wall part of it, is built upon the ground frequented by the eagle, and an opening left at the foot of the wall, sufficient for the egress of the bird. To the outside of this opening, a bit of strong skeiny (packthread) is fixed, with a noose on the one end, and the other end returning through the noose. After this operation is finished, a piece of carrion is thrown into the house, which the eagle finds out and perches upon. It eats voraciously, and when it is fully satiated, it never thinks of taking its flight immediately upward, unless disturbed, provided it can find an easier way out of the house; for it appears, that it is not easy for it to begin its flight, but in an oblique direction; consequently, it walks deliberately out at the opening left for it, and the skeiny being fitly contrived and placed for the purpose, catches hold of it, and fairly strangles it."

It would require many volumes to detail the habits of all the feathered tribes that appear seasonally or constantly in the neighbourhood of lakes; and the circumstances of climate and situation, as well as those instincts of the birds themselves which cannot be explained, farther increase the difficulty. The most remarkable of those that wade in the shallows, and skim the waters, for predatory purposes, have been mentioned. The birds which are found in the rocks, woods, and coppices, near lakes, will be more properly
noticed in another place. The same may be said of quadrupeds and insects. There are none of the former peculiar to British lakes, and the latter are more abundant over pools and rivulets, than on those expanses of water, which are the fishing grounds of the eagle and the osprey. Of the feathered tenants of the water,—those which are web-footed for swimming, and have their feathers so constantly oiled as never to be wet, though immersed in water, the largest, and probably the rarest, is

THE WILD SWAN.

The Wild Swan, or Whistling Swan, (anas cygnus of Linnaeus,) is but a bird of passage in the British isles, though generally a few of them breed in the northern counties of Scotland, and in the Orkney and Shetland islands, where their places of retreat or breeding are the secluded lakes. The wild swan is a majestic bird. The full-grown male measures nearly four feet in length, and about seven feet in the expanse of the wings. The weight, about twenty-five pounds. The dimensions of the female are rather less. The body of the wild swan is white, like that of the tame swan; but the head and nape are yellowish, and the wings are tipt with ashen gray. The appearance of the bird, the different note which it utters, and the different formation of the wind-pipe, upon which that note seems to depend, all point out this as a species entirely different from the tame or mute swan. The note of the wild swan is a deep and hoarse whistle, which, however, is rather musical, though not sufficiently so to have gained
for it that vocal celebrity, with which it has been invested by the ancients. It is somewhat singular, that this music of the swan, which was celebrated by all the ancients who mentioned the bird, with the exception of Lucian, should be still admired in Iceland, where vast flocks of wild swans repair annually to breed. The Icelanders compare the music of the swan to that of the violin, though the swan has but one note.

Wild swans are, strictly speaking, natives of the cold regions; and do not migrate so far south even as the warmer shores of England or France, except in very severe winters. In the north of Scotland they are much more common, and some remain for all the year, except when the lakes and waters, in which they find their food, are frozen over. The food of the swan is aquatic plants with their seeds and roots, and insects that float upon the surface of the water, or are found at the bottom where that is shallow. It does not appear that they prey on fish, excepting perhaps the fry when very young; and to other birds and quadrupeds they are perfectly innocuous, except when themselves or their young are assailed. On these occasions, especially the latter, they are both bold and formidable; and not only able to beat off other assailants, but to render the approach of man dangerous. The power of whistling in the wild swan is supposed to depend on the singular flexures of the trachea, or wind-pipe. That organ enters a cavity of the breast-bone, from which it is reflected backwards before its termination in the lungs. It is probable that this peculiarity aids in the respiration of the bird, as well as in the production of sound,—the length and flexibility of the neck being
apt to occasion partial interruptions of that essential operation, which the air contained in the cavity of the bone may enable the bird to bear.

The quiet regions of the north are the favourite abodes of the swans; and they are said to protract their residence there as long as they can; and, when the lakes begin to freeze, to assemble in flocks and break the ice with their wings, or prevent it from forming by flapping and dashing in the water. Their chosen abodes are to the north of Iceland, for, though far more of them breed there than in the northern parts of Scotland, the Icelanders regard them as birds of passage. Iceland, indeed, seems a place of rendezvous in which numerous flocks, each containing a hundred or more, assemble in their passage northward, in the spring, and again in their passage southward, in the autumn. Their flight is elevated, and the line or wedge in which they are arranged, is so close and serried that the bill of the one is nearly in contact with the tail of that before. Though birds of powerful wing, their progress depends a good deal upon the wind. When they go before a brisk gale, they fly at the rate of one hundred miles an hour; but, when the wind is against them, their flight is comparatively slow; and a side wind, which blows them from their course, is understood to hinder them more than one which is right a-head. When on the wing, swans are very difficult to shoot,—as, on account of the height at which they fly, and the rapidity of their motion, the aim, even at the time of pulling the trigger, must be taken ten or twelve feet before the bird, otherwise it will have passed before the shot reaches its height. In fact, they are shot with difficulty at any
time, because the great thickness of the feathers and down both deaden the force of the shot, and make it slide off.

The nest of the female is formed of reeds, without leaves and rushes; she lays from four to seven eggs, which are of a rusty colour, with some white blotches about the middle; and she sits for about six weeks, so that the young are not in a condition to quit the places where they are hatched during the first season. They begin to moult, or cast their feathers, in August, during which operation they are unable to fly, and thus readily become the prey of the people of the north, who hunt them with dogs, or knock them on the head with clubs. The young swans are not unpleasant food; but the people of the countries where they breed do not hesitate to kill and eat the old ones, the flesh of which is very hard, tough, and black. The feathers and down of the swan are articles of commercial value; and the northern people dress the skins, with the feathers and down upon them, for winter garments. In the north of Scotland both the birds and eggs are sometimes wantonly destroyed.

The migration of birds is a singular provision of nature, and though the rapidity of their motion makes their passage across the widest seas a matter easily accomplished, yet the instinct which leads them to change their latitude with the seasons is worthy of notice;—the more so, that it is also one of the resources of man in a state of nature. The same necessity, that of finding food, seems to actuate both. The Siberian hordes follow the course of vegetation, moving to the south as the winter cold nips the vegetation of the north; and to the
north, as the summer heat parches it in the south. The Esquimaux, on the other hand, move to the south in summer, and support themselves by hunting; while they return northward to the sea in winter, to feed upon seals and other breathing natives of the deep, which must keep open holes in the ice to preserve their existence. In like manner, the migratory flights of birds appear to be chiefly influenced by the necessity of seeking food, though partly also by the finding of proper places for rearing their young.

From the nature of their powers of motion, the seasonal migrations of quadrupeds are necessarily limited. If they be inhabitants of islands, they cannot pass over the sea; and upon continents, large rivers, mountains, or deserts, limit their range. In Britain, the stag and the roe, which are found only in the uplands in the warm season, find their way to the warm and sheltered plains in the winter; and on more extensive lands some of the quadrupeds take longer journeys; but they are all comparatively limited, and extensive migrations are performed only by those animals that can make their pathways in the sea or the air. The seal, which during summer is found in such numbers on the dreary shores of Greenland, Jan Mayen, and Spitzbergen, finds its way to Iceland in the winter; but its migration is limited; and numbers still remain in the most northern regions that have been visited. The inhabitants of the water have, indeed, less necessity for seasonal changes of abode than those of the land; as the water undergoes less change of temperature, and as some of those sea animals which, like the seal, require to come frequently to the surface to
breathe, do not require to remain long above water, or have much of their bodies exposed to the air. The grand inconvenience which they seek to avoid, appears to be the labour of keeping open those breathing holes, without which they could not live under the ice. Or if there is any other instinct, it may be the desire of escaping their enemies, as the bears and the northern people watch them at their holes, and make them a sure and easy prey. Those who have not thought rightly upon the subject, are apt to say that they could not know of those dangers, and therefore could not seek to avoid them without experience. But that is part of the general error into which we are so apt to fall when we begin the study of nature. We make ourselves the standard of comparison, and think of the animals not only as if they had to deal with men, but as if they actually were men themselves. Whereas, in their natural state they need no teaching, and the danger, or the means of life, and the instinct by which the one is avoided and the other secured, are co-existent. We are in the habit of attributing superior sagacity to animals in certain stages of their being; as we give the "old fox" credit for greater cunning. That may be, indeed must be true, as regards the arts of man, because the means to which he resorts for the capture or destruction of animals are not natural, and thus it would be a violation of the law of nature to suppose that they should be met by a natural instinct. In situations which nature produces, the children of nature are never at a loss; but as the contrivances of man are no part of her plans, it would be contrary to the general law to suppose that they should be in-
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stinctively provided against these. That they do learn a little wisdom from experience, is a proof that they are not mere machines; that they are something more than mechanical; that life in the humblest thing that lives, is different in kind from the action of mere matter; and that there runs through the whole of organized being, a philosophy which man, when he thinks of it, must admire, but which he cannot fathom. The animal, or even the plant, is not like an engine, confined to certain movements which it cannot vary, but has a certain range of volition (if we may give it the name) by means of which it can deviate a little from that which would otherwise be its path, if that path contain ought that is dangerous or inconvenient. Thus, if we would come to the living productions of nature with minds fit for learning those lessons which they are so well calculated for imparting, we must equally avoid two extremes, the one of which would lead us to confound organic being with the mere inorganic clods of the valley, and the other would lead us to confound their instantaneous impulses with de-
leveration, and measure instinct by the standard of reason.

The migrations of birds are more remarkable, and have been more early and more carefully observed; and that birds should have a greater range, is in perfect accordance with the general law of nature. The apparatus with which the majority of birds are furnished for preparing their food for digestion in the stomach, confines that food within a smaller compass than the food of the quadrupeds. With the exception of the birds of prey, which can rend other animals for their
subsistence, and are thus capable of living at all seasons of the year, the birds must subsist upon soft substances, as insects and their larvae, or the seeds, and green and succulent leaves of plants; while quadrupeds, being furnished with organs of mastication which, along with the saliva, reduce their food to a sort of pulp before it be swallowed, can subsist upon dry leaves and bark, and even upon twigs. Thus, in even the coldest countries, there is still some food for a portion of those quadrupeds that live upon vegetables; and these again afford subsistence for the carnivorous ones, as well as for the more powerful birds of prey. In very cold places too, the smaller quadrupeds, and even some of the larger ones, are so constituted that they hybernate, or pass the winter in a state of torpidity, in which they have no necessity for food, and consequently none for change of place.

But in the severity of the northern winter, the food of the feathered tribes fails. The earth and the waters are bound up in ice, so that the worms and larvae are beyond their reach; the air, which in summer is so peopled with insects, is left without a living thing; the buds of the lowly evergreen shrubs, and those seeds which have fallen to the ground, are hid under that cold but fertilizing mantle of snow, which, cold as it seems, secures the vegetation of the coming summer; the berries and capsules that rise above the snow are soon exhausted; and the buds of the alpine trees are generally so enveloped in resin and other indigestible matters, that they cannot be eaten. Thus the birds must roam in quest of food: nor is it a hardship,—it is a wise provision. Were they to remain, and had they
access to the embryos of life in their then state, one season would go far to make the country a desart; and even the birds would be deprived of their summer subsistence for themselves and their young. They are also provided with means by which they can transport themselves, in average states of the weather, without much inconvenience; and thus, while in migration they seek their own immediate comfort, they preserve other races of being. In some of the species, too, they preserve a portion of their own race. It has been mentioned that the young of the swan are unable to migrate the first year; and of most migratory birds, there are always a few that are unable for the fatigue of migration. If the strong did not go away, the whole of the weak, and in cases like that of the swan, the whole of the young, would perish. After the moulting takes place, in most birds, perhaps in all of them in a state of nature, the paternal instinct ceases to operate; they feel no more for the brood of that year. It is each for itself individually during the necessity of the winter; and when the genial warmth of the spring again awakens the more kindly feelings, the objects of those feelings are a new brood. In her march, nature never looks back; her instinct is fixed on the present, and thus leads to the future, without any reference to that experience which the progress of reason and thought requires. In consequence of this, the strong would take the food from the weak, the active from the feeble, and the full-grown from their offspring, if nature were not true to her purpose, and prompted the powerful to wing their way to regions in which food is more easily to be found, and leave the young
and the feeble to pick up the fragments that are left, in those places which they are unable to quit.

It has been said that the *teachableness* which is the characteristic of man, has nothing to do with the instincts of the animals; but it does not follow that he should not take a lesson from those instincts; because the instincts of animals and the reason of man are all intended to forward the very same objects—the good of the individual and of the race. Now, in this very fact of the migration of birds, simple and natural as it may seem, and unheeded as it is by careless observers, we have an example worth copying, even in the most refined and best governed society. The strong and the active go upon far journeys, and subsist in distant lands, and leave what food there is for their more helpless brethren. Would men do the same—would they temper the work to the capacity of the worker, in the way that it is done by the instincts of those migratory birds—the world would be spared a deal of misery. It is thus that, in the careful study of nature, man stands reproved at the example of the lower creatures, and learns, by doing by reason as they do by instinct, to be grateful to that Power, "who teacheth us more than the beasts of the field, and maketh us wiser than the fowls of heaven."

The migrating birds that spend part of the year in the British islands, may be divided into two classes,—*summer birds* and *winter birds*; but of both classes some are only *occasional visitants*, and others are mere birds of passage, tarrying only for a short time, as they are on their route to other countries.

The two general classes observe the same law in
both of their migratory instincts—the finding of food, and of fit places for the rearing of their young. The general motion for these two purposes is in opposite directions—they move toward warmer regions in search of food, and toward colder ones in order to build their nests. The winter birds come to us for food, and the summer ones for nidification. The winter ones never are those that feed upon land insects, and but seldom those that feed upon seeds; because when they come, there are few of these. They are chiefly water-birds, in some sense or other. They frequent the shores of the seas, the inland lakes, or the margins of springs, rivulets, and rivers, and they swim or wade, or merely run along the bank, according to their nature; and resort to those haunts where their food is to be found with the most unerring certainty. They are all common inhabitants of regions farther to the north, have reared their broods there, and remained till the supply of food began to fail. The extent of their flight southward depends upon the severity of the winter; they come earlier, and extend farther, when that is severe; and their departure is accelerated by a warm spring, and retarded by a cold one. Though the diffusion of the same species of birds be much more extended than that of the same species of quadrupeds, there is still a variation according to the longitude. The birds of passage which appear in Britain are not exactly the same as those either of continental Europe or of America; and that accounts for the appearance of the occasional visiters. A strong wind from the east during the time of their flight often wafts a continental bird to our shores; and a strong wind from the
west occasionally brings us an American visitor. The flight of birds is therefore a sort of augury, though a very different sort from that believed in by the superstitions of antiquity. It has no connexion with the offices or fortunes of men, but it tells what kind of season prevails in those climes whence the visitors come. The early appearance of the winter birds is a sure sign of an early winter in the northern countries; and the early appearance of the summer ones is just as sure a sign of an early and genial spring in the south.

The migration of our winter visitants is a very simple matter; we can easily understand why birds, when their supply of food begins to fail, should fly off in a warm direction; but the return—the general migration northward for the purpose of rearing their young, is, at first consideration, a more difficult matter. Yet when we think a little, the difficulty ceases, and the one movement becomes no more a miracle or a marvel than the other. Very many of the summer birds feed upon insects; and summer insects are more abundant in the northern regions than in the south. This happens particularly with the water-flies, of which there are supposed to be several generations in the course of a long summer's day; and the short night at that season occasions little interruption to their production. The same causes which produce the greater supply of insect food, increase the daily period during which the bird can hunt, and this gives it a farther facility of finding food, over what it would have in the comparatively short days farther to the south. But the breeding time is that at which the birds are called upon for extraordinary labour. During the period that the nest
is building, there is a new occupation altogether; and the nests even of very small birds are constructed with so much care, that that and the finding of subsistence demand more than the average power of industry. When the female begins to sit on the eggs, the feeding of her partially depends upon the male; and when the young are hatched, their support, till they are in a condition for supporting themselves, requires a considerable portion of the time and industry of both parents. When the young are fledged, the parent birds still require long days: the operation of moulting, by which their tattered plumage is replaced by a new supply, exhausts them: thus they have long days, and also food in abundance, when they are least able to make exertions in search of it; and by the time that the decreasing supply warns them that it is time to seek more southern climes, they are in prime feather and vigorous health, and able to sustain the fatigues of the voyage. The return, too, is, generally speaking, after the autumnal equinox, so that in their migration southward they have the same advantage of a longer day than in places northward. Thus, even in this common-place matter,—a matter which is so common-place that few take the trouble of heeding it, and almost none inquire farther than saying that it is the instinct of the birds,—we may trace as perfect a succession of antecedent and consequent, or as we say, of cause and effect, as in any other part of the works or economy of creation. We ought, indeed, to guard very carefully against stopping at the word instinct, or indeed at any other word which is so very general that we cannot attach a clear and definite meaning to it. Those
general words are the stumbling-blocks and barriers in the way to knowledge; and when we turn to them who take upon themselves the important business of instruction, and ask them for an explanation, they but too frequently give us a word, and when we get one, in our own language or in any other, to which we can attach no meaning, the path to knowledge is closed. Perhaps there are few words by which it is more frequently closed than this same word, "instinct;" because we are apt to rest satisfied with it as an ultimate or insulated fact, and never inquire into that chain of phenomena of which it forms a part. Now nothing in nature stands alone:—Creation needs no new fiat; but the succession of events throughout all her works depends on laws which are unerring, because they are not imposed by any thing from without, but are the very nature and constitution of the beings that appear to obey them. It is this which makes nature so wonderful, which so stamps upon it the impress of an almighty Creator:—its parts and phenomena are millions; the primary power that puts all in motion, is but One.

These reflections have been a little extended, because they are often in danger of being overlooked; and because the tranquil shore of an expansive lake is one of the best scenes for contemplation,—one at which the several elements and their inhabitants are more easily brought together than at almost any other. But it is not the broad expanse of water, with its mountains and its majestic scenery, that is alone worthy of our contemplation. The mountain tarn, which gleams out in the bosom of some brown hill or beetling rock, like
a gem in the desart, when one does not expect it;—
the sheet of glittering water amid encircling forests;
and the shelving pool amid undulated green hills, with
its margins alternating of white marle, clean pebbles,
and sedgy banks, have all their beauty and their re-
spective inhabitants. It is true that the osprey and
the fishing-eagle do not there display their feats of
strength, and the wild swan does not bring forth her
young, or even often visit; but our old friend the heron
is there, and she finds new associates with whom she
can dwell in peace. One of the common summer in-
habitants of those more lowly and retired and warm
situations, is

THE COOT.

The common coot, or black coot, sometimes called, on
account of the pale colour of its forehead, the bald
coot, (fulica atra, Linnaeus,) is a bird about the size of
a domestic fowl. The length is about eighteen inches,
the expansion of the wings about twenty-eight, and the
weight, from a pound and a half to two pounds. The
bill of the coot is straight, and of a conical shape; it,
and the fore-part of the head are usually flesh-coloured,
but in the breeding season the latter is spotted with
red. This pointed beak is less in the female than in
the male. The body is blackish, with a little white on
the outer edges of the wings. The legs are greenish,
and the bands or bracelets greenish yellow; the toes
are long, and armed with crooked claws of considerable
length. The three front toes are pinnated, or have
three lobed fin-like membranes upon each side, but
they are not united by a membrane, and the hind toes

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are bare. Though the pinnated feet of the coot adapt it for swimming, and the water be its principal element, it walks with some vigour, but with the waddling motion that is so general among the web-footed animals, and it is said even to be adroit in climbing trees.

The coot is common in all the northern parts of the world, and is by no means a rare bird in Britain. It is a permanent resident within the island, but it changes its residence with the seasons. In winter, coots are found about the larger lakes, and sometimes in bogs, and the estuaries of rivers; but none in the open sea, and not in salt water until the fresh-water lakes be frozen over. They are commonly found in flocks. Being rather timid birds, they are not much seen during the day, and are very inert or lazy; so much so, that they can hardly be driven from their concealment in the reeds and rushes, by water spaniels, but will attempt to dive in the water, or bury themselves in the mud. When compelled to take wing, they do it with much apparent difficulty, and even pain. They come abroad in the evening, and feed upon fishes, insects, seeds, and herbage; and pick up grain with more rapidity than common poultry.

When the breeding time approaches, which is early in the spring, the coots separate into pairs, and betake themselves to the margins of smaller pieces of water, where they find rushes, reeds, or sedges to conceal their nests. The rush, however, is their favourite, and they choose a place surrounded with water, generally on the margin of a clear pool or small lake. The nest is generally begun at or near the surface of the water. The quantity of materials is large. They are flags,
rushes, and other dry herbage, matted together with grass, fastened to the bush of rushes with the same, and lined with soft, dry grass. There is a provision of nature in the construction of the coot's nest. She builds at so early a period of the season, that she is in danger of being inundated by the spring rains. Against casualties from these, she guards both by the quantity and the buoyancy of her materials. The height of her nest allows a considerable rise in the surface of the surrounding water, and when that increases too much, the nest is so buoyant that it can float off, bearing her and her eggs in safety, to another portion of the water. This elevation of the nest is apt to expose both the coot and her eggs to the buzzard, and other predatory birds, and for this purpose she carefully seeks the concealment of the tallest flags and rushes. The coots are prolific birds; the female lays from twelve to twenty eggs, and she generally has two broods in the year. The eggs are about the size of those of the common hen, and of a dull white colour, with dark spots running into blotches at the thick end. In some places those eggs are in considerable request. In flavour they are certainly inferior to those of the hen, but they are more handsome in appearance. The female sits about three weeks; and the instant the young quit the shell, they swim and dive and play in the water with the greatest ease and activity.

Many other water-fowl are found seasonally on the margins of lakes; but they, and indeed those that have been mentioned, are not so strictly speaking inhabitants of lakes, as they are of pools, fens, marshes, and the banks of rivers, or upon the shores of the sea.
Deep and clear water is not adapted to the habits of an animal that must float on the surface, and yet find its food, or a part of its food, at the bottom. Shallow waters, where there are the roots of plants, are not only the places where the food of water fowl is found in the greatest abundance, but they are the only places where it is accessible. The features of the great lakes are characterised by grandeur, and as the birds that frequent them have this character, their numbers are comparatively few.

Very deep lakes appear to be as little adapted for fish, especially for the catching of them: the plenty and the sport being in waters that are more shallow, or in the streams and rivers. Many of the British lakes are, however, interesting on account of the fish they contain, and several have species that are peculiar.

Of the indigenous British fishes that are found only in lakes, and are peculiar to certain lakes, and not found in others, the most remarkable are,

1.—THE CASE CHAR.

The Case Char, (salmo alpinus,) of which the habits are not very well known, is found, chiefly, if not exclusively, in Winander-Mere, in Westmoreland. It is nearly in the form of a trout. The back is black, which passes gradually into blue on the sides, which again passes into yellow on the belly, upon which there are a few pale red spots. Though the case char has been found in Winander-Mere, it is not a permanent inhabitant of that lake, but appears to enter it from the sea, for the purpose of spawning, which operation it
performs about the end of September. When it first appears, it is in considerable esteem, but probably more on account of its rarity than of any thing else. It is commonly about a foot long.

2.—THE TORGOC; OR, RED BELLY.

This fish, to which the Highlanders of Scotland give the name of tarrag-gcheal, is much more, strictly speaking, a lake and an alpine fish, than the former, being found in the mountain lakes of Wales and Scotland, in situations from which it is not very likely to migrate to the sea. It is a most beautiful fish, being of a shining bluish purple on the back, which passes into silvery yellow and scarlet, marked with spots of deeper red on the under part. Its flesh is of a red colour: but there is not much known of its habits, only it is understood to remain permanently in the lakes, and to spawn about the beginning of the year. It is in best season in autumn. In size and form, it does not differ much from the case char.

3.—THE GUINIAD.

This fish (coregonus lavaretus,) has some resemblance in its form to the trout, and was classed by Linnaeus in the genus salmo. It is about the size of the former; but has the mouth very like that of a herring, and the covers of the gills of a silvery hue and lustre, but sprinkled with small black spots. The first dorsal or back fin is of a deep blue colour. This fish is found in the larger lakes, in most parts of the
United Kingdom, where the situation is not very high and the cold not very intense. It is found in shoals, and is supposed to deposit its spawn about Christmas.

Trout are found in most lakes, and in many of them eels and pike; perch and other fish are also met with; but some of these are (by common tradition) said not to be natives of the United Kingdom; and, at any rate, lakes are not the best places in which either to catch fishes or to study their natural history. Some of the most interesting fresh-water ones may be mentioned to more advantage in the next chapter.
CHAPTER IV.

THE RIVER.

There is no object in nature, of which the associations are more delightful, than a river. The mountain and the lake have their sublimity; and in the economy of nature they have their uses,—the mountain is the father of streams, and the lake is the regulator of their discharge. The lofty summit attracts and breaks the clouds, which would otherwise not be carried so far inland, or would pass over without falling to fertilize the earth. These are collected in snow, and laid up in a store against the bleak drought of the spring; and as the water, into which the melting snow is gradually converted during the thaw, penetrates deep into the fissures of the rock, or into the porous strata of loose materials, the fountains continue to pour out their cooling stores during the summer. The lake, as has been mentioned, prevents the waste of water which would otherwise take place in mountain rivers, as well as the ravage and ruin by which that waste would be attended.

These have their beauty and their value; but they can, in neither respect, be compared to the river. They are fixed in their places, but that is continually in motion,—the emblem of life;—the source of fertility,
the active servant of man; and one of the greatest means of intercourse, and, consequently, of civilization. The spots where man first put forth his powers as a rational being, were on the banks of rivers; and, if no Euphrates had rolled its waters to the Indian Ocean, and no Nile its flood to the Mediterranean, the learning of the Chaldeans and the wisdom of the Egyptians would never have shone forth; and the western world, which is indebted to them for the rudiments of science and the spirit that leads to the cultivation of science, might have still been in a state of ignorance and barbarity no way superior to that of the nations of Australia, where the want of rivers separates the people into little hordes, and prevents that general intercourse which is essential to even a very moderate degree of civilization.

The river is a minister of health and purity. It carries off the superabundant moisture, which, if stagnating on the surface of the ground, would be injurious both to plants and animals. It carries off to the sea, those saline products, which result from animal and vegetable decomposition, and which soon convert into deserts those places where there are no streams. When the alkalis and alkaline earths, that enter into the composition of organized bodies, are once united with the more powerful acids, they cease to be capable of again forming part of the living structure. Lime, which, chiefly combined with phosphoric acid, enters largely into the composition of bones, combines more intimately with sulphuric acid, and is then unavailing for animal purposes. It is the same with those alkalis which enter into the composition of plants.
and animals. Potass and soda are the alkalis usually found in vegetables; and the acids, with which they are found in combination, are, principally, the carbonic and acetic; though, in saline plants growing near the sea, there is usually a small portion of muriate of soda, or common salt. Now these combinations are easily dissolved by sulphuric or nitric acids, and the compounds which these form with the alkalis cannot be again dissolved by the weaker acid; so that if potass of soda be once united to either of those acids, it ceases to be fit for entering into the vegetable structure. The alkali which is found most abundant in animal structures, is soda, and the acids with which it is found combined are principally the muriatic and phosphoric, or some having a weaker attraction for it than the muriatic. Ammonia is obtained abundantly in the decomposition of animal matter; but there is much reason to believe that it is formed during the process. Now, whenever any of those salts are changed to the nitrate or the sulphate, or when any of their alkaline bases are combined with nitric or sulphuric acid,—combinations that are sure to take place in every instance when the salt or the base comes in contact with either of these acids,—a substance is formed which cannot, by any natural process of which we have any knowledge, be again separated so that the alkali may again enter into the composition of an organic structure. Thus, if these substances were allowed to remain, they would gradually accumulate, and the termination both of animal and of vegetable life would be the consequence.

Of this we have many proofs: in those warm regions which, through the want of irrigation by water, have
become deserts, there is always a crust of some of those salts upon the surface; and the beds of dried-up lakes in warm climates contain quantities of the same, while all their vicinity is sterile. On the surface of the neglected lands, the coat is comparatively thin, but in the basins that once were lakes (as in some of those in Mexico,) it is several inches, or even feet, in thickness. The greater thickness in the beds of the lakes, shows that there must have been an accumulation there while the bed was filled with water; and hence it is evident that the purification of the soil from saline compounds, deleterious to vegetable and animal life, is one of the most important functions of rivers; and if not so immediately necessary to the existing races of beings, at least essential to their permanent continuation.

Rivers also tend to purify the air, as well as to drain the earth of deleterious matter. The current of water that descends from the high ground, causes a gradual motion in the air, by which that over different kinds of surfaces is interchanged. This is all that is meant by purifying the air. When it remains long over any particular kind of surface, it ceases to take up the effluvia, which, by stagnating, would be converted into a poison. It is by changes of this kind, that winds, hurricanes, and thunder-storms are said to clear the air; and what they do with violence, is silently done by the ever-flowing current of a living stream.

Nor, important though they be, are these all. Dead animal and vegetable matters accumulate in water, and then undergo decomposition, in the course of which they give out gases which are pernicious. Disease is always found about stagnant waters; and "the reek o'
the rotten fens,” is one of the most disagreeable things
that can well be imagined. But the river carries off all
these, and runs pure and limpid; and thus its motion
is an instrument as well as an emblem of life. Nor are
the advantages confined to the river, while it is a
rapid stream winding its way among hills and uplands;
they continue through all its course; and, in the puri-
fication of the air especially, have their full effect when
it has sunk down nearly to a level estuary, enjoys the
benefit of a tide from the sea, and is useful for the
purposes of navigation.

Take, as an instance, the British metropolis—waiving
the benefit that its commerce derives from the river,
and the utter impossibility of carrying on that com-
merce without it. Suppose, for a moment, that nearly
a million and a half of human beings, with all their
domestic animals, and their fires and furnaces, and other
means of contaminating the air, were huddled together
on a plain, elevated only a few feet above the level of
the sea, and surrounded by marshes, which London
once partially was, and always would have been, had it
not been for the drainage of the Thames, and the gra-
dual elevation of the banks of that river, by the debris
that it is constantly bringing down. It would have
been a region of death, instead of the healthy place
which, in spite of all its magnitude, it is. The tide in
the Thames not only produces a constant current, and
therefore change of air, in the direction of the river;
but the sea and the land air that it ultimately brings,
occasion, by their difference of temperature, a play
of cross wind to and from the hills on the north
and south; and thus the river puts in motion currents,
by means of which the whole city and suburbs are ventilated.

Thus we see that, setting aside all its natural beauty, all the direct fertility that it produces, all the living creatures that without it could not exist, all the uses to which it is applied in the arts, and all the facilities which it gives to intercourse and trade,—that, setting all these aside, and looking upon a river as merely a physical part of the creation, it is one of the most important that can engage our attention. But when, to the abstract consideration of the river itself, we unite that of those adjuncts, they pour in and swell the utility, just as the tributary streams roll in and augment the parent tide. Occupying the most sheltered part of the district, and the part toward which the rains and torrents wash all the more fertile mould of the uplands, the river possesses on its banks the most rich and abundant food for vegetation; and, by doing so, it affords both the best shelter and the most plentiful subsistence for animals. Hence quadrupeds, birds, and insects, flock to it, to drink its waters, to browse the herbage upon its banks, to walk in its groves, to sport over its surface, or to commit their young to its tide. Nor is it the favourite only of the tenants of the earth and the air; for there is a charm about the aquatic tenants of a river, that is not found in those either of sea or of lake. They seem to partake of the wholesome freshness of the living water, and to show the effects in the beauty of their colours, the briskness of their motions, and probably in the delicacy of their flesh as food. Those who carry sentiment into nature, condemn angling as a cruel sport, though anglers, from the time of Izaac
Walton, and probably from long before that, have been proverbially a kind-hearted and poetic class of men,—models of mildness, as compared with any other sportsmen. A man who is amid the beauties of nature in calm and silent contemplation, or intent only upon the capture of a trout, is in a situation the very best calculated for forgetting animosity, and cherishing kindness and good-will for all mankind; and any means by which that frame of mind can be ensured, are cheaply purchased at the expense of any quantity of mere spoken sentiment,—more especially of that very questionable kind, which is just as forward to batten upon the fish, as to condemn the angler.

In Sir Humphry Davy's "Salmonia," there is a passage, descriptive of river scenery, which is so true to nature, and, at the same time, so poetical and beautiful that we cannot refrain from quoting it:—"As to its (angling's) practical relations, it carries us into the most wild and beautiful scenery of nature; amongst the mountain-lakes, and the clear and lovely streams, that gush from the higher ranges of elevated hills, or make their way through the cavities of calcareous strata." (We should not, for our fishing, give a preference to streams that run through calcareous strata; but n'importe.) "How delightful, in the early spring, after the dull and tedious winter, when the frosts disappear, and the sunshine warms the earth and waters, to wander forth by some clear stream,—to see the leaf bursting from the purple bud,—to scent the odours of the bank, perfumed by the violet, and enamelled, as it were, with the primrose and the daisy;—to wander upon the fresh turf, below the shade of trees;—and, on the surface of the
waters, to view the gaudy flies sparkling, like animated gems, in the sunbeams, while the bright, beautiful trout is watching them from below;—to hear the twittering of the water-birds, who, alarmed at your approach, hide themselves beneath the flowers and leaves of the water-lilies;—and, as the season advances, to find all these objects changed for others of the same kind, but better and brighter, till the swallow and the trout contend, as it were, for the gaudy May-fly; and till, in pursuing your amusement in the calm and balmy evening, you are serenaded by the songs of the cheerful thrush, and the melodious nightingale, performing the offices of paternal love, in thickets ornamented with the rose and woodbine."

There is, indeed, a calmness and repose about angling which belongs to no other sport,—hardly to any other exercise. To be alone and silent, amid the beauties of nature when she is just shaking off the last emblems of the winter's destruction, and springing into life, fresh, green, and blooming,—that, that is the charm. The osier bed, as the supple twigs register every fit of the breeze, display the down on the under side of their leaves, and play like a sea of molten silver, for the production of which no slave every toiled in the mine; and at that little nook where the stream, after working itself into a ripple through the thick matting of confervae and water-lilies, glides silently under the hollow bank, and lies dark, deep, and still as a mirror, is made exquisitely touching by the pendent boughs of the weeping willow that stands "mournfully ever" over the stilly stream. In such a place, who could refrain from moralizing? From the
days of Pliny, and probably from days long before Pliny was born, it has been customary to look upon a river as the emblem of human life. It brawls its sparkling and playful childhood among the mountains, "leaps down into life" by the last cascade. Then it mingles among busy scenes:—laves alike the castle and the cottage, grinds at the mill, and glitters round the churchyard; broadening, and slackening its pace while it runs; and at last mingles in the mass of departed rivers in the boundless expanse of the ocean. The simile is not a bad one; and as a well chosen simile is to him who wishes for thought without pedantry and formality, what a well-dressed fly is to an angler, it will bear to be pursued a little farther; and this is the more pardonable, that the termination—which at the ocean is tinged with gloom and despair, may be brightened into hope and exultation.

The river is not, in its physical structure, in the water of which it is composed, the same for one day, or even for one hour; but still, there is an identity which is never lost, amid all those changes. Just so with man: in his structure, in his pursuits, in his feelings and associations, he changes every hour; but still he is the same individual,—the chain of identity is never broken. Whence does the river receive that constant supply, which enables it to run perennial to the sea, in omne volubilis ævum,—ever draining, yet never dry,—ever wasting, yet never the nearer done? There is a spirit in the air,—an invisible agent, which sustains the fountains of life; and by the action of which, the river is enabled to flow, and man to contemplate its beauties, and meditate upon its wonders. It has been mentioned
that the river, in its course, washes away those substances, which would be hurtful to plants and animals, and carries them to the great laver of the ocean, where the materials of new lands are mixed and prepared. Over the surface of that ocean the atmosphere spreads its wings,—a spirit brooding over the abyss; and it, by an imperceptible and inscrutable chemistry, separates the water pure and limpid, sending it back to the mountains to feed the springs; and thus the river, which otherwise would run completely dry in a very short time, is kept in perpetual flow. It is thus hidden for a time in the ocean, but it is not lost; it enters there, foul with the course which it has run upon earth, and it ascends again, purified by the breath of heaven. Just so with man: the faculties of the body are laid and lost in the dust; but the Spirit from on high calls him up again, pure and immortal, equally safe from the contamination of the world, and the corruption of the tomb.

Even that little nook is an emblem of life; so true is it that nature is beset with tongues, if we would but cease our own idle noise and listen to them. There are the activity, the flowers, and the weeds of life in that little rapid and struggle; there is the calmness of the grave in that smooth, dark, and stilly pool; and the weeping willow is both a monument and a mourner.—The wind is on the pool, however; it has shaken the May-flies from the pendent boughs of the willow; the little things are struggling upon the waters; and mark those boiling circles! the trout hastens to the feast. One plunge after another, and every plunge is the death-note of a fly. Well may
the willow weep; for its shade, calm and beautiful
though it be, is a very Golgoltha, where thousands are
immolated every hour, and thousands more perish in
the stream.

They who pule about the trout, have no compassion
for the fly, to which life is as sweet as to any other
living creature. They cry out at the putting of a
hook in its jaws, but they mention not the millions
of which the same jaws have been the grave; they
complain that a net is spread for the fish, but they
never will reflect that the same fish converts the whole
stream into a net for the capture of his prey. If there
be cruelty in the one case, there must be cruelty
also in the other; but the fact is, there is cruelty in
neither. The trout feeds upon the flies; man feeds
upon the trout; the purposes of life are served; and
nature tempers the supply to the waste.

One word more about the cruelty of angling. As
man is superior to all other earthly creatures, the
purposes of man are those that ought first to be con-
sidered; and there are two points to guide the con-
sideration,—moral justice to ourselves, that we do not
waste our time, or injure our sense of right and wrong
by our purpose; and moral equity, that we invade
not the privileges of other men. Now in any of these
acts that we call cruelty to the animals, we are wrong
when the purpose in view does not call for the act,
or when there are other means of accomplishing that
purpose,—as when a brutal person attempts to beat
into action an animal that stands more in need of food
or rest. When we do the act even with a purpose,
there is apt to be a taint, a lessening of the delicacy
of feeling toward our fellows, in proportion as the animal to which the act is done approximates to man in structure or association. That which shrieks and throbs with pain, from which the blood flows warm, and the breath escapes in sighs and convulsions,—the killing of a hare or a rabbit, or even a pig, is much more likely to contaminate, than the death of a trout, which has little or nothing in common with us. A cat is a predatory animal, and yet a man of any pretensions to right feelings would rather pull a few thousand fishes from the stream, than kill the mouser which sat basking in the lone old woman's cottage window, and had for ten long years been the only associate of its mistress. This maudlin tenderness, which is often the cloak of cruelty of a far worse description, is another of the fruits of that bastard tree of knowledge, which produces words, not things; and the very summit of which is so dwarfed and lowly, that it can command but a little shred of the prospect. Before we decide, we should see the whole; for if we do not understand that, we shall never be able to comprehend the purpose and working of any of the parts. But we had almost forgotten

THE WATER-FLIES.

The habits of the water-flies show that nature has intended them as food for the fishes. Very many of them pass through the first stages of their being in water; and when they become perfect flies, the surface and vicinity of that element are still their haunts. They are in general short-lived; and the instinct of
continuing their races brings them to the water that they may there deposit their eggs, and that when the ends of their being are accomplished, their bodies may not be lost, but serve as food for those inhabitants of the water, which in their turn serve as food for each other, for fishing birds and quadrupeds, and for man.

Water-flies are of many genera and species; and many flies which do not naturally breed in water, and also beetles, are blown upon the water by accident, and supply food for fish.

The water-flies, properly so called, that are most abundant on trouting streams and other waters that are shaded and sheltered by trees, may be reduced to three leading genera:—

*Phryganæ*, or water-moths;
*Ephemerae*, or day-flies; and
*Tipule*, or crane-flies,—though the latter are rather meadow-flies than water ones, as most of the species deposit their eggs in the earth, in fungous plants and other substances on land, and not in the water.

The *Phryganæ* include all the species of water-flies that have very long *antennæ*, or feelers, besides four wings, which, when they are at rest, they fold over their bodies in the same manner as moths. Their wings, however, want that exquisite powdery plumage which characterises the wings of the moths, properly so called. They belong to the Linnaean order of *Neuroptera*, or nerve-winged insects, the wings consisting of a fine membrane spread upon a nervous tissue resembling that in the leaves of plants. These flies
are vulgarly called green flies and yellow flies, from the colours of their bodies, and also willow flies, alder flies, or other names, according to the trees that may be most prevalent on the banks of the rivers, as they usually deposit their young on the leaves of trees. The eggs are attached to those parts of the tree that hang over the stream, the mother glueing them on with a viscid juice that nature has supplied her with for the purpose. The eggs remain there till they are hatched, and produce larvae, which are long, with the body divided into rings, and having six feet. When those larvae fall into the water they would instantly be devoured by water beetles, by fish, and by the larvae of other insects, such as those of the dragon-fly and the dytiscus beetle, were it not that they instantly build a house or case for themselves. These houses are formed of various substances, as grains of sand, small shells, bits of vegetable matter, cemented together by a glue which the larva produces. One species makes choice of lemna or duck-meat, the little green plant which covers the surface of ponds and other stagnated waters in the summer. The leaves of the duck-meat are naturally round, and therefore not very well adapted for being united into a solid fabric without a great waste of materials, but the larva cuts them into perfect squares, and puts them together so neatly, that its house seems to be covered with a delicately chequered green riband wrapped spirally round it. This case connects them entirely, but they can at pleasure protrude the head for the purpose of feeding, which they do indiscriminately upon vegetable and animal food. These larvae are well known to anglers, who give them
the name of callis, and consider them as an excellent bait. When the larva is about to change its state, it rises with its case to the surface, fastens that to some water-plant by silken threads; and after remaining for two or three weeks in the state of a chrysalis, comes forth from its case a perfect fly. The Phryganæ are usually the first flies upon the water, and on that account they get their common name of spring flies. In the early part of the season they appear only during the warm time of the day, and in those gleams of clear sunshine which brighten the variable weather of March and April; but as the season becomes warmer, they make their appearance only in the morning and evening; and at the very hottest period of the season only during the night. Thus their habits, as well as the structure of their wings, have some resemblance to those of the moths. Fish are exceedingly fond of those insects; and therefore when they are upon the waters, imitations of them are the surest fishing-flies.
The Ephemere, or day-flies, which name they get rather on account of the period to which their longest life is supposed to be limited, than to the time of their appearance, come later upon the water than the Phryganeae. These, like the former, have four neuropterous wings, but the hinder pair are so small, that they seem only to have two. Their antennae are short, compared with those of the spring flies; and they carry their wings erect. Some of them have three, and others two long filaments in the tail.

The economy of these little creatures is very curious. The females of most, if not of all the species, deposit their eggs upon the surface of the water, when they sink to the bottom, and the maternal duties and cares are at an end. The egg thus deposited is soon hatched
in the water, and the little animal enters upon the longest of its states of existence. They are furnished with six feet and six fins, so that they can either burrow in the mud or swim in the water. The former is a favourite practice with many of them: they are said to live upon the soft mud; and they certainly do make holes into it for some little distance, when they turn and burrow their way back to the water by another route. They live in this manner for two or three years, or possibly for a longer period, without quitting the water, or coming to its surface; and the larva and chrysalis are not easily distinguished from each other. They are supposed to remain in the latter state for some time, until the temperature of the air suits their final transformation. When in the water, they cast their coats several times, and empty coats may be found floating on the surface; but these may in many cases have had their substance sucked out by the larvae of other insects.

There seems indeed to be more labour in the bringing forward of this little creature of a few hours' existence, than in that of an elephant. The three or four years' preparation in the water, and the change at the surface, from the cased nymph to the winged insect, are not all. Even when winged, it is but for flight to the nearest bank, where it again casts its covering, wings and all, and comes out the final fly in which the wonderful life soon closes. The males appear to do little else than shake their wings, and then drop down and die; but the females are more active, though they too hurry their task of depositing their eggs, lest death should overtake them ere it be accomplished.
The numbers in which these creatures escape from the water, are truly astonishing. Under favourable circumstances, they literally fill the air in a few minutes, and their cast skins are like a scum upon the water. Those which appear in the heat of summer are supposed to be the longest lived; for in spring and autumn, when the nights are cold, there is usually a new and a different race every day; and sometimes two or more between sunrise and sunset. The females of most of the species light upon the surface of the water, and deposit the whole of their eggs; but there are others, such as that called the grey drake, that gambol over the surface, and only occasionally touch the water. Skilful anglers often take advantage of this, by having an imitation of the green May-fly which they allow to float, and a grey drake farther up the line, which by a nice management of the rod they contrive to make touch the surface only occasionally. Those which sit upon the water, deposit their eggs all at once, in two packets or bags, each containing from three to four hundred. So immediate a change of bulk might derange the action of the little animal, but it is prepared with two air-cells of considerable magnitude, which it instantly inflates, and thus is enabled to rise if it shall escape the watchful eyes of the fish; and as there are thousands for every fish, abundant store of eggs is at all times deposited. We are apt to wonder at this apparent waste of labour upon creatures so small, so short-lived, and so destined for destruction; but nature knows no labour; the laws of her productions are simple, certain, and unerring, and no effort is needed but the primary one of creation.
The Tipulæ are different in their appearance from any of their genera. Gaffer Longlegs, who so often buzzes round the candle, and pays for his temerity with limb and life, is one of the giants of the race. They are dipterous or two-winged insects, and their legs are generally long in proportion to their bodies. The small insects that are seen so constantly over moist places in warm weather, are tipulæ. They frisk, gambol, and buzz like the gnat, (culex pipiens,) but they do not sting like that insect, neither is their noise troublesome during the night. Many of the species deposit their eggs in the earth; but there are also others that do so in the water, the larvae of which burrow in the banks.

Those three genera of little creatures, in their successive generations, probably exceed in number every other description of visible animals; and as one passes from them to those that are still more minute, and cannot be discovered without the aid of magnifying glasses, one cannot help being astonished at the abundance and variety of life of which the world is full; nor is the demonstration of an Almighty Creator the less clear and forcible when we attempt to trace the infinitely small of his works, than when we think of millions of systems of worlds, and turn our contemplation to that universe, "whose centre is everywhere, and its boundary nowhere;" wherever our course of inquiry lies, there is always a point at which we must drop that inquiry as beyond our powers, and turn in adoration of Him who is infinitely mightier and more wonderful than it all.

Of the inhabitants of the water, by which the summer
triflers on the surface are consumed, the most interesting to man are

**THE GENUS SALMO.**

That prince of fishes, the salmon, \((salmo salar,\) from which the genus is named, is an estuary fish rather than a river one; and though angled for in some rivers at a great distance from the sea, it is never there in its primest perfection. It ascends the rivers for a particular purpose, and when it has reached the grounds that are adapted for that, it should be left undisturbed, as the capture is then wanton, a race being destroyed; and yet the parent, in whose capture they are lost, is not in a condition for being wholesome food. The proper fish for the river angler's sport is

**THE TROUT.**

There are a good many ascertained varieties of trout, and there are probably more supposed ones, arising from differences of the water in which they live, or the substances on which they feed. The proper freshwater trout \((salmo fario)\) is found, in large lakes, of a very great size, weighing as much as sixty or seventy pounds. It is somewhat like the salmon in the sea; however, not often or easily caught; but when it begins to ascend the rivers, which it does for the purpose of spawning, at an earlier or later period of the summer, according to the situation, it may be taken. Whether the fishes themselves be large or small, the eggs in the roe of the trout are said to be all of the same size,
only the very large ones contain ten or even a hundred times as many as the small.

The time when the trout spawn is generally about the month of November. The eggs, or roe, are first deposited, and then the milt over them, and they are wholly or partially covered with sand or gravel. The bottom of clear running water is the best adapted for the purpose; and that is the kind of ground which the trout instinctively choose for their operations. Four or five weeks are supposed to be sufficient for the hatching of the eggs, but that depends a good deal upon the situation and the weather; the eggs in a shallow mountain stream which is apt to freeze, being supposed to remain unhatched till the ice be cleared away in the spring. When the young fish first make their appearance, they are not wholly detached from the egg, but have a portion of the yolk attached to the lower part of their bodies, which is understood to constitute their first nutriment. It does not appear that the eggs can be hatched in water that is distilled, or in any other manner deprived of air, or in that which is impregnated with lime, or any other ingredient that is deleterious to the fish in a grown state. Some have even said that they have seen the young trout still attached to the remains of the eggs upon a shallow sand bank, poking their little heads above the water; but though we have looked for this, we have not found it, neither have we found the fry of the trout adhering to the place where the spawn had been deposited. We have seen it in the case of those of the salmon, and thus can have no doubt that it also happens with trout.

About a week or ten days after the first bursting of
the egg, the fry are entirely clear of it, and begin to seek their food with avidity, preying upon very minute insects and larvæ, though there are some larvæ which are said to prey in turn upon them, while they are also the prey of all larger fishes, even of those of their own species.

The trout, when in a healthy state, is always marked with fine crimson spots, but the general colour varies with the quality of the water in which it is found. If that be good and clear, the trout is of a fine pale brown on the back, passing into yellowish and silver grey on the belly; but when the water is blackened with moss or otherwise habitually foul, the colour is more dark and dusky. The colour of the flesh is always white, and the scales never have any of that pearly lustre which characterizes the sea-trout and salmon. The river-trout is not understood to migrate to the sea; or if it does, its habits become changed, and the stages of the change have not been observed. There is a good deal of confusion about the history and habits of fish, especially of some of those that are found only at particular places, such as periodically in the estuaries of rivers, and, indeed, with trout themselves,—the produce of different rivers, even those that are at no very great distance from each other, being dissimilar in their appearance, though not so much so in their habits. It is generally supposed that the larvæ and insects, and earth worms in a recent state, which form the principal food of trout in clear and rapid streams, are the causes of the greater brightness and beauty of their colours, as well as of their superior sweetness. It is said also that the Gillaroo trouts at
Galway in Ireland, are not a peculiar species, but that they are the common trout changed by habit, the thick and almost cartilaginous stomach, somewhat like the gizzard of a fowl, being produced by the shell-fish upon which they feed; and that the sea-water, with the saline substances on which they feed, redden the flesh and give the pearly lustre to the scales of the sea-trout. The salmon is adduced as a collateral proof, and certainly the flesh of the salmon is a much finer red, and the scales have much more lustre, when it first leaves the sea-shore, than when it has been long in the fresh water, and especially after it has spawned. But the condition of the flesh at those two times depends upon other causes than the difference between fresh and salt water; and if salt water had a tendency to redden the flesh of any kind of fish, one would be apt to think that it would have the same with all fish; yet of those taken in the sea the majority are white.

The trout is a very voracious fish; and as, like those of very many fishes, the teeth are not adapted for mastication or chewing, the prey is taken into the stomach entire; and there, in ordinary cases, probably reduced to a chymé, or substance fit for nutriment, by solution. In some cases, however, such as that of the Gillaroo-trout, where the animal has to subsist on crustaceous food, which it has no means of taking out of the shells, or otherwise managing, but by swallowing them whole, the stomach acquires great thickness, and probably the food is ground and reduced by muscular action. That part of the subject is, however, involved in considerable obscurity; and indeed a great part of the economy of fishes demands more careful attention than has hitherto been bestowed upon it.
Besides larvae, insects, worms, fresh-water mollusca, and smaller fishes, trouts feed on frogs, water lizards, and sometimes, it is said, on toads, though from the acrid secretion that exudes from the skins of the latter, which they seem to be preparing when they swell themselves up, and which is probably their only means of defence, they cannot be either palatable or wholesome. It seems doubtful whether trout, or any of the other fishes that swallow their food without mastication, have much, if any, sense of taste. On their tongues, or the internal surface of their mouths, there is nothing analogous to the papillae on the tongues of the mammalia; and it may therefore be concluded that they have no means of discriminating the qualities of the substances on which they feed. Some writers have even gone so far as to conclude that, as the fishes have no means of judging of the substances that enter their stomachs, they cannot be poisoned in that way. Perhaps that may be going a little too far; but certainly they admit of a wonderful latitude of aliment, and are certainly much less affected by any change of it than quadrupeds or birds. The organs of respiration seem to be the only delicate or sensitive part of fishes; as it is always in the gills that they are immediately affected by impure waters.

Though there has been a good deal of investigation of the subject, and organs of hearing, of some sort or other, have been found in most species of fishes, yet they are simple and obscure, as compared with those of land animals; and hence we may conclude that their sense of hearing is proportionally feeble. That they are affected by loud sounds has been proved by ex-
periment; as there are authenticated cases of trout and carp coming for their food upon the ringing of a bell. It is not understood that there is much sense of touch in the mouth of fishes, and that the fixing a hook there does not affect them much, unless it interpose with, and prevent, the action of those muscles, upon which the motion of the gills and the operation of respiration depend. But that they are not destitute of sensibility on the general surface of their bodies, is proved by the well known operation of tickling a trout; in the course of which, the fish, instead of making the least effort to escape, will press itself against the hand, as if to invite a continuation of the enjoyment.

When out of the water, trout appear to feel a great deal of pain; and as that is an unnecessary continuation of suffering, anglers generally dispatch them the instant that they are off the hook. Eager fishers, when they have a prospect of success, sometimes neglect that, and we once witnessed rather a ludicrous retribution. A gentleman, who is now a professor in one of the universities, was a great enthusiast both in literature and angling; and as he lived in a fine retired part of the country, well adapted for both, he generally pursued them together by the bank of the river. When it was unfavourable for the rod, he took up the pen; and when the shadow or the breeze came, the rod was resumed. One day he had succeeded in landing a fine trout, which he put into his basket alive, and as the time was favourable, he began to fish with double ardour: but his hook got entangled in the bank, which was rather steep, covered with long grass and bushes, and contained the holes of water-rats,
shrews, and, as was understood, otters. As he lay along the bank, and stretched down to disentangle the hook, the trout, in the basket on his back, gave a flutter, and the belt of the basket came in contact with his neck. The idea that *lutra* had him by the throat, in vengeance for the inroad both upon his mansion and preserve, darted across the angler's mind; to escape from the foe, he tried to start up; but position had given his heels the buoyancy, and he pitched somerset-wise into the water.

**THE OTTER.**

![Image of an otter](image)

The Common Otter (*lutra vulgaris, mustela lutra*, Linnaeus) is the most formidable of British aquatic quadrupeds. It is found near both lakes and rivers, but it prefers the latter, as they are better fishing grounds.

The body of the otter is of a blackish brown colour, with three white spots; one under the chin, and one on each side of the nose. It is a long animal, the body measuring about two feet, and the tail sixteen inches.
Though the otter swims and dives with wonderful facility, it cannot be considered as an amphibious animal, or an animal that can remain very long under water. When by accident it is entangled there, which it sometimes is, by getting into nets, and attempting to plunder them of fish, but not able to get out again, it is soon drowned. It is indeed provided with a diving apparatus, which shows that the water must be carefully excluded from its lungs; the nostrils are furnished with membranes, which close them like valves, whenever the muzzle gets under water. The ears and eyes of the otter are also very small; but the latter, which are clear and bright, and adapted for enabling it to see under the water, are so placed, that its vision takes in a very wide range. The feet of the otter are short, but they are armed with very strong claws or nails, which are grooved on their under sides, as is usual with animals that burrow in the earth.

Otters are rather solitary animals; at least, not more than one pair are usually found in the same immediate neighbourhood, and their haunts are in concealed banks. As is the case with the golden eagle and some other birds of prey, the young are driven from the paternal dwelling by the old ones, as soon as they are able to procure their own food.

The nest or burrow is sometimes a crevice that is found ready made, but as often an artificial one, the entrance of which is under the water, or at least so close to it, that no land animal can enter. The female goes with young about nine weeks, and brings forth four or five at a litter. The time of their usual appearance is in March or April, later in the colder parts of the country.
than in the warm. When taken young, the otter may be tamed with very little attention, and in that state it is very playful, and shows a good deal of affection for those who feed it. It may be trained to catch fish for its master. The cubs may be suckled along with puppies, or fed upon milk and bread, as if they get animal food, especially fish, at too early a period, they are not so apt to obey, but will attempt to make their escape when allowed to take the water. When once its attachment has been won, it is, however, very steady; as is the case with all animals which, in their natural state, find their food chiefly in the water.

When in a state of nature, the otter is exceedingly ferocious, or rather it maintains its ground with great resolution. Its bite is very hard; and when seized by dogs, it catches them by the fore leg, a part in which they are very tender, and will retain its hold till the bone snaps. Vulgarly, it is said to do the same with men; and stories are told of the hunters stuffing their boots with cinders, in order that the animal, which is then allowed to fasten upon the boot, may mistake the cracking of the cinders for that of the bone; but though we have seen an otter send dogs off howling, we never saw one offer to attack a human being, but rather show every wish to be suffered to carry on its fishing with peace and quietness.

When food is plentiful, the otter is delicate in its eating. The time when the salmon are ascending the rivers to spawn, is the feasting time of the otter; and then it is so dainty, that it eats only the choice portion near the head; and the country people, in some places, watch, and carry off the rest of the fish. It is sometimes
taken in a naked trap, set in the pathway between its hole and the water, but seldom in a baited one, as it is not fond of any prey but that which it catches for itself. Instances are mentioned, in which it has been said to be taken by seizing the minnows with which people have been fishing, but the accounts are not very well authenticated.

The fishings of the otter are not confined to, though they be chiefly carried on in, fresh waters. In the Shetland Islands, it frequents the shores of the sea, and fishes along with the seals.

When the otter is "frozen out," by the snow storms, it is forced to enter upon a new course of life. It will then travel to a considerable distance, attack lambs, poultry, and sucking pigs; and is very destructive to rabbits, as it follows them through all the windings of their burrows. These are the times at which it is most successfully hunted, and the time too at which the skin, which is a very excellent fur, is the most valuable. When the water is not frozen, the otter is difficult to capture, unless it can be shot, as it takes to the water, and only occasionally "vents," as the hunters call it—that is, raises its nose to the surface to breathe. The old hunters, who set more value upon the difficulty of the capture, than on the prey itself, attack the otter in posse comitatus, beat the banks with dogs, hedge in a space with nets, and assail the otter with clubs and spears, when he comes up to breathe. In catholic times, the otter was eaten, and was ranked among fish, of which it has the smell and taste, certainly; and therefore it was a feast in Lenten days. Now it is caught only for the skin, which is valuable at all times,
except in the very heat of summer, when the fur is dry and loose. The hair, which is delicately sleek and glossy, is used, either along with the skin as a fur, or felted as a finishing pile to fine hats. Almost the only other British quadruped that is found near, and in fresh waters, is,

**THE WATER-SHREW, OR WATER-RAT.**

*The Water-Shrew* (*sorex fodiens*) is a small quadruped, compared with the otter. It is a handsome little creature, at least, in as far as hue and gloss of covering go. On the back, it is of a fine raven black, and the under part is white, but with a black line along the middle. The ears are wide, and lined with a tuft of pale-coloured fur, apparently to defend them from the action of the water. The eyes are small, and have the same sort of protection. The hair upon the tail of the water-shrew is very short, and the tip is almost white. Its body is about three inches long, and the tail two, its weight is less than half an ounce.

When alive, the fur of this animal is remarkable for its power in resisting water, and as it plunges into the streams, the drops recoil from its dark coat like pearls. For so little a creature, it swims and dives very fast, and shows great agility in catching the fry of small fishes, young frogs, and insects; but it also feeds upon roots, and probably upon grass, as the approach to its hole is kept very neatly shorn. It burrows very fast in the soft banks of rivers and ponds, and as it carries its galleries a long way, it is injurious to the banks of the latter. In Holland, where a great portion of the
surface is below the level of the tide and the sea fenced off by dykes, the water-shrew is hunted as one of the most dangerous enemies of the country. In Britain it is not much heeded, though dogs search for it, and sometimes make their appearance with it hanging to their noses. The female shrew is said to produce nine young in a litter, and to have several litters in the course of the year.

There is one very singular aquatic animal on which the shrew feeds—an animal at the very lowest extremity of animated life—an animal without organs of locomotion, and, indeed, hardly organized, and yet it preys upon animal food. That is the fresh-water polypus, \((hydra \text{ viridis})\). It is found sticking to plants, in slow running shallow streams of fresh water, and it is by no means uncommon. It consists of a single sack or tube, about an inch in length, and open at both ends. Its substance is of a jelly-looking matter, mixed with small glandular bodies. It is furnished with filaments, or, \(tentaculce\), by means of which, it lays hold of small \(molluscae\), the remains of which are, after digestion of the soluble parts, discharged by the mouth. Simple as it seems, however, it can make a sort of progressive motion, in which it fastens its head and tail like a leech. It can even rise to the surface, where, opening the tail like a funnel, it holds itself suspended, its body with the air in the funnel being lighter than the bulk in water. It is chiefly when in this state of exhibition that it is hunted and captured by the shrew.

The means of reproduction in this apparently very simple animal are very singular. Little buds appear
on the sides of the parent *hydra*, gradually expand and acquire tentaculæ, and when these are of sufficient size for catching food, the young animals loosen from the sides of their parent, drop off, and become independent. Nor is the reproduction confined to the formation of new animals by buds; for sluggish as life seems to be in this Zoophyte, it seems not to depend on even the simple organization of the whole animal, but to be instinctive and perfect in every part of it: if the water hydra be cut in two or more pieces, these pieces do not die, but gradually reproduce the other parts and become perfect animals. Thus, even in that which a careless observer would not believe to be a living animal at all, but merely part of the remains of a dead one, there is not only one life, but absolutely a number of lives,—all so perfect and vigorous as to be capable of fabricating new organs for their use, and preserving its existence. Here we have a remarkable instance of that ingenuity which is displayed in all the works of nature; which is even the most remarkable where we would least expect it; and which should teach us, that every thing around us is fraught with information.

As the greater number of fishes deposit their spawn in shallow water, where it may be acted upon by the air—an action which appears to be absolutely necessary for the hatching of the young, the estuaries of rivers are the resorts of many finny visitants; and, at times, they literally swarm with the fry, or young. These are sometimes beaten back by storms when they are in the act of entering the sea, and cast upon the shore in myriads. We have seen a bank of young herrings nearly a foot high, and extending for miles along the shore,
after a sudden and violent storm, cast on the eastern coast of Scotland. That might naturally be expected: the soft structure of a young fish cannot be supposed capable of resisting the tumbling and lashing of that broken water, which can tear asunder beams of oak and bolts of iron. When the fish is in the deep, it is safe from those casualties; but even whales, that sometimes leave their distant haunts, and visit the British seas, are unable to contend with the surge, and thus they are wrecked, cast on shore, and left by the tide. We are not aware of any instance where that has taken place, except upon low and shelving beaches, or where the fish has got entangled among rocks and been left dry or aground at low water. Thus we find that, though the provisions of nature are abundant, they are never superfluous: the animal that can live and move in the water, which is a homogeneous element, is unable to sustain the conflict of air, sea, and earth in a storm.

The migration of fishes is even a more curious matter than that of birds, especially in those that alternately visit salt and fresh water. The water is their atmosphere—the element from which they elaborate the air necessary for their life and growth; and any change of air, even nearly as great as the change from salt water to fresh, would be fatal to any land animal with which we are acquainted. Change of temperature in the element which they breathe, is that which land animals can endure best, while fishes are adapted to bear a change in the composition. The former are protected against variations of temperature, by the heat of their bodies being, in general, greater than that of the air; for, when the air is warm, they suffer and pant, pro-
bably, because they have no excess of heat to enable them to decompose the air, and mix the oxygen with the blood and the superfluous carbon.

Fishes do not bear their change so easily. A salmon, when caught in the open sea, dies if put into fresh water; and if one that has been for some months in fresh water, be put into salt, it also dies. It is the same with almost every fish. Hence the breathing apparatus of a fish must undergo a change, every time that it passes from the sea to fresh water, or from fresh water to the sea. These changes are not immediate; and therefore the fish linger awhile in the estuaries, upon every journey, in order that, by the brackish water, and by that alternate play of fresh and salt water which is occasioned by the tides, they may prepare themselves gradually for their new element.

Though, generally speaking, the sea pasture tends more to promote the growth, vigour, and fatness of the fish, than the river pasture; yet it also demands the stronger organization; and thus, those fish that enter the rivers for the purpose of spawning, are all of delicate descriptions, and the young often linger so long about particular parts of the estuaries, that they are not unfrequently mistaken for distinct species. Still, all this is in strict accordance with principle; and affords (as, in fact, every thing upon which we can reflect affords) a proof that, though the works of creation be many, the plan and the purpose are one. There is not one power to adapt the fish to the water, and another to adapt the water to the fish: the adaptation is reciprocal, clearly proving that the power is one. The whole is one complete machine, and no part can be
wanted or subsist alone. If the accomplishment of any purpose demands a change of power, or even of structure, there is ample provision for the effecting of that. When young frogs, and naked larvae of insects, continue habitually in the water, they have the fins and the habits of fish; but, when they change their abodes, they change also their forms and habits.

The organs of respiration in fishes are very curious,—more so, perhaps, than those of land animals, because they have a double function to perform,—first, to separate the air from the water,—and then, to decompose it. The system of circulation in fishes is, however, less complicated than that of the warm-blooded land animals. In these, the heart is double; and every time that it is compressed, that which has been aerated in the lungs, is poured, by the aorta and its ramifications, over the whole system; while that which has passed through the system, and in its course supplied new materials, and washed away such as were unfit for life, is sent by the pulmonary artery to the lungs, in order that it may be there washed, renovated, and made fit for the purposes of life, by contact with the air. It may be that this double circulation is necessary for keeping up the heat of the animal; and this is rendered as probable as any thing of a similar kind can be, by the fact of its being peculiar to the warm-blooded animals, and by their being always the animals which are most exposed to the atmosphere, and liable to be affected by its changes of temperature.

In fishes, the heart is single, and the whole of the blood which returns from the circulation by the veins is sent directly to the organs of respiration. For this
purpose, the heart of a fish is situated very near the gills; and sends off from its ventricle one artery, which is ultimately ramified over the whole fibrous mass of the gills in a very minute manner, and forming a tissue which is very tender and sensible, and bleeds profusely when lacerated. The surface which the gills present to the water is very great; for Dr. Monro, whose researches threw much light upon this curious branch of Natural History, calculates that those of a large skate at 2250 inches, about equal to the whole surface of a man's body.

In the cartilaginous bodies, which have their skeletons comparatively soft and pliable, and are therefore without distinct joints, the gills are fixed; while in bony fishes they are free; each gill, or mass of fringe, being attached to a separate curved and moveable bone. The gills are, with at least few if any exceptions, open to receive the water from the mouth only. The filaments float backwards from the bones, and the action is produced from the motion of the gills themselves—and the gill-covers and the gill-flaps in which these terminate in some species. If the water enters the gills from behind, the filaments appear to get entangled, the circulation of the blood is stopped, and the fish is strangled, or as it is usually called, drowned. The very same takes place when, by wounding the muscles that move the breathing apparatus, the motion of the gills is prevented, and also, when the application of any caustic substance, such as quick-lime, destroys the surface. The breathing apparatus of fishes is thus liable to be deranged both by mechanical and by chemical injuries.

It is impossible to contrast this complicated respi-
ratory apparatus in fishes, with the simplicity of their general structure, without admiration. Their organs of motion are as simple as the fluid in which they swim, considered merely in a mechanical point of view; but when they have to perform their double purpose of decomposing water and air, nature heaps resource upon resource, till observation is bewildered and confounded at the multiplicity of parts and the nicety of their action; while acuteness of feeling, which would be superfluous in the organs of motion, or in those of the mouth and palate, is bestowed largely upon the gills to defend them from injury. When a fish is allowed to expire, the last convulsive motion is in the gills and gill-covers.

In fishes that inhabit the sea, there is a triple function for the gills, as the salts which the water holds in solution have to be separated. They have also, in many cases, to be separated from the food: and probably it is this separation which calls for a more powerful organization in sea fishes than in those that live only in fresh water. Among the older marvels with which triflers in the study of nature amused themselves, one was, "why the salt sea produces fresh fish!" but that is nowise more wonderful than that the sea should produce fish at all.

THE SALMON.

Of all the migratory fish that frequent the British rivers, the salmon is by far the most valuable, both as an object of study, and an article of food. Its form is fine, its motions graceful, and when in the very prime of its condition, it is certainly the most delicious food
that the water supplies, and it has the advantage over other delicious kinds, of being very abundant. So long as the inhabitants of the north have their salmon, they need not envy those of the south their turtle.

Salmon being fond of a low temperature, are confined to the northern hemisphere, and even in that they are not found only from about the parallel of the south of England northwards, from which, toward the arctic circle, they are found in the greatest numbers. They seek the alpine streams, but they prefer those that are not frozen over; and they are said instinctively to return to those in which they were produced. This cannot of course be absolutely authenticated, as their march in the deep cannot be followed; yet there are characteristic differences in those of different rivers, sufficient to enable the fisherman to know them; but whether these characters be derived from the place of their nativity, or stamped upon them annually after they leave the sea, and enter the estuary, is not absolutely determined. There are some facts, however, which would lead one to conclude that their local characters are not annual. After they have once entered an estuary, there is no reason for supposing that they descend again, till they have deposited their spawn; and thus it is by no means probable that the same individual would be found in two estuaries during the same season; and yet if the characters were seasonal, this would be required, before a Tweed salmon could be found in the Tyne, or a Tay salmon in the Forth. These are, however, of frequent occurrence, and so decided, that those who are familiar with the varieties of salmon, never mistake
them. The salmon having ascended the streams as far as they are able, and penetrated into rivulets and brooks, where there is hardly water to cover them, begin to deposit their spawn in the early part of September, and continue it till the end of October; those which leave the sea first, being the first to deposit the spawn. The growth of the roes and the milts is attended with a falling off in the flesh, flavour, and general condition of the fish; and by the time that the eggs in the roe have acquired the size of common duck-shot, the fish ceases to be eatable, or at least to be wholesome. As the period for depositing the eggs approaches, the head of the male salmon undergoes a considerable change. The points of the jaws are elongated and curved, and become of a horny consistency, which is a preparation of nature for enabling him to make the nest or bed for the young.

When the female is ready to deposit the eggs, she becomes the suitor, going in quest of a male, which accompanies her from the deep water, to the shallow or bank that is fitted for their purpose. When she has made her choice, they begin their operations by the male forming a trench, which he does in a hollow of the bank as soon as possible; and the female assists him, though she takes a comparatively light share of the labour. Those poachers who destroy salmon in close time, are well aware of the power which the female has of attracting the male to the shallows; accordingly they watch till the two have begun digging; and then, knowing the male by his crooked jaws, they transfix him with a spear. The capture is both wanton and wicked: wanton, because the fish
is not really wholesome food; and wicked, because it causes, for no adequate compensation, the loss of thousands of salmon. When the male is thus captured, the female does not continue her operations, but goes in quest of another male; and we have heard of instances in which one female has thus occasioned the death of five or six males in the course of a day.

When no such wasteful outrage is committed, the salmon labour at their trench, till it and the heap of sand or gravel with which it has again to be covered, be of sufficient size. Then the female deposits her eggs, and the male deposits upon them a milky fluid, in appearance very like that which is found in lettuce and many other plants; and when the eggs are all deposited and covered in this manner, the parents spread the gravel and sand over them, which closes their paternal labour for the season. The operation lasts for some time, often for several days; and the male is so assiduous in digging the beds and replacing the gravel, that he has been known to die of fatigue.

Both are indeed very much exhausted; their very appearance is altered. Their heads seem out of proportion, and the horny curvature of the lower jaw of the male penetrates, and even perforates the upper jaw; their colour is dull and brownish; their bodies lank and flabby; their scales almost entirely rubbed off; and their fins are ragged. Nor is exhaustion the only inconvenience to which they are subjected; for a fresh water worm, (lernea salmonea,) infests that most sensitive part of them, their gills—and is, in all probability, instrumental in driving them to the sea.
Salmon that have spawned, are called "shotten salmon." They are also called kelts, black fish, foul fish, shedders, and kippers. They are found only in the deep places, and avoid the banks of the rivers. Their course is regularly toward the sea; but it is sluggish, on account of their exhausted state; and they are often observed resting in those places where the water is more than usually still. The length of time that the salmon take to descend the rivers must, of course, bear some proportion to the distance to which they ascend. In British rivers, the descent may be considered as, on the average, over by the end of December; but as they are not gregarious, and do not even go in pairs, except while spawning, their progress is quite irregular, and some have begun to ascend, or at least appeared in the estuaries, before the last of the kelts have descended the river.

A question has been raised as to whether the salmon do, or do not spawn every year; and, though the question does not admit of direct proof, there are some circumstances that would lead to a belief, that they do not spawn annually. The fishers include both males and females under the common name of "spawners;" and, in addition to these, they distinguish "barren fish," in which neither milt nor roe is found, and which do not ascend the rivers, or change their places, except by going a little further off the shores, or out of the estuary, in the tempestuous months. Another fact is, that the length of time between the kelts leaving the river, and the fish, in very fine condition, entering it, is rather short for allowing the great change which they exhibit to take place. We have heard intelligent salmon-fishers
say, that those barren fish are not quite in so high condition, or nearly so much infected with the sea-louse, as the spawners, when these are first found in the salt water. Further, those barren fish are not gilses, or young salmon; as they are of full size, and as the gilses ascend the rivers to spawn, as well as the full-grown salmon. Thus there is, at least, some ground for believing that, after the exhaustion of ascending the rivers and spawning, the salmon take one season, or probably more, to recruit themselves in the sea; and if such be the fact, the continuance of the barren fish, for the greater part of the year, would lead one to conclude that salmon never make long journeys at sea; and this again would explain why the varieties, peculiar to different rivers, are so easily distinguished. The same fishermen have assured us, that, in the lower part of the estuaries, the spawning salmon, or, as they are sometimes called, the "run fish," are never taken near the shore, but that the barren fish are more abundant there than in the strength of the tide or current. This further strengthens the opinion that has been hazarded, and it also agrees with the habits of the salmon. Its principal food in the sea, is the sand-eel or launce, *(ammodytis tobianus,* a fish, on the average, about four inches long, which buries itself with wonderful rapidity in the sand, and which is most abundant in shallow water, or near the shores.

It is rather singular that the natural history of a fish which is so well known, and so productive of profit, should be so very imperfect. But we ought to reflect who have been the compilers of the popular systems of natural history in this country. Even Lord Bacon, in
spite of all his sagacity, set down the salmon as a short-lived animal, because it grows rapidly, an analogy which may be true in animals or plants of the same species, but which is certainly not true in those of different ones. The goose and the eagle are both rapid growers, and they are both remarkable for their longevity. Goldsmith has set the salmon down as a ruminating animal, and the mullet and some others have also been said to chew the cud: they do not chew at all; though they, in all probability, discharge by the mouth those parts of their prey which are not digestible, and which are too large for passing through the pylorus into the intestines, just as is the case with the birds of prey; or, the motion of the jaws and gill-covers, when the fish is breathing, may have been mistaken for rumination. The food of the salmon, when in the rivers, as well as that of the herring, when on the coasts, is rather an obscure matter; as the stomachs of both are generally found empty. That they do eat flies and also small fishes and worms, is certain, as they are taken by imitation flies, and by various baits; but the fly is their favourite food, as when they do not rise to a well-dressed fly, it is in vain to attempt their capture with bait. Even those that are captured in the sea, have not, generally, any thing in their stomachs, though instances have occurred of their containing the launce above mentioned, as also sprats, and other small fish; but it has not been ascertained whether the individuals in which these substances were found, belonged to the spawners or the barren fish of the fishers, as they have been met with only in salt water.

At a period, varying a little with the state of the
weather, but, generally, about the month of April, the heat of the sun begins to hatch the eggs, which not only lie dormant during the winter, but are supposed not to be in the least injured, though completely frozen. The young fish begin to raise their heads through the sand and gravel, but continue for some time attached to the eggs, from the remains of which they derive their nourishment. A fisherman, who had long been familiar with salmon, in all their visible stages, compared their first appearance to the springing of a bed of "young onions."

After the fry are once detached from the eggs, they increase very rapidly in size; and at the age of a month or six weeks they take their passage downwards to the sea, increasing in bulk as they proceed; and making a halt for some time when they first come to brackish water, as they are not able to bear the salt without a sort of gradual preparation. In this state they are called "smouts" by the fishermen, and numbers of them are often stranded in stormy weather. In June and July the smouts disappear; and by the time that the last of them have vanished, the first re-ascend the river as gilse. Sometimes these are larger than the smaller full-grown salmon, but in general they are not so large; their tails are straight at the end, whereas those of the salmon are forked; and they have neither the pearly lustre, nor the rich colour and flavour, of a salmon immediately from the sea. They ascend the river for the purpose of spawning, which operation they no doubt perform in the same manner as the mature fish; but they either change to salmon after their first spawning, or they
continue more than one season in the sea; as they have not been found to ascend the rivers twice as gilses.

The appearances of the salmon in these three states, have led to the same mistakes with regard to them that we have noticed in eagles. There are milts and roes in the gilses, and rudiments of them in the smouts; and on this account, as well as on the differences in their appearance, they have been regarded as distinct species,—although a different appearance before and after the period of full maturity be so far from a rare occurrence, that it is one of the most common in the economy of nature. The salmon is not the only fish about which there is this confusion and difference of opinion. The smelt, \textit{(osmerus epirlanus,)} which comes from the sea to the estuaries of some rivers in the beginning of winter, hardly ascends farther than the water continues to be salt, or at least brackish, spawns early in the spring, and retires to the sea in the summer, has been often regarded as the fry of some fish, known or unknown. The fry of the \textit{Shad,} or mother herring, \textit{(clupea alosa,)} has often been considered as a distinct species. The shad is a larger fish than the smelt, being as long as eighteen inches; while the other is seldom so much as twelve. But, excepting that they come into the rivers at different times of the year, they are rather similar in their habits. The shad leaves the sea about May, ascends a little way into the fresh water, and having deposited its eggs, again returns to the sea. Salmon fishers often catch it in their nets; and when "stake nets," or permanent nets, were used in the lower parts of rivers, for the
purpose of catching salmon, they entangled and destroyed a great deal of the fry, both of the smelt and the shad. The fry of the shad lingers a good while in the fresh water before it enters into the salt. In the Thames it remains about Greenwich during the month of July. During the time that it remains it is sought after as a great delicacy; and the corporation of London, as conservators of the river, in vain attempt to monopolize it, under the name of white-bait. As this fry of the shad, when in the state of white-bait, is very young, not above a month or six weeks old, it contains only the mere rudiments of roes and milts; and thus they who have made a species of it, have been put to some shifts in attempting to account for the mode of its production.

Besides the instinct which guides them to those places where they can deposit their spawn in fresh water, so shallow as that it can be acted upon and warmed into life in the spring, the salmon appear to have another inducement to quit the sea. At that time it is covered with a parasitical insect, which, though the fact be not very well authenticated, is supposed to cause a disagreeable itching in the surface of its body. The natural history, and even the species of this insect, is obscure; and it has not been properly studied; neither is it known whether it feeds upon the substance of the salmon, or merely attaches itself to the body of that fish in the same manner that other sea-insects attach themselves to rocks, marine plants, the bottoms of ships and other substances, from which, though they can get support, they cannot get any nourishment. The fishers call this parasite the "sea-
louse;" and that may have led to the belief that it feeds upon the salmon, or is annoying to it. But the remarkably high condition and vigour of the salmon are proofs that this adhering animal cannot be a very great annoyance, or very destructive in its ravages, if it be a ravager at all. At all events, if the salmon be necessary for its existence, the sea is obviously more so; for it shrinks and drops off almost immediately after the fish has entered into fresh, or even into weak brackish water. The more that this parasite is found upon the fish, the more exquisite the flavour; and those who have not tasted it, can form no idea of the richness of a sea salmon, instantly out of the water, which has not been injured either by its own struggles or by being handled. The flakes are firm, brilliant in colour, and delicious; and sauce is superfluous, any further than a little of the liquor in which the fish has been boiled. There is a rich curdy matter between the flakes which dissolves in the liquor and thickens it to the consistency of cream; and there is a flavour, and even a perfume about the whole, which cookery would find it very difficult to imitate. But this exquisite richness of the salmon, like the aroma of some of the more delicious fruits, cannot be transported. The salmon that are taken with it, lose it when they are carried, even in boxes of ice; and those which pass only a small number of miles up the fresh water lose it also. So striking is the difference, that those who are accustomed to taste the salmon caught in the estuary of the Tay, to seaward of Broughty Ferry, where the banks and shallows are of pure sand, and the water is nearly as
much impregnated with saline matters as that of the ocean, do not relish the salmon that is caught about Perth, only about five and twenty miles up the river, with a wide estuary for great part of the way, and a tide, though of fresh water, to the termination.

On this account it is to be regretted that, in consequence of a decision of the House of Lords, given, as one regrets to say, more in the spirit of aristocracy than in that of wisdom, the fishings in the lower or sea part of the Scottish estuaries have been in a great measure destroyed; and that, for the keeping, or upon the pretext, of laws and privileges, made and granted in times of comparative barbarity and ignorance, the public should be compelled to use salmon in a state much inferior to that in which they might have had it. At one time, permanent nets, extending for a considerable way into the water, were erected in all the estuaries; and, while there was plenty of room for the free run of spawning fish in the centre or deep part of the river, great numbers of fish in the very best condition were caught in these nets. But as these modern improvements could not have been contemplated generations before any one thought of putting them in execution, the proprietors of the upper parts of the rivers had got vested rights in the salmon; and, that these might not be interfered with, the public are obliged to content themselves with salmon in a state closely verging upon that in which it is not wholesome, instead of having it in prime condition.

When the salmon have once entered a river, their progress is not easily stopped. In Europe, notwithstanding the length of the course, and the number of
difficulties with which they have to contend, they are said to ascend the Rhine and the Aar, pass through the Lake of Zurich, and find those places in the shallows of the Limmat, among the secluded valleys of the central Alps, in which they were at first produced. In like manner, the salmon of North America ascend the long rivers of that country, pass through the lakes, and find their way to their native streams, with the most persevering industry and the most unerring certainty.

In their progress, they always have their heads to the stream; and their muscular power must be very great, as they shoot up the rapids with the velocity of arrows. They are sensitive and delicate in the extreme; and equally avoid water that is turbid or tainted, and that which is dark with woods or any other shade. They serve as a sort of weather-glasses; as they leap and sport above the surface before rain or wind; but during violent weather, especially if it be thunder, they keep close to the bottom; and they either hear better than many other species of fish, or they are more sensitive to those concussions of the air produced by sound, as any loud noise on the bank throws them into a state of agitation. When their progress is interrupted by a cascade, they make wonderful efforts to surmount it by leaping; and as they continue to do that at places which a salmon has never been known to ascend, their instinct cannot be to go to the particular spot where they were spawned, but simply to some small and shallow stream.

Many "salmon-leaps" are celebrated, in those parts of the country where there are cascades upon the clear
rivers in which they delight; and their efforts and devices have been a little exaggerated both in prose and in verse. All fishes that take long or powerful leaps, incurvate their bodies when they spring from the water; and that has given rise to the vulgar belief that, when they are to spring over a cascade, they take their tails in their mouths. Michael Drayton, the poet, has described this as part of the economy of the salmon at the leap of Kennerth upon the Tivy, in the county of Pembroke; and the same has been said of those at other places; but instead of fact, it is utter impossibility,—a salmon so fastened could not leap at all. That the fish bends itself laterally is true, because the muscles have of course their principal action in that direction in which the tail can act as an oar in swimming, and as a fulcrum in leaping; and that, when they put forth all their vigour, the tail is brought nearly in contact with the head. We have watched them often, both in places where they could succeed, and where they could not; but though we could distinctly see the curvature before the fish vaulted into the air, the whole effort was so instantaneous, that we could not discover clearly whether the body was bent to or from the fall; we think, however, that it was bent toward it; and as, in the eddies from which they take their spring, this position would give the tail most power as a fulcrum, there is every reason to believe that that is their position.

The rivers of the Scottish mountains are the best adapted for witnessing those feats; and the places where we have seen them to most advantage are at the fall of Kilmorac, on the Beauly, in Inverness-shire, and
at the Keith of Blairgowrie, upon the Erich, in Perthshire. Both these places have many charms for the naturalist and the lover of nature. They are the first passes into the mountains; the scenery around is peculiarly fine; and plants and animals are very abundant. The rocks by the very margin of the stream are in some places of stupendous elevation, while their bases are shaded, and even their beetling tops crowned with native timber, rich in foliage and vigorous in growth. They are, in fact, zoological and botanical gardens of nature's own preparing, in which there are very ample collections. The rocks are lofty enough for affording an eyrie to the eagle; and the coppices by the banks of the stream are close and tangled enough for sheltering the wood-cat and the otter. Both have this advantage too, that they have habitations which harmonize with the wildest of these beauties. The house of Craighhall stands hundreds of feet above the foaming Erich, on the top of an abrupt precipice. The garden at Kilmorac parsonage also overhangs the fall.

The pool below that fall is very large; and as it is the head of the run in one of the finest salmon rivers in the north, and only a few miles distant from the sea, it is literally thronged with salmon, which are continually attempting to pass the fall, but without success, as the limit of their perpendicular spring does not appear to exceed twelve or fourteen feet; at least, if they leap higher than that, they are aimless and exhausted, and the force of the current dashes them down again before they have recovered their energy. At Kilmorac they often kill themselves by the violence of their exertions to ascend; and sometimes they fall
upon the rocks and are captured. It is, indeed, said, that one of the wonders which the Frasers of Lovat, who are lords of the manor, used to show their guests, was a voluntarily cooked salmon at the falls of Kil-morac. For this purpose a kettle was placed upon the flat rock on the south side of the fall, close by the edge of the water, and kept full and boiling. There is a considerable extent of the rock, where tents were erected, and the whole was under a canopy of overshadowing trees. There the company are said to have waited until a salmon fell into the kettle and was boiled in their presence. We have already mentioned the avidity with which the wild cats watch the salmon at this fall, and we need hardly add that the otters commit great depredations. The salmon are remarkably abundant in that river; and as the fall confines them to the space below, they are found in good condition. We have seen as many as eighty taken in a pool lower down the river, at one haul of the seine, and one of the number weighed more than sixty pounds.

The Keith of Blairgowrie is a still more singular place. It is at the junction of the hard mountain breccia, with the soft red sand-stone which is found along a great extent of the southern edge of the Grampians. All the rivers in that quarter have cut deep channels in the sandstone: but the breccia being in many places very hard, it offers interruptions. Its hardness is, however, not uniform; so it is hollowed into very singular cavities. Some of these are circular pits of regular figure and considerable dimensions and depth; often deeper than the adjoining bed of the river, and unconnected with it, save during floods.
Locally, they are called "giants' kettles;" and the country people regard them as the productions of men or of magic, though they be simply the effect of the stream dissolving the softer parts of the rock. It is probable that they have been produced by little cascades, caused by interruptions that are now worn away; as they are found under those cascades which still exist. The Keith is a remarkable one. The river has cut a channel for itself in the upper surface of the mass of breccia, by which, during drought, it is almost concealed, and it is so pent up in the gorge, that an agile and adventurous person could at these times jump across. In this gorge, there is still partially concealed, under the rocks, a fall of about thirteen feet in height, which would not prevent the ascent of the salmon on account of its height, but does so when the river is low, on account of the great velocity with which the water passes through and discharges itself from the narrow gorge. The pool, or kettle, into which the water falls, is of great depth, not less than thirty feet. During a long continuance of dry weather, the salmon accumulate in it in considerable numbers; and in a favourable state of the light, they may be seen, not merely covering the extent from side to side, but actually built, as it were, one stratum above another, all hanging suspended in the water, and waiting till a flood shall come, and, by filling the gorge, overflow the rocks, and thus convert the fall into a brawling rapid which they can ascend. As this place is much further from the sea than the fall at Kilmorac, the fish are not in so good condition when they arrive at it; but great numbers of them are caught by a bag-net on the end
of a very long pole, which is plunged into the water until the net is supposed to be further down than the salmon, then it is moved laterally out of the place where it was plunged, and drawn to the surface, generally with success. This fishing is not, however, unattended with danger; the rocks are slippery with spray, and small aquatic plants; and as the fishers have to overhang the rock in getting to the best fishing, they are sometimes thrown off their balance by the struggling of the salmon, and precipitated into the abyss, from which escape, even on the part of an expert swimmer, is very difficult. The otter, which is active enough in many other parts of the Erich, is said never to attempt fishing in the cauldron at the Keith. But we must close our desultory notice of this beautiful and interesting fish. Its natural history would fill volumes; and therefore, all that can be done in a portion of a single chapter, is to point out how worthy it is of the most complete investigation; and that in studying the instincts and habits of the salmon, science and practical use are inseparably united. We cannot, however, resist quoting the following directions for salmon-angling from the Edinburgh Encyclopædia. They accord far more with our own observation than any thing that we have seen in print.

**CATCHING A SALMON.**

"There is scarcely any time, unless when it thunders, or when the water is thick with mud, but you may chance to tempt the salmon to rise to an artificial fly. But the most propitious are critical moments; or, un-
doubtlessly, when, clearing after a flood, the water has turned to a light whey or rather brown colour; when the wind blows pretty fresh, approaching to a mackerel gale, (if not from the north,) against the stream or course of the river; when the sun shines through showers, or when the cloudy rack runs fast and thick, and at intervals discovers the pure blue ether from above. In these situations of the water and of the weather, you may always depend upon excellent sport.

"The most difficult thing for a beginner, is to throw the line far, neatly, and to make the fly first touch the water. A few attentive trials will, however, bring him to do it with dexterity. It should always be across the river, and on the far side, when you expect the fish to rise. If he appears, do not be too eager to strike, but give him time to catch the fly; then, with a gentle twist, fix the hook in his lip or mouth; if he is hooked on a bone, or feels sore, he will shoot, spring, and plunge with so much strength and vehemence, as to make the reel run with a loud and whizzing noise, and your arms to shake and quiver most violently. In this situation, take out the line from the winch quickly, though with composure, keeping it always at the same time stretched, but yet ever ready to yield to his leaping. Do not let it run to any great length, as it is then apt to be unmanageable, but rather follow him, and if he comes nearer, you retire, and wind up as fast as possible, so as to have the line tight; and hold your rod nearly in a perpendicular situation. When he becomes calmer, he often turns sullen, and remains motionless at the bottom of the water. Then cast a few stones upon the spot where you think he is, and this,
in all probability, will rouse him from his inactive position. If you have no servant or attendant to do it for you, be cautious in the lifting and throwing of them, as the salmon may spring at that instant, and break your tackle, should you be off your guard. Being again in motion, he generally takes his way up the current, do not then check him, as by this way his strength will be the sooner exhausted. When, now fatigued, and no longer able to keep his direction, he once more tries all his wiles in disengaging himself from the guileful and hated hook; he crosses and recrosses, sweeps and flounces through every part of the pool and stream; but finding all his efforts to be vain, he at last, indignant of his fate, with immense velocity, rushes headlong down the stream. If the ground is rough or uneven, or if you cannot keep pace with him, give him line enough, and when it slackens wind up again until you nearly approach him. You will then probably observe him floating on his side, his motion feeble, and all his vigour gone. Being unable to make any farther resistance, it behoves you now to lead him gently to the nearest shelving shore; use no gaff, as it mangles the fish very much, but take him softly by the gills into your arms, or throw him, if not too heavy, upon the top of some adjacent bank."

As the salmon is seldom in the rivers in time for the spring fly, the May fly is often imitated as a lure for him, but is only an imitation, as it has to be made of gigantic dimensions. The only fly of which a natural imitation makes a good salmon fly, is,
THE DRAGON FLY.

The under figure is the nymph case; the one attached to it, the fly in the act of escaping. The upper is the full formed *libellula varia*.

Of the Dragon Fly (*libellula*) there are several varieties, called water nymphs, adder bolts, and other names, varying in length from half an inch to two inches and a quarter. They are all remarkable in their appearance, and gaudy in their colours; and salmon at all times, but more especially when the water is clearing after a flood, prefer them to any other food. The dragon flies are the most vigorous of British winged insects; and their long wings, of which they all have four, make a whizzing noise as they vibrate them in the air. Though the largest and most gaudy are usually seen about the margins of rivers, rivulets,
and ponds, they are not, when in their winged state, confined to those situations, but roam to a considerable distance in quest of their food. They may be often seen hovering over flowers, especially those of which the nectaries are so deep that the small flies, which live upon the honey, are forced to creep into them. From this, one who had not watched them, would be apt to suppose that they were in quest of honey. That, however, is not their food: they frequent those places in order that they may prey upon the flies which are intent upon the honey; and if one finds a dragon fly quietly pounced upon a flower, one may be sure that he has made a capture. The large ones may be found on the margins of rivers, beating the reeds and sedges, and other aquatic plants, with the greatest assiduity, in order to discover the moths that shelter there in the heat of the day. The only safety of the moth is in concealment, for the dragon fly is provided with powerful organs of vision as well as of motion, and if he once gets sight of the prey, he seldom quits it, and will even pick it up from the surface of the water with great agility, though, in those cases, the salmon sometimes make reprisals. The usual way with the dragon fly is to pounce upon his victims while they are sitting; and for that purpose, his favourite time of hunting is when the sun is clear. This not only finds him easier prey, as the moths are very reluctant to stir in such states of the atmosphere; but it also contributes to his security, as the times when he feeds are those at which the fish usually lie basking and inert.

The female deposits her eggs in the water, and as
the times at which she does that are those that are too dusky for hunting, she is very apt to be captured by the fish. Indeed, when the salmon are intent upon fishing, they do not wait till the fly touches, but spring up and catch it at a considerable distance; and we have observed, that when a dragon fly has been thus hit in the air by a salmon, but not caught, and fallen upon the surface of the water, another salmon has risen at it, and borne it off in triumph.

The bringing of so many winged insects to hover over the water, either in search of food, or for the depositing of their eggs, is one of the principal means by which the fish of ponds and rivers, whether migrant or stationary, are nourished; for if there were no flies upon the water, there would be neither salmon nor trout; and even in the vulgar view of the matter, in which animals which know no law but the law of nature, and never violate that unless they are compelled, are accused of cruelty, the dragon fly suffers no injustice. The whole of its own history is a tissue of destructions, both when it has come into the air and become a fly, and when it is in the water. Nay, such is its voracity, that it slaughters prey in all the states of its being, even in those states in which many insects are not only abstemious, but motionless.

The eggs which the dragon fly drops into the water, fall to the bottom, and if they are not found by fishes or insects, they are soon hatched in the sand; and when the larvae make their appearance, they commence their depredations upon every thing smaller and weaker than themselves. It is generally understood, that, all insects, whatever may be the number and times of
their transformations, and however much they may vary in appearance, have the forms or cases of the whole, the one within the other, in the same manner as those that cast their skins without altering their forms, are understood to have the rudiments of all the skins; but where the transition from one state to another is great, a period of quiescence is required; for which the insect prepares, by forming for itself a case, out of materials furnished from its own substance. With water insects, the transitions are not so great; and therefore there is less quiescence, and a less change in the quantity and nature of their food. The phryganeæ and ephemerae, already mentioned, have, both in their larva and their chrysalid state, a very remarkable resemblance to the perfect fly, only they are without wings, which would be worse than superfluous, so long as they inhabit the water. When they come up to the surface, it is only the bursting of a thin membrane, in which they are enclosed, and they are free and fit for their new mode of life. It is the same with the dragon fly. The head of the larva bears a very great likeness to that of the fly; the body is also like, only it is not so thick at the thorax, most likely, because the muscles that are to move the future wings are not developed till they be needed. The larvae of the dragon flies are of a dusky colour, inclining to brown or green, according to the species,—those of the Lib. varia, the largest and most showy of the British species, are brown, and far from handsome. They have the same hard mandibles as the winged insects, and six legs, ending in feet armed with claws. They eat voraciously, and cast their skins several times before they arrive at their full growth. No prey comes wrong to them; for
be it insect or larva, if they can hold it with their mandibles, they do not quit it, till it be drained of all its juices. They are even said to commit havoc for its own sake, and kill when they have no intention of eating. This can hardly be supposed, because there is no purpose in it, and there is a purpose for every instinct; but still they may kill without the necessity of immediate eating. Many animals hoard up food; and, when a fox or a vicious dog kills a number of sheep, he does it not from any hatred to sheep, but that he may have a store of food. Now there is no reason why a voracious larva should not obey, in the water, the same kind of instinct which a voracious quadruped obeys upon the land. The larva is, no doubt, a much smaller animal than the other, and we are much less acquainted with its habits; but it does not hence follow that its instincts are less perfect.—Life and instinct have nothing to do with physical extension.

The dragon fly is understood to inhabit the water for about two years, during which time it continues to feed voraciously, and to change by slow degrees from the first larva to the ultimate fly. Sometime before this takes place, the rudiments of the wings are discernible under the covering or sheath of the animal, and the thorax has increased considerably in size. When it is to change to a fly, it creeps up the stem of some water plant during the night, that it may not fall a victim to the swallow or any other insectiverous bird, that preys on the surface of the water. In order to extricate itself, it collects the whole energy of its body into the head and thorax, and by grasping the stem on which it hangs with its claws, and making an effort, apparently
inflating the thorax at the same time, it bursts the case along the back, and gradually effects its escape; but it does not entirely leave the case, until its wings, which are at first folded together, have acquired their full extent and lustre, which they speedily do upon exposure to the atmosphere; and the new-born fly wings away to sport its beauties and continue its ravages.

The eyes of the dragon fly are singular pieces of mechanism, and admirably adapted for enabling them to see, in all directions, those insects on which they feed. The surface of the eye is reticulated, or divided into a net-work, of which the compartments are regular six-sided figures. It is computed that there are between twelve and thirteen thousand of these in each eye of the species that has been examined; and that each of these is a distinct and perfect organ of vision, though the whole five and twenty thousand, which the two eyes contain, are for the information of one living principle, and the preservation of one little insect!

We are apt to envy the dragon fly his five and twenty thousand eyes, when we think we have but two; and yet, when we come to reflect upon it, we have the advantage even in the number of our points of vision. The single lens of our eyes is capable of motion in every direction, and with almost instant celerity, over the whole field of vision. The number of points that we can therefore examine without turning the head, is not only greater than that which the eyes of the dragon fly can command, but greater than arithmetic can sum up.

Such are a few of the most obvious and accessible subjects which offer themselves to human contem-
plation on the banks, or in the waters of a river; but they are few as compared with the whole catalogue; and he who would hope to linger by the margin till he had exhausted the whole of its natural history, would be as sure of disappointment as the clown, in Horace, who sat down on the bank to wait until the stream should run dry. The information and the flood are equally perennial; and the one is as refreshing and fertilizing to the mind, as the other is to that accumulated abundance of life of which it is the parent and the support.
CHAPTER V.

THE SEA.

From the consideration of rivers, the transition is natural to that of the sea,—the grand parent and destroyer of rivers,—the source whence they derive their waters pure and limpid, and into which they discharge them to be cleansed from those impurities which they have acquired in their progress through decaying animal and vegetable substances, and their motion along the surface of the earth.

To those who are capable of only gazing upon its surface, the ocean is a sublime sight. "The waste of waters," as we are in the habit of calling it—though it be any thing but a waste, girdles the globe from pole to pole, and occupies nearly three-fourths of its surface. When, on some calm and pleasant day, when there is not a cloud to dapple the sky, or a breath to ruffle the waters, we look out from some lone promontory or beetling rock, upon the soft green face of ocean, and see it extending on and on in one glassy level, till it blend its farther blue so softly with that of the air, that we know not which is sea and which sky, but are apt to fancy that this limpid watery curtain is drawn over the universe; and that the sun, the planets, and the stars, are islands in the same sea in which our own habitation is cast. In the soft but
sublime contemplation, we find the mind expand with the subject; the fancy glides off to places more high than line can measure, more deep than plummet can sound; we feel the link that binds us to creation; and finding it to be fair and lovely, our kindly feelings only are touched, and we exult in the general happiness of that of which we feel that we are a part. If then a vessel should come in sight, with the sun illuminating its canvas, like a beam of light on the blue sea, and moving slow and stately, not seeming to us to be in motion, and yet shifting miles before we can count minutes, how we long to be passengers—to walk upon the waters—to be wafted by the winds—to visit the remotest parts of the earth without half the effort which is required before the sluggard can turn on his couch. Then, if we linger till the sun declines, and his beams are wholly reflected from the glowing surface, what an excess of brightness! An infinitude of burnished gold, and of burnished gold all living and in motion, stretches out at our feet; and as the reflected light upon the shore wakens a gentle zephyr of the air in that direction, the dimpling water plays in alternate sunshine and shade, as if the luminary had been broken to fragments, and gently strewed along its surface.

But if the elements are in motion, if the winds are up,—if the "blackness of darkness," which cloud upon cloud, rolling in masses and roaring in thunder, which answers to the call of the forked lightning, has flung its shadow upon the sea, so as to change the soft green to a dark and dismal raven blue, which gives all the effect of contrast to the spray that dances on the
crests of the waves, chafes around the reef, dashes with angry foam against the precipice, or ever and anon, as the fitful blast puts on all its fury, covers the whole with recking confusion, as if by the force of the agitation, the very water had taken fire;—if one can stand so as to view the full swell of the tempest-tossed ocean sideways, it is indeed a spirit-stirring sight! The dark trough, between every two ridges, appears as if the waters were cleft in twain, and both a pathway and a shelter displayed, while ridge courses after ridge in eager race, but with equal celerity. Some, indeed, appear to fall in their course, and to be trampled down by those that are behind. They are hit by one of those momentary gusts which fall; and where, as Burns expressively has it, the wind is every where blowing

"As 'twould blaw its last,"

it lashes a portion of the surge to a greater elevation than it can bear; or, some bank or hidden rock from below arrests it in its course; and down it thunders in brawling and foam, interrupting the succession, and embroiling its successors in its fate.

Even when seen from the pebbly beach of a lee-shore, the ocean in a storm is a sight both to be enjoyed and remembered. The wave comes rolling onward, dark and silent, till it meets with the reflux of its predecessor, which produces a motion to seaward on the ground, and throws the approaching wave off its equilibrium. Its progress is arrested for a moment; the wall of water vibrates, and as it now meets the wind, instead of moving before it, its crest becomes hoary
with spray; it shakes—it nods—it curls forward, and for a moment the liquid column hangs suspended in the air; but down it dashes in one volume of snow-white foam, which dances and ripples upon the beach. There is an instant retreat, and the clean and smooth pebbles, as they are drawn back by the reflux of the water, emulate in more harsh and grating sounds the thunder of the wave.

Here we may see what a wonderful thing motion is. What is so bland and limpid as still water! what substance half so soft and fine as the motionless atmosphere! The one does not loosen a particle of sand: the other—you must question with yourself, and even add a little faith to feeling, before you be quite sure of its existence. But arm them once with life, or with that which is the best emblem and the most universal indication of life, motion, and they are terrible both in their grandeur and their power. The sand is driven like stubble; the solid earth must give way; and the rocks are rent from the promontory, and flung in ruins along its base. Need we, therefore, wonder that the masts and cordage that man constructs should be rent as if they were gossamer, and his navies scattered like chaff.

The grandest scenes, however, are found at those places where former storms have washed away all the softer parts, and the caverned and rifted rocks—the firm skeleton of the globe, as it were—stand out to contend with the turmoiling waters. The long roll of the Atlantic upon the Cornish coast; a south-easter upon the cliffs of Yorkshire, or among the stupendous caves to the eastward of Arbroath; a north-easter in the Bullers of Buchan; or, better still, the whole mass
of the Northern ocean dashed by the black north wind against the ragged brows of Caithness and Sutherland; those—that especially—are situations in which, if it can be viewed in these islands, the majesty of the deep may be seen. Upon the last, in the acme of its sublimity, one dares hardly look. The wind blows ice; and the spray, which dashes thick over five hundred feet of perpendicular cliffs, falls in torrents of chilling rain; while the vellied stones which the surges batter against the cliffs, the hissing of the imprisoned air in the unperforated caves, and the spouting water through those that are perforated, and the dashing and regurgitation of the latter, as it falls in the pauses of the commotion, produce a combination of the terrible, which the nerves of those who are unaccustomed to such scenes can hardly bear.

And yet there is an enchantment—a fascination almost to madness—in those terrible scenes. Mere height often has this singular effect, which is alluded to by the Philosopher of Poets in his admirable description of Dover cliff:

"I'll look no more;
Lest my brain turn, and the deficient sight
Topple down headlong."

But when the elements are in fury,—when the earth is rocking, and the sea and the sky reeling and confounding their distinctive characters in one tremendous chaos,—when, in all that is seen, the common laws of nature seem to be abrogated, and her productions of peace cast aside, in order that there may be an end of her works, and that the sway of "the Anarch old" may again be universal—the heroism of desperation—
that which tempers the soldier to the strife of the field, and the sailor to the yet more terrible conflict on the flood—comes, and comes in its power,—and the disposition to dash into the thickest of the strife, and die in the death-struggle of nature, is one of the most powerful feelings of one who can enter into the spirit of the mighty scene.

We leave those who allocate the feelings of men according to the scale of their artificial systems, to find the place of this singular emotion, and call it a good or an evil one, as they choose. But we have been in the habit of feeling and thinking that it is an impulse of natural theology,—one of those unbidden aspirations toward his Maker which man feels when the ties that bind him to nature and the earth appear to be loosening, and there remains no hope, but in the consciousness of his God, and of that eternity, the gate of which is in the shadow of death. Thus, amid the fury of the elements, the unsophisticated hopes of man cling to Him, who "rideth in the whirlwind and directeth the storm."

But beautiful or sublime as the ocean is, according to situation and circumstances, we should lose its value were we to look upon it only as a spectacle, and were the emotions that it produced to be only the dreams of feeling, however touching or however allied to religion. To admire and to feel are both essential and valuable parts of our nature; but neither of them is so essential, as to know. That is the antecedent matter; because by it, and by it only, the admiration and the feeling can be properly directed. The first property of the ocean that strikes our sight, is its vast extent; and
the first that addresses our understanding, is the vast extent of its usefulness. The evaporation of water from its surface, cleared from the impurities of the land, and adapted for the promoting of life and fertility, has already been mentioned. But the ocean is also the grand messenger of physical nature: that general law, or phenomenon of the constitution of matter, (for the laws and the phenomena of nature are the same,) by which the earth is maintained in its orbit, and has the figure and consistency which it possesses, and by which the objects on its surface preserve their forms and their places,—that simple law occasions the tides of the ocean; and these, by moving in the very directions which an obedience to this law points out, produce currents, by means of which there is a constant circulation of the waters of the ocean through all parts of the earth’s surface; and the immediate consequence is an equalization of warmth, by means of which, the extremes, both of heat and cold, are mitigated, and the general fertility and comfort promoted.

But, when we come to look a little more attentively at the structure of the earth, we find that the ocean has been one of the grand agents in elaborating it to its present consistency. Large tracks are covered, to a great depth, by beds of gravel, containing nodules of the hardest stone, which are not in angular masses, as if they had been reduced from their native rocks by any action apart from the water—such as that which, by means of alternate frost and thaw, produces the heaps of broken stone that we find on the brows of rocky mountains, and at the bottoms of precipices—but smoothed, and rounded, as if they had been for ages rolled upon
FORMATION OF LAND.

The gravel in the valley of the Thames, for instance, which we find in the most elevated parts of that valley, as at Wimbledon Common, and Hampstead Heath, contains no stone but that very same flint, which at a distance from the river, or even near it, as in the county of Kent, is contained in the chalk formation; but while the pieces of flint that are found in the chalk are angular, and covered with a rugged crust, those in the gravel are all, more or less, rounded; and they have been rounded by rubbing against each other in water, as the hollows in them, which could not be so easily rubbed, have still the same rough surface as those found in the chalk. It is therefore impossible to avoid coming to the conclusion, that the gravel in the valley of the Thames has been formed out of the chalk soil, and formed too by the action of water; nor can we easily suppose that that water has been any other than the sea; because, the gravel has a principle of adhesion, which is not found in the gravel of rivers. Great part of the connecting matter in the binding gravel, is the powder of flint, just in the same manner as in that which does not bind; but it also contains a quantity of salts of lime, which it could have derived only from the impregnation, by the sea, of a portion of the original chalk; and to that it owes its adhesive nature. But wherever the river has continued to wash it, those salts of lime have been decomposed and floated away, and the flint-dust has been left loose. The very same happens if we expose a heap of the best "binding" gravel to the action of rain for a sufficient length of time; it loses its adhesiveness, and becomes loose. Thus it is evident, that the gravel has been
produced by the action of water, and that that water must have been the sea. Many more striking instances could easily be adduced, but this one has been preferred, just because of its simplicity. If we find vast masses of gravel, some of them moulded into hills of considerable elevation, which could not have been produced without the action of the ocean, we need not hesitate to refer to that action, those formations in which the remains of marine plants and animals are clearly to be seen.

But we see the operation in progress. Along most of the high and cliffy shores, even in this country, we find places where every storm and every season take something from the land. We find the stony fragments in the course of being ground and rounded on some of the shelving beaches, and new banks in the progress of formation upon others. It is generally the lofty shore that suffers, because that offers a resistance both to the water of the ocean, and the wind upon its surface, while shores that shelve out, receive the water in a thin plate, and allow the wind to pass over.

In some districts, we find very remarkable traces of the former action of water. In the vicinity of granitic mountains, there are always found vast detached masses of that rock, exposed upon the surface, and rounded as if they had been rolled in water. If those were found only upon the slopes of granitic mountains, their presence could be accounted for by the frost loosening them in winter, and their rolling down the slopes during the rains of spring or summer. Even the rounding of them might be at least partially accounted for, by the action of the water in the places where they
are now found. In Cornwall and Devon, those blocks of stone are numerous; and, indeed, there is hardly a granitic country in which they are not to be found. In fact, we meet with them in all places where there is a valley or water-course, or slope, from mountains of granite to the sea; and yet they could not have been brought to the places where they are found by the action of the existing rivers, in a state any thing like their present one.

The southern part of Finland, which is far from the granitic mountains, and consists of an alternation of pine forests and pools of water, is full of them; and they have lain so long, that the soil has accumulated thick enough for the growth of trees; and that which is only a single stone, has all the appearance of a hillock. The pedestal of the celebrated equestrian statue of Peter the Great, at St. Petersburgh, is formed of one of those masses. It is fifteen hundred tons in weight; was found as a single detached fragment, and brought from a distance of several miles. Some of the granite quarries at Aberdeen consist of those enormous fragments, which are not found in a continuous mass as granite is in the primitive mountains, but in huge separate masses, among gravel and rubbish, which in the lapse of years has become covered with heath or grass.

A very singular stone of this description, lies upon a hill, on the south side of the valley of the Earn, near Perth. We forget whether that stone is granite, sienite, or gneiss, we rather think the latter; but at all events, it lies upon the top of a hill, nearly, or fully, twelve hundred feet high, which is surrounded by lower grounds on every side. This hill is green-stone
itself; and there is not a portion of any of the three alpine rocks above-named found native within twenty miles of it; and the nearest is separated by the deep beds of two or three rivers. Though nothing to the pedestal of Peter's statue, this is rather a large stone, weighing at least six tons, and it is so poised upon a ridge of the green-stone, that it vibrates to the slightest touch of the little finger. Art has had something to do in producing this easy vibration, as the one end of the stone has been chipped, and as these "rocking stones," as they are called, were used as ordeals in the times of superstition; but art had nothing to do with the bringing of it, or of the hundreds of others in the same district, to the places where they are now found. Thus there must at one time have been a power in operation, at a higher level than the present surface of the ocean, which could move masses of many tons in weight to considerable distances; and the only power adequate to effect that purpose, with which we are acquainted, is the ocean.

The remains of animals, even of marine ones, are usually found in soft deposits, where they may have been covered by the return of successive floods, in the rivers now existing. The bones and teeth of the northern elephant, the latter of which, as ivory, form an article of export from Siberia; the accumulated animals in the caves of Germany, England, and other places; the vast mass of fishes in the hill of Bolca, near Verona—with the whales and other animals that have been found in the flat lands near the mouth of the great rivers—such as in the clay at Brentford, and in various clay formations in Scotland, may all be ac-
counted for in this manner: and yet there must have been some general change since they were deposited; because we believe we may say that, without exception, they have been all found higher than the present level of high water. The skeleton of the whale found in the clay at Airthrey, on the Forth, was twenty feet higher than the highest tide. It was seventy-two feet long; and it would not be easy to see how, without the agency of water, a fish of such dimensions could have been raised to such a height. That, however, is nothing to the heights at which remains, in all probability, of marine shells have been found in other countries. They have been found on the Alps, at an elevation of more than seven thousand feet; on the Pyrenees, at more than ten thousand; and on the Andes, in South America, at more than thirteen thousand. Nay, the probability is, that in all the formations of carbonate of lime, from the primitive lime-stone of the mountains to chalk, and those marbles in which shells are distinctly visible, animals have been employed; as we know of no process in the chemistry of dead matter by which carbonate of lime can be produced. We are therefore at a loss to see how those marbles could have been consolidated and crystallized, without the aid of another power than the water; but we do know, from direct experiment, that carbonate of lime in the state of shells, or even of powder, can be consolidated and crystallized by heat under pressure.

Thus, if we attempt to look back at the history of the ocean, we find that it involves also that of the whole surface of the globe, and the subject becomes too mighty for our comprehension, and too obscure
for our being able to draw any certain conclusion respecting it. On this most interesting, but most difficult branch of the science of nature, modern investigation has done much, but it must do much more before any general theory can be established with the certainty of being true. Out of the existing materials, it would be easy to form a hypothesis—just as it is easy to manufacture the tale of a life out of a few traits; but a mere hypothesis in the study of nature is a much more blind and unsafe guide than a mere romance in the study of man.

But we do not need to ransack the tombs and monuments of the ocean and its inhabitants, for subjects of pleasure or instruction. Every portion of it is full of life; and though the structure, habits, and economy of its plants and its animals are different from those of the land, the wisdom displayed in fitting them for the element in which they live is not the less manifest, or the less worthy of admiration. In the British seas, though only as occasional visitants, the animals that claim the first attention are

**WHALES.**

There are many species to which the general name of whales or cetaceous animals is given; and they vary considerably in their size, their habits, and the structure of particular parts of their bodies; but they all have these in common;—that they inhale the air directly into lungs, and do not separate it from the water by gills; that they are warm-blooded, and have the circulating system and the composition of the blood very
little different from those of land animals, and that they bring forth their young alive, and suckle them with milk, in the same manner as the mammalia; they are therefore not fishes, but mammalia,—adapted to swim, feed, and do every thing in the water but breathe, and that they must do at the surface.

Though the skeleton of this tribe of animals be concealed under the mass of muscles and of fat, it has many points of resemblance to those of land animals. The hinder part of the animal is that in which the greatest difference is found. There are no pelvis or lower extremities, but the vertebrae of the back are continued to those of the tail. The bones of the fore extremities are very similar, both in number and articulation, to those of the human race: there is a scapula, or blade-bone, a humerus, or shoulder-bone, two bones in the fore-arm, and the articulation of a hand with five fingers. The substance of the muscles, too, is not like fish, but like that of land animals, hardly to be known from the flesh on the horse or ox. Even the skin is unlike the skin of fishes, with its scales and mucus-glands. Externally, it resembles the skin on the sole of the human foot, and consists of an epidermis, or scarf skin, a mucous net, and a true skin. Below all these, there is a cellular texture, similar in its structure to that of the hog, capable of containing, and usually containing, a vast quantity of fat in its cells. That fat generally contains more fluid oil, and less of white crystallizable suet or stearine, than the fat of land animals; but in some of the species there is a great deal, easily separated from the fluid oil, and known in commerce by the name of Spermaceti: and
those species in which it is found, are called *spermaceti* whales. This substance has nothing to do with sper-matic purposes, neither is it peculiar to whales, but may be obtained from suet, lard, butter, or any other animal fat, and is itself easily changed into a colourless oil, by distillation. Indeed, the fats owe their white colour to its existing in them partially crystallized, just as snow owes its white colour to the little crystals of water it is made of. This great mass of fat, with which the bodies of this species of animals are sur-rounded, is of the utmost importance in their economy. They are, as has been said, warm-blooded animals; and, therefore, their health demands that the temper-ature, through all that part of their bodies where there is a rapid circulation, should be kept as uniform as possible. But the whale is an inhabitant of the most inhospitable seas, and at certain seasons, he may at once be exposed to three great variations of temper-ature. Even when feeding, the whale swims with a considerable portion of its body above water. Now as there is almost always ice, either freezing or thawing, in the northern haunts of the whale, that portion of its body which is in the water must have a temperature of about thirty-two degrees; the sunny side may be seventy or eighty, or even higher, and the shady one as low as ten, or even at zero. If the muscles and circulation of the animal were exposed naked to such varieties of heat, the structure would be destroyed; but the oil, which has a slow conducting power, defends it.

There is one difference between the bones of whales and those of land animals: the texture of the former is loose and spongy throughout, full of pores and of oil,
but destitute of medullary cavity or marrow. The fat probably answers another purpose, that of preserving the body of the animal from the effect of pressure when it descends to the immense depths, to which it sometimes plunges perpendicularly.

The respiration of the whale tribe is one of the most singular parts of their economy. They must feed in the water, and the balaenæ, or common whales, must, from the size of their bodies, and the smallness of their gullet, which admits a hen's egg with difficulty, spend a great deal of time in that operation; so that breathing by the mouth would be very inconvenient. Instead of this, the blow-holes, or openings through which the whale breathes, are on the very highest part of the head; and as in land animals the mouth is made to assist the nostrils in the function of breathing, so the nose in whales is made to assist the mouth in the discharge of that part of the water, which, from the rapidity of its motion, cannot so easily escape by the gape of the jaws.

In all the tribe, there are two openings leading from the back part of the mouth to the top of the head; but in many of the species, there is only one external opening, though in the common whales there be two. At the top of the larynx, there are two tubes of the gullet in these animals, one of which goes to the cavities of the head, into which the blow-holes open, and the other to the mouth. The larynx opens into the former, but is so formed, that it cannot be opened by pressure from without, so that any water which gets so far into the gullet, is forced up into the cavities in the head. The tubes which lead to those
cavities have valves, near their upper extremities, which open only from below, and thus retain any water that may be forced up by the circular construction of the canal that leads from the larynx. Above those valves there are two elastic sacs, capable of containing a considerable quantity of water, and also of contracting with great force; and the structure of the whale is such that the water, which must, in some portion at least, always get as far as the gullet, can be sent to those sacs without interrupting the respiration of the animal. Thus the whale is enabled to swim and feed open-mouthed, without the water either entering the stomach, or disturbing its breathing; a contrivance essential to its mode of life. The water appears to go to those receptacles always when the animal swims with its mouth below the surface; but only in a small quantity; and while it does so, it prevents the accumulation of mucus in the breathing apparatus. But there is no waste of power; the discharge of the water is not so constant as its reception. It is a voluntary operation, performed at intervals, and with much force. The compression of the sacs projects the water, through the blow-holes, to the height of nearly fifty feet, and with much noise, both by the ascent of the water, and by its fall. This operation is called spouting, and it is one of the means by which whales are found in foggy weather, as it is audible at a considerable distance.

Whales are now usually divided into four orders: 1. Toothless whales, (edentate), or those that have not teeth in either jaw; 2. Upper-toothed whales, (praedentatae), or those that have teeth only in the fore-part of the upper jaw; 3. Lower-toothed whales,
(subdentatae,) or those having teeth only in the lower jaw; 4. Double-toothed whales, (ambidentatae,) or those that have teeth in both jaws. The common Greenland or black whale is an instance of the toothless; the narwhal, or sea-unicorn, of those with teeth above; the spermaceti whale, of those with teeth below; and the porpesse, of those with teeth in both jaws. With the exception of the porpesse, none of them can be considered as constant inhabitants of the British seas; but they are all at times occasional visitants; and therefore, independently of their peculiar interest, they fall within the proper limits of British Natural History.

BALEEN, OR WHALEBONE WHALES.

Of the common, or toothless whales, there are two genera, balaenae, without fins on the back; and balaenopterae, with fins on the back; and there are usually reckoned two species of each genus.

The Common Whale (balaena mysticetus) is the most renowned of all those giants of the deep; and it is still met with of from fifty to seventy feet in length, and from thirty-four to forty-five in circumference. But from the length of time that it has been fished for in the polar seas, the great avidity with which the fishing has been carried on, and the gentle and unsuspicious nature of the great animal, there is reason to believe that there were much larger specimens formerly than any that are now to be met with. The ancient naturalists, who were rather too much allied to that
class which deals only in the wonderful, and partially at least invents the wonderful in which it deals, give to the whale a length of nine hundred or a thousand feet; but there are well authenticated accounts of individuals having been met with, in the early days of the Greenland fishery, that have measured from one hundred and twenty to one hundred and fifty feet. Thus it must be regarded as the largest animal of which naturalists have any knowledge. In the present times, indeed, some of the spermaceti whales, which are much more active and ferocious animals, and therefore less frequently caught, are said to exceed the common whale in size, though none of them come up even to the authenticated dimensions that were formerly assigned to it.

The whale is, independently of its size, and its value in a commercial point of view, one of the most interesting of animals. Its powers of motion are incredible; and its tail, as a weapon of defence, is most formidable; but it has neither the disposition nor the means of doing voluntary harm to any other fish. It is endowed with the most tender affection for its young; and though its eyes are small, the expression of them indicates a degree of perception or even of understanding, of which the eyes of fish properly so called have not a trace. It has been compared to the eye of the elephant; and it is not a little singular that the largest animal, both of the land and the sea, should be endowed with the greatest intelligence, and not a voluntary destroyer of other animals. Both have this common character too, that they are clumsy in appearance, and would not, at the first, lead one to look for that vast muscular power which they can exhibit.
When the common whale is at rest upon the water, it looks like a shapeless mass—some rock, black with the beating of many storms, that rises above the surface. On approaching it, the profile of its head appears triangular, but blunted at the snout, and carried upwards in the upper part, at the elevation of which are the blow-holes, and behind them there is a sort of depression for the neck. The body is cylindrical, a little thicker just behind the swimming paws than anywhere else, and it tapers off to the tail in the form of a frustum of a cone. Generally speaking, the whale is of a glossy black upon the back, with the sides slate-coloured, and the under part of the purest white; but the colour is not uniform; it seems to depend both on age and situation—the whales near the European coasts being in general much whiter than those near the coast of America. The tail is a curious piece of mechanism. It consists of two oval lobes, which are entirely made up of tendinous fibres, of a very strong texture, and these are connected with the greater part of the muscular structure of the body. There are three distinct layers of those fibres, the two external ones lying in the direction of the lobes, and the internal in the contrary direction. In consequence of this structure, the tail of the whale is, perhaps, the most moveable organ in the animal creation. The whole of it can move in all directions with equal ease, and every individual part has also its motion; and while it is so powerful that a blow of it can stun the largest animal, or cut the strongest-built boat in two, its consistency is so firm, that it sustains no injury from the most powerful effort, or from striking against the hardest
substance. The termination of the lobes forms a very graceful curve. The one is elegantly convex, and the other concave; so that the termination of the whole is like the *cima recta* in architecture. The extent of this organ is immense: the measure, from the tip of the one lobe to that of the other, being, in a large whale, more than twenty feet; so that it can hit the entire surface of a boat at once; and when it does so, the boat is plunged so deep in the water that it never is seen to rise again to the surface. Though the position of the lobes of the whale's tail be naturally horizontal, and not vertical like the fishes, the oblique tendons can bring it into almost any position. The horizontal position enables it to sink and rise in the water with much more celerity than fishes; and when the whale is struck by the harpoon of the fisher, it often descends quite perpendicularly to an incredible depth; and there are instances of its bounding to the surface again so near the spot, as to dash the boat into the air before the crew can guard against that catastrophe.

Notwithstanding the unwieldy bulk of the whale, and the quantity of fluid which it must displace, its motion through the water is at the rate of about twenty-four miles in an hour; and while moving at that rapid rate, it continues feeding, so that in six weeks it could circumnavigate the globe.

The size and structure of the mouth of this animal are both worthy of notice. The gape extends back nearly to the swimming paws; and the lips, which are firm and cartilaginous, overlap each other so as to form a curve, which is convex toward the one extremity, and concave toward the other. The tongue is of vast size,
WHALES.

filling the greater part of the mouth, and appearing, contrary to the tongues of fishes, to be an organ of taste. It abounds in fat, and sometimes will produce several tons of oil.

The Greenland whale is, as has been said, wholly destitute of teeth, or indeed of any means of seizing its prey with the mouth, vast though that be. It has jawbones that support the lips, but those bones more nearly resemble ribs than ordinary jawbones; and they are without those organs of rapid compression which are found in all animals that chew or bite. In feeding, the whale has little motion of the jaws; and if it were to move these unwieldy instruments every time that it swallows one of the small and soft substances on which it feeds, the labour would be so out of all proportion to the result, that it would be contrary to the universal practice of nature—that of accomplishing every end by the simplest possible means. The whale feeds with the mouth open; and the food is caught within that huge cavity. Along the middle of the upper part of the mouth there is a cartilaginous space, called the gum, from which the palatal bones slope down on both sides, and form a cavity having some similarity to the inside of a boat, of which the gum represents the keel. To both sides of this gum are articulated those horny plates of baleen, commonly called whalebone, and in commerce, absurdly enough, whale fins—as if they formed part of the swimming apparatus of the animal. Those plates line the whole palate of the animal, and vary in number and size with its age. In large whales, the number on each side often exceeds a hundred, and the principal ones are more than ten feet long. The
largest ones are a little behind the middle of the mouth; and they become shorter, both toward the throat and the snout. These plates are a little curved, and taper toward their extremities. The front edges are nearly smooth; and the back ones, which are thinner, are fringed with horny fibres, of the texture of coarse hair, which increase towards the extremities. They are sometimes black, and sometimes of a grayish colour, though the latter often appears only in the membrane with which they are covered. The substance of which these plates are composed, is nearly the same as horn; and so is the texture, though less compact. Parallel to the flat surface, it can be divided into smaller plates, of indefinite fineness; but across that direction the cleavage is rough and thready. It is used for many purposes in the arts; but though it has considerable toughness, elasticity, and gloss, it is very apt to split. It is sometimes substituted for bristles in the manufacture of brushes; but it is very inferior, and lasts but a very short time.

When the mouth of the whale is open, the fringes of the whalebone are brought in contact with the surface of the tongue; and the mouth is thus filled with a kind of net, in which the mollusca, which are the principal food of the whale, are entangled, and by the joint action of the tongue and the plates of whalebone, conveyed to the gullet. From the size and position of the eyes, they can be of little use to the animal in finding its food; though they enable it to make its way in the water, and to avoid those animals that are hostile to it, and likewise submerged rocks, which, if it were to strike when in full velocity, it would be severely
injured, if not killed. The organs of hearing in the whale are nearly perfect, and that sense is rather acute, but can be of little avail to it in feeding. It has no visible organ of smell, except we suppose such to exist in the spiracles or blow-holes; but there is reason to conclude that it has such a sense, and that that sense is of use in guiding it to those streams of green-coloured water, in which it is chiefly found, and which derive their colour from myriads of small mollusca.

The habits or age of the whale are not very much known; and what is stated, cannot implicitly be relied upon. The period of gestation in the female is supposed to be about ten months, and the period of suckling is about a year. The general produce is one young one, though two have sometimes been found following the same female. Some fanciful accounts have been given of the mode in which the mother-whale nurses her offspring; but they are not to be relied on. Whales are sought for only to be captured; and capturing the female when she has her young under her care, is a matter that leaves little time for minute attention to her habits, any further than that she is remarkably careful of her young, and very bold and active in its defence. If come upon unawares, she may be harpooned, and then she clutches the young one in her paws and dives with it; but returns sooner to the surface than she would if she had it not in charge, apparently to enable it to breathe. If alarmed, or aware of the danger, and sometimes after she has been wounded unawares, she makes terrible resistance, boldly approaching the boat, and lashing at it with blows loud as thunder; or plung-
ing, and attempting to rise under it, and dash it to pieces with her back. The female is usually larger than the male, and generally has a young one in attendance; so that the desire of capturing her increases with the danger. Even the young when following the mother, in which state the fishermen call them *short-heads*, yield a great deal of oil,—often as much as fifty barrels. Those that are in their second year, and are supposed to be just weaned, being much less valuable. The fishers call them *stunts*, and reckon them not half so valuable as *short-heads*. After this they get fatter, and appear to grow progressively for a period of years, the prime length of which is not known; but below a certain size they are called *skull-fish*, and after that, *fish*, the size being described by the length of the whalebone.

It is by no means improbable that, before whales were so much thinned by fishing, they occupied a much greater range of the ocean than they do at the present time; as there are many allusions to them in the writings of the ancients. These accounts must, however, be received with a great deal of caution, not only on account of the mass of fable that they blended with all descriptions of natural objects, but because we are never absolutely certain of the species. The *Muṣṭiκῆτος*, mentioned by Aristotle, is more likely to have been some of the spermaceti whales, than the *mysticetus* of the moderns; as these whales range more extensively, are furnished with teeth, and have much wider throats; which last are two qualities that the ancients generally give to their sea-monsters; though as they give them teeth in both jaws, the dolphin or
the grampus must have been their general type. At present, the black whale is found only in the seas near the two poles; though it may occasionally pass from the one to the other: the spermaceti whale is much more generally diffused, and is occasionally met with in all latitudes.

If they were not so common that they pass unheeded, the voyages for the capture of those vast animals might rank high in the annals of human adventure. The islands and mountains of ice swimming about in all directions, and producing winds from every point of the compass within the same horizon—the dreadful crashes with which those cold islands and continents meet,—the fields which they then turn up on edge—the masses that they project into the sky—ships thrown out of the water, or having their hulls cut in two, and one part above the ice and the other sunk to the bottom—while (for the storms are often as loud as they are violent) within sight, others are coursing among the whales,—throwing their harpoons,—running out their lines after the plunging fish, and piercing him with their lances when exhausted;—or having him lashed to the ship's side, and flencing off the fat with shovels, amid the noise of clouds of sea-fowl, screaming in expectation of the kreng, or carcass, or contending with the crew for the fat:—these exhibit both nature and art in an aspect full of interest;—and, could they be seen by spectators unengaged and at their ease, would form a spectacle of a very animated character. Nor would the interest be diminished by the consideration, that every full-sized whale that is captured, is worth upon the average
about a thousand pounds, a value far exceeding that of the carcass of any other animal.

As is the case with the ox and the sheep, there are few parts of the whale that are not useful, in some way or other. The oil and the whale-bone are well known. The tendons may be split down, and used as a thread; the membranous coats of the intestines make no bad substitute for window-glass; the fibrous fringes of the whale-bone make ropes and fishing-nets; the jaws and ribs serve as beams and rafters for the habitations of those northern people whose countries produce no timber; and the flesh is eaten by the same people with avidity,—the heart and the tongue being accounted choice dainties. The muscle of the young ones is far from unpalatable, and both looks and tastes something like veal.

Though the whale has been often regarded as the emblem of longevity, and the period of its natural life set down at a thousand years, there is no information upon the point, further than that to acquire so vast a size it must live a long time. Neither is it known whether, independently of the ravages of man, the race be diminishing. Analogy would lead one to think so, because the native races of large land animals are decreasing in the northern hemisphere, and some of them extinct; but the case is one in which no dependence can be placed upon analogies.

The Nordcaper is a smaller variety of the common whale, the head and under-part of the body are white, and the upper part, grey. It tapers more to the tail than the common whale, and is more active in its
motions, and more ferocious in its disposition. It is found further to the south than the other,—on the coasts of Iceland and Norway, where it feeds upon medusæ, herrings, and shell-fish.

Though both these species were formerly cast upon the British shores, especially on those of Scotland; and though, if we can trust the statements of the Romans, (which are any thing but precise,) the shores of Britain were the regular home of great whales in their days, yet they are now of rare occurrence. Not so with the balænopterae, or whales with a fin on the back. There are two species of these, and of the one there are two varieties.

One, the Razor-back, (balænoptera physalis,) has been cast upon the shores of Scotland, as long as eighty feet, and it is met with in the Greenland seas more than one hundred feet long, but not nearly so thick in proportion as the common whale. It has a large triangular fin on the back, from which it sometimes gets the name of the fin-fish. It is a very active fish, swims with immense velocity, and is seldom taken for its oil, as the quantity is not great; but the northern people like it as food, especially the swimming paws and the skin, which is smooth and gelatinous. The plates of baleen, in the razor-back, are very short, but they are fringed with long hair. This animal is much more active in its feeding than the common whale, and preys upon herrings, mackerel, and other small fish, which it occasionally follows so far south as the Hebrides, but seldom so far as the English coast. It blows with much more force than the common whale, and sends the spout of
water to a much greater height. Its appearance on the fishing grounds is not liked, because the common whales then disappear; but whether they are driven away by any act of hostility on the part of the razor-back, has not been ascertained.

The Round-lipped Whale (*balænoptera musculus*) resembles the former in its habits, and rivals it in size; and is distinguished by the upper lip being narrow and pointed, and the under one having a semi-circular margin. Instances have occurred of its being washed upon the Scottish shores, in specimens nearly eighty feet long. Generally, however, it is much smaller. It follows the herrings pretty regularly as far as the coasts of Argyleshire, and even into the Firth of Forth and Loch Fyne. Individuals of this species have often been known to frequent the same station for many years. That which is described, by Sir Robert Sibbald, as having come ashore at Abercorn, in the Firth of Forth, in September 1692, had been for twenty years well known to the fishermen, who called it the "hollie pike," from a bullet hole that had perforated its dorsal fin. That one was seventy-eight feet long, and thirty-five in circumference, where thickest. The gape of its mouth was very wide; the lower jaw more than thirteen feet long; and the tongue, which was much furrowed, fifteen feet and a half long, and fifteen broad. The plates of baleen were three feet in length; the eyes, thirteen feet from the snout; the breast-fins, ten feet long; the back one, three feet high; and the extent of the lobes of the tail, eighteen feet. The skin, on the belly of this species, is full of folds and corrugations, as if it could be
distended to a much greater diameter than the animal usually has.

The sharp-lipped variety (*balaenoptera boops*), is of inferior dimensions, and is indeed the smallest of the baleen or whalebone whales. The upper jaw in this, as in the last variety, is much shorter and narrower than the lower, but they both terminate in sharp points, which circumstance has obtained for it the name of the "beaked whale." This, indiscriminately, with the former variety, is called the "offin whale" by common observers, and therefore the one may have sometimes been confounded with the other. Indeed, with the exception of the form of the lower lip, and the difference of size in some of the specimens, their appearance and habits are very much alike. They both have the same corrugated skin on the belly; and probably the same means of inflating or blowing it up, to increase their buoyancy. Though their native region is the Greenland seas, they are yet not unfrequent visitants of the most northern part of the British ocean. They are often seen in the sounds and bays among the Orkney islands, at the time when the shoals of herrings are migrating to the south. A very beautiful specimen, seventeen feet in length, which was caught upon the dogger-bank, is described by Hunter in the Philosophical Transactions for 1787. The remains found in its stomach were those of the dog-fish (*spinax acanthias*), the usual length of which is about three feet, which proves that the finned *balaenae*, though equally destitute of the means of biting, are much more voracious in their swallowing than the common whale. The
largest stranded on the British shores, was at Alloa, on the Firth of Forth. It was forty-three feet long, and twenty in circumference; the jaws were fourteen feet long; there were about three hundred plates of baleen on each side of the mouth, the longest of which were about eighteen inches.

Both these varieties are great depredators. They may be seen with just the top of the dorsal fin, and that part of the head in which the blow-holes are situated, above water, driving along with vast rapidity, while fishes even of very considerable dimensions, and which are themselves given to plunder, are ever and anon leaping out of the water, to avoid that current which would carry them into the wide mouth of the finner, entangle them amid the fringes of the baleen, and ultimately find them their graves in the maw of that voracious animal. Their only means of escape is gaining water so shallow, that their pursuer cannot follow them; and the huge ones that have been found on the shores, have generally met their fate by following their prey too eagerly, and running aground during the ebbing of the tide. These finned whales are of comparatively little value for their oil; but the Greenlanders are remarkably fond of the flesh, which they procure, not by harpooning, as they do with the larger whales, but by shooting the fish with arrows.

PRÆDENTATAE. NARWALS.

These, though much inferior in size to the former, are a singular race of animals. Their native habitations, like those of the whales, are in the Greenland
seas, but they occasionally make their appearance on the northern shores of Scotland, or among the Orkney or Shetland islands. Of these, there are two species, the common, or "sea-unicorn," and the "microcephalus," or small headed. Their length seldom exceeds twenty-two feet; their head and mouth are small in proportion to their bodies, as compared with those of the whales; their mouths have neither teeth nor whalebone, they have only one blow-hole, and they have no dorsal fin, but there is a ridge from the tail to the middle part of their back. The greatest peculiarity about them, and that which has got them the name of monodon, (one-toothed,) and monoceros, (one-horned,) is a tooth which projects from one side of the upper jaw, and extends, in a straight direction, a considerable way in advance of the snout. This tooth is sometimes on the one side of the head, and sometimes on the other; but though there be a preparation for the production of one on each side, the two have very seldom been found. The tooth is composed of a substance resembling ivory, and spirally twisted. The animal is said to use it both as a weapon of war, and as a means of driving shell-fish from the rocks. The tooth, or "horn," as it is usually called, though much more brittle than ivory, is of some value in the arts; walking-sticks are made of the small ones; and bed-posts and other articles of those that are larger; and the Greenlanders use them as poles. Though armed with this powerful weapon, the narwals are very harmless animals, except to those fishes on which they feed; but they are said to be very revengeful when ill used; and to plunge their formidable tooth into the bodies of
animals much larger than themselves. Their motions are light and graceful, and they swim with uncommon velocity. The tooth is sometimes ten feet in length, and according to Captain Scoresby, to whom we are indebted for much valuable information respecting the polar seas and their inhabitants, they are found only on the male; but sometimes, though rarely, they are found on the female. The tusk is most commonly found on the left side, while on the right there is the rudiment of another, which has not perforated the bones of the skull in which it is contained. On the British shores the narwal is very rare; but it has appeared on the coast of Lincolnshire, probably at the Isle of May, ("Prope insulam Mayam,"—Tulpius,) in the Firth of Forth, and at the Sound of Werdale in Zetland. The oil of the narwal is in considerable quantity, and peculiarly pure and valuable; but from the activity of the animal, the rapidity with which it swims, and the ease with which it dives, it is caught with the greatest difficulty.

Mention is made of a very small species of whale, the Anarnak, found in the Greenland seas, with teeth in the upper jaw, instead of the projecting tusk of the narwal; but its history is rather obscure, and no specimen of it has been met with upon the British shores.

SUBDENTATÆ. SPERMACETI WHALES.

The animals of this genus are very formid able, of great value in the arts, and much more widely diffused over the globe than any of those that have been hitherto mentioned. The most remarkable characteristic of the
genus, is the immense size of the head which is, at the least, equal to a third, and in some to a half of the body. The upper jaw is remarkably broad and deep, with a very hard gum, in which there are generally some rudiments of teeth, and also cavities to receive the teeth of the lower jaw, which are strong, conical, and very formidable. The spermaceti is found in a cavity under the snout of these animals, and the substance known by the name of ambergris, is found in their intestines. None of their mouths are furnished with plates and fringes of baleen, as they are all capable of biting and seizing their prey. Their throats are a great deal wider than those of the common whale; and the remains of fishes, even sharks more than twelve feet in length, have been found in their stomachs. Their ferocity, indeed, forms a remarkable contrast to the gentle manners of the balana mysticetus. There are a good many species of spermaceti whales, inhabiting different parts of the globe; but the most remarkable for size and character are the following, all of which have been met with on the British shores, and in other parts of the European seas:

The Blunt-headed. *Physeter Trumpo.*
The Small-eyed. *Physeter Microps.*

The Great-headed Spermaceti Whale is a very clumsy-looking animal. The back is black, or slate-colour, sometimes mottled with white, and the under part white. The head has something the appearance of a great tilted wagon; the jaws are of immense depth, the eyes small, and very far from the snout, the
tongue a huge mass, of a red colour; the teeth in the lower jaw very strong, with holes in the upper one to receive them, and the rudiments of teeth in the intervals between. The head exceeds in size all the rest of the body.

But notwithstanding the clumsiness of its form, it is a very active animal, swimming with great rapidity, and vaulting almost out of the water with apparent ease. The bones are hard, and made into weapons by the Greenlanders, while the teeth are of the purest ivory. It is not very productive of oil, but the Greenlanders are very fond of its flesh, which is of a pale colour, and has some resemblance to pork. It attains the length of sixty or seventy feet, with a circumference of thirty. It is not very common in the British seas, though it has been found occasionally there, as also on the coast of France.

The Blunt-headed Spermaceti Whale resembles the former, only the muzzle is more blunt, and its body, which grows to as great a length as that of the former, is thicker in proportion; and vastly more valuable, both for its spermaceti and its oil. The capture of it is not, however, unattended with danger, as it comes open-mouthed with great velocity against its assailants. Instead of a dorsal fin, it has a hump or protuberance on the back. It is occasionally met with in the British seas.

The Small-eyed, also called the black-headed spermaceti whale, is characterized by the smallness of its eyes, and the enormous size and dark colour of its
head, which, excepting the tail fin, is fully as long as all the rest of the body. This animal is provided with a dorsal fin. Its teeth are remarkably formidable. There are twenty-one on each side of the lower jaw; strong, sharply-pointed, and incurvated backwards a little: the principal ones are more than nine inches in length in a large specimen, and they project more than four inches from the jaw, so that its bite is much more powerful than that of any land animal,—the lion not excepted, which, were it to come within the crunch of this terrible animal, would be crushed to death in an instant. La Cepède, with some poetic license certainly, but still, in the main, true to the facts, says of it: "The *physeter microps* is one of the largest and most cruel and dangerous inhabitants of the deep. Adding to formidable weapons, the two great sources of strength, bulk and velocity,—greedy of carnage,—a daring enemy,—and an intrepid fighter; what part of the sea does he not stain with blood!"

The small-eyed spermaceti whale is often more than fifty feet in length, and it swims about with the greatest activity, and an apparent consciousness that it is the monarch of the deep. The blow of its tail is not, indeed, so formidable as that of the common whale, and there is no instance of its venturing to attack full-grown animals of that species; but sharks, dolphins, and porpesses are an easy prey; it attacks the balænopteræ, and tears large masses from their bodies; and the Greenland whale, when not full-grown, plunges into the depths of the ocean at its approach. This animal takes a considerable range; and is probably more frequent upon the Scottish coast than any of the other large
whales. It is also found on the shores of Germany and France; and in the year 1723, seventeen of them appeared off the mouth of the Elbe, and with their high dorsal fins, like sails, were, by the Fishermen of Cuxhaven, mistaken for a fleet of Dutch fishing boats. This species also finds its way into the Mediterranean; and La Cepède, who seems disposed to magnify all the powers of this animal—and they do not stand much in need of magnifying—will have it, that the sea-monster, from which the valorous Perseus delivered the fair Andromeda, was an animal of this species; and that the Orca with which, as Pliny says, the emperor Claudius and his troops fought in the port of Ostia, was another. These suppositions, like the tales themselves, may be true or they may be false, but there is enough contained in authentic history, to show that the physeter microps, if not the most powerful animal, is among the most powerful animals that inhabit the globe.

The habits of the animal are of too active a nature for admitting of a very great quantity of oil; but its enormous head contains a good deal of spermaceti, of very excellent quality. Like the rest of the spermaceti whales, it has only one blow-hole, but that is of considerable dimensions, and it throws its jet of water to a great height.

**AMBIDENTATÆ.**

The animals of this class are not of so large dimensions as those of any of the former,—the largest of them not measuring more than five and twenty feet in length. Still they are formidable animals, and in some
of the species at least, they are much more frequent and constant inhabitants of the British shores.

The general name which naturalists give to these animals, is delphini, or dolphins; and the principal species are, the common dolphin, the ca'ing whale, the grampus, and the porpesse, with the bottle-head, and the beluga or white dolphin, which are more rarely met with in the British seas. All the species are voracious, and remarkable for the depredations that they commit upon various fish; and many of them are gregarious, or found in herds.

The Dolphin (delphinus delphis) is about as unlike the pictures that are usually made of it as can well be imagined. It is usually about nine or ten feet long, rarely more than twelve. Its body is straight, blackish on the upper part, and white below. The nose is long, narrow, and pointed, on which account the animal sometimes gets the name of the "sea-goose." Its favourite haunts are rather in warmer latitudes; but it is occasionally found in the British seas. The ordinary prey is small fishes, but it can eat any garbage. In former times, it was much esteemed as food, perhaps on account of the difficulty of getting it, more than anything else: at present it is not in much request. The stories that are told about dolphins changing their colours when they are dying, and after they are dead, do not appear to be very well founded. The colour of the fish is very apt to vary with the angle under which it is seen, or at which the light falls upon it.

The Ca'ing Whale (delphinus melas) was for a considerable time confounded with the grampus. It
is by no means rare upon the shores of the northern parts of the island, where it arrives in herds; and these are so sluggish in their motions, that they get aground and are captured. The largest are rather more than twenty feet long, and about twelve feet in circumference. The upper part of the body is a bluish black, and the under part white. They feed upon small fishes, and are not understood to be so voracious as some of the rest of the genus. Their teeth are formidable, however, and those of the two jaws lock into each other like a trap; but they are apt to decay as the animal becomes old.

The Grampus (delphinus orca) is a constant inhabitant of the British seas. There is a little confusion in its natural history, some making two varieties, or even species, and some only one. Probably, there is only one species, though the habits of that one may be changed a little with climate and food. It is a most voracious animal, more so than any other of the genus, for it attacks the porpesse, and probably, also, the weaker individuals of its own species. It is large too, sometimes equalling, or even exceeding, twenty-four feet in length, with thickness and strength in proportion. Packs of them are said to attack the Greenland whale, and tear off his flesh in masses. Indeed, they are so ferocious and such indiscriminate spoilers, that they spare not even their own kind. But though, in the one grand object of its being, the grampus be thus ferocious, there lies against it no charge of cruelty; and in the other part, the care of its young, it shows the greatest tenderness and solicitude. This instinct
should be taken along with the other, in every estimate
which is made of the characters of animals; and it is
chiefly because that is not done, that we find some of
them praised and loved, and others persecuted.

We are apt to carry man, and man’s love of governing
and directing, into all our reasonings and judgings of
the works of nature, and by this means we take an
erroneous view of the subject. The preservation of
salmon, though man would like them to be preserved,
and though he be justified in using every means that
men have legalized for the furtherance of his wish, is
no part of the end which nature had in view in the
formation of a grampus, any more than the preservation
of sheep is a natural purpose of the wolf, or that of flies,
a natural purpose of a spider. The law of each is the
preservation of itself individually, and of the race to
which it belongs; and this law, though it be different
in manner, according to the difference in structure and
habitation, is uniform in principle. The eagle, the
grampus, and the lion, may be reckoned among the
principal depredators in the three grand departments
of the kingdom of nature; but they are not on that
account destroyers. They are preservers: preserving
respectively eagles, grampuses, and lions,—the only
animals with whose preservation they are charged.
Where man does not come to claim his dominion,
and to call the prey of those animals his, the system
is so admirably balanced that it never stands still,
or wants the least repair,—the supply being so re-
gulated in accordance with the waste, that, if we
would but imitate it, it is a far better system of
economy than that of the wisest of human philosophy.
It must be so: for it is the original and immediate workmanship of God, while the greatest ingenuity of man is second-hand,—only one step removed from the Divinity it is true, but to our comprehension that single step is infinite. Man can make a trap that will catch animals, if they go into it, as certainly as the claws of a lion, the talons of an eagle, or the teeth of a grampus; but he must stop at the mere mechanism,—he cannot give it that little invisible impulse by which it goes of its own accord to seek them. But man has any thing but cause to complain of that. He himself is the animating power of all his engines; and, armed with these, he is in truth the lord of the creation; and, when he joins wisdom to his power, there is hardly any limit that can be assigned to his dominion.

Many tales, not only interesting, but absolutely affecting, have been told of the maternal affection of the grampus. It has even been the theme of poets; for Waller has a beautiful description of an instance:—A mother grampus and her cub had been following their lawful calling—that is, catching fish as fast as they could in the estuary of a river; and they had been so industrious and intent upon their work, that they were stranded by the ebbing of the tide. This being observed by the country people, their instinct of catching was immediately roused, and they came, in posse comitatus, to capture the animals. These were speedily pierced by a number of wounds, and the shallow water was dyed with their blood. But they made a terrible resistance; and the old one bounded into the deep water and was safe. But her young one was exposed alone to the danger; and she had no sooner turned her head
toward the shore, than she dashed again into the shallow water, where she made so terrible a resistance, by lashing around her in every direction, that she kept the enemy at bay till the tide rose, upon which she and her young one rode triumphantly to the sea!

As the body of the grampus contains very little oil,—not enough to pay for the capture,—the animal floats very deep in the water; but then, both its velocity and its voracity are such, that it is very apt to dash itself aground, where it makes a violent resistance, and is exceedingly difficult to kill.

Though many specimens of the larger kinds of *dolphins* have been met with, yet there is a good deal of confusion in their history. La Cepède, in his natural history of the *cetacea*, makes two species of the dark-coloured and voracious grampus, with the long dorsal fin,—*delphinus orca*, the common grampus; and *delphinus gladiator*, the sea sword; while Cuvier and others reckon but one, and some consider the Ca'ing whale as only a variety of the grampus. In form and colour they are all very much alike, being clumsy and unsightly in appearance, dark on the upper part, and very white below; but their habits are described as varying from the extreme of active ferocity to that of indolence. That may in part be owing to the condition they were in at the time when they were observed; but the ca'ing whale has the swimming paws much narrower, and wants not only the white spot on the shoulder and near the eye, that is found on the others, but sometimes has the body entirely black.

About twelve years ago, a vast shoal of these animals entered the Firth of Tay, and two dozen, at least,
grounded on the shoal off Dundee. Their high dorsal fins had been for some time observed by the fishermen, coursing to and fro in the offing; but as the fins of porpesses are often seen in the same place, they did not excite much attention. A new harbour being in the progress of construction, a number of masons, excavators, and other labourers, were at work upon the sea-wall and its foundations. As the tide ebbed to the depth of four or five feet, a violent splashing drew the attention of the workmen, who found the shoal of grampuses, close by the place where they were working; the larger ones already grounded, and lashing furiously with their tails, and the smaller ones flouncing and plunging; the whole having their heads toward the land, and working nearer to it. Stimulated by the joint expectation of great fun and great wealth, the men armed themselves with shovels, pickaxes, crowbars, boat-hooks, mallets, and chisels, and, in short, every thing that seemed to have any chance of inflicting a wound, and plunged into the water in a body. Some of them had the temerity to catch hold of the tails, and vaulting across the narrow part at the root of the fins, to impel the fish further out of the water; but they were jerked off in an instant, and men and grampuses were weltering in one common confusion; still, as the water was very shallow, and the men inured to it, there was no danger. One got astride, just before the dorsal fin, with his face to the tail; and grasping that, rode the sea like another Arion; but though he treated his beast of burden with plenty of music, or at least noise, it did not show the same gratitude; for it turned, got toward the deep water, and he was glad to escape.
The greater number came close to the wall, however, and were left nearly dry, and subjected to all sorts of wounds. Here one man was hacking with a hatchet, or the edge of a shovel; there another was aiming a blow at the head of one fish with a pick-axe, while the flap of the tail of another sent him and his pick-axe into the mud. Two were uniting their force at one place, in order to give a death thrust with a crow-bar; while on the neck of one of the largest, sat a stone-mason, malletting his pointed chisel into the skull. The place soon became a sea of blood; and what with that, and the natural slipperiness of the skins, together with the convulsive struggles of the wounded animals, ever and anon caused some one to souse into the mire, to the great amusement of the rest. The splutter, the activity, the shouting, and the jocularity and glee with which the whole was conducted, formed a scene to which no pen, and hardly any pencil, could do justice.

The largest of these animals was more than twenty feet long, and the smallest more than twelve. They produced very little oil.

The cetaceous animal found most frequently and habitually upon the British shores, is

THE PORPESSE.

The Porpesse (delphinus phocæna) is comparatively a short animal, being seldom more than six feet long, but it is very thick and fat; hence the common saying, "As fat as a porpesse." The weight of the porpesse is great for its length. One, only five feet three inches in length, examined by Dr. Fleming, to whom natural
history is under many obligations, weighed one hundred and thirty pounds. The upper part of the porpesse is of a dull bluish or brownish black, and the under part whitish. It has a number of small teeth, at least forty-eight in each jaw; the dorsal fin is not very high, and placed far back, and the animal makes a curious tumbling appearance in the water, through which, however, it courses along with considerable rapidity. Herrings, mackerel, whitings, and all other small fish, appear to be its principal food; though it also catches salmon, and may be seen coursing them in the estuaries. This chase is best seen on those clear sunny evenings which, in the season at which the salmon ascend the estuaries, often succeed to rainy mornings. The porpesses are commonly in a shoal, and their dark backs may be seen tumbling on the troughs of the waves, while the salmon are, ever and anon, springing out of the water, with their pearly scales glittering in the sun in all the radiance of prismatic colours; but, as is understood, falling down again to their certain destruction, as they do not spring out of the water till the porpesse be near them, and fall down again, exhausted, within its reach.

With each other, the porpesses seem to be very affectionate and playful animals. They are always together; and frisk, leap, and sport a great deal upon the water,—especially before storms, as the sailors allege. In this they bear some resemblance to pigs, which are understood to be very frolicsome before wind; and probably this, as well as the form of their bodies, may have helped to procure them the name of "sea swine," by which they are vulgarly called in most of
the European languages in which they have any name at all.

In former times, the flesh of the porpesse was esteemed a great delicacy. It appeared at the tables of nobles; and was accounted by kings a donation worthy of being granted to favourite monasteries:—Malcolm IV. of Scotland granted it to the Abbey of Dumfermline. In modern times it is not eaten, though it is far from being unpalatable. The old people had a peculiar sauce for it, made of crumbs of bread, vinegar, and sugar. The animal is still valuable for its oil, which is good in quality, and rather abundant in quantity; but at many of the fishing villages, the kreng or carcass is left rather offensively upon the beach. Even the skin of the porpesse, which is very compact, and capable of being applied to many useful purposes, is neglected in this country; but in America the poor people use it as an article of clothing; and it is also dressed and tanned as a covering for coaches and trunks, for which purposes it is very well adapted, being firm, and impervious to water.

The porpesse is rather a timid animal, and is easily alarmed by any thing moving in the water, on which account it is sometimes caught by an enclosure made of twigs. These are fixed on a bank in the tideway, so that they shall be covered at high water, but appear as the tide ebbs. Shoals of porpesses pass over them in the former state, in eager pursuit of the small fishes which come near the shore with the tide. But as they continue their fishing till the water has subsided, the twigs appear in a state of motion, and the porpesses,
afraid to pass or approach them, remain till they are all dry, when they are killed with clubs.

Two other delphini, of the peaked or long-nosed species, are sometimes found in the British seas. These are, the Beluga, (delphinus aptera, so called from its having no dorsal fin, but only a ridge on the back); and the Bottle-nose, (hyproodon,—so called from its having tubercles resembling teeth upon the palate).

The Beluga, which from its colour is sometimes called the white dolphin, is found in large flocks in the Greenland seas. It also enters the estuaries of rivers, after fish, like the grampus; but so far as we know, it has not appeared on the coasts of England, and it is but rare on those of Scotland. It has been found in the Orkneys, and one was caught in the Forth below Stirling, in the summer of 1815. Those larger visiters are found in that river more frequently than in others further to the north, the entrances of which are less extended and more interrupted by banks and bars. The salmon, on the other hand, as if instinctively to avoid their enemies, are more abundant in the confined estuaries.

Sometimes this animal, which is to all appearance a very quiet and harmless one, and finds the Greenlanders in many a dainty dinner, is supposed to create great alarm. It is large, (from twelve to eighteen feet long) and it is white, therefore it is mistaken for the formidable shark of the warmer latitudes. The shark is not a warm-blooded animal, neither does it suckle its young, or, though it brings them forth alive, appear to care any thing about them afterwards. Their
young are produced from eggs, which are hatched internally, as is probably the case with all the cartilaginous fishes that have fixed gills. The white shark (charcharias vulgaris) is very rare indeed upon the British coasts, and we are not sure that there is any very well authenticated instance of its appearance north of the channel, nor very many there; so that British bathers are not in any very great danger from it.

The Bottle-nose, so called from its muzzle being elongated like the neck of a bottle, is a much longer fish than the former, being found as long as thirty feet. The body is conical, the head thick, and terminating in a projecting snout. It has been occasionally found in most of the estuaries of our large rivers; but it is far from common, and probably it does not follow fish like the rest of the tribe; but feeds mostly upon mollusca—as the snout of the cuttle-fish are the remains usually found in its stomach. It has only two teeth in the lower jaw; and the tubercles on its palate serve to bruise its molluscous food. The habits of many of these animals, especially the two last mentioned, are but very imperfectly known. The habits of all the natives of the deep, even of those that are caught in thousands every day, want much investigation; and, from the nature of their element, the task is not an easy one.

There is one fish, belonging to the same tribe with the shark, which common observers are apt to confound with some of the dolphin tribe, and that is
THE SAIL FISH.

The Sail-Fish, called also the Sun-Fish, and the Basking-Shark, (squalus maximus,) is not often met with on the east coast of this country, though it be a pretty regular summer visitant on the west. It is about thirty feet long, and has two fins on the back, the one on the middle and the other near the tail. The former is commonly above water, and, from that circumstance, with the shape and size of the fin, the fish has its common name. The fin is dark, and the upper part of the fish of a bluish colour, but the under part is white. The skin feels smooth when the hand is passed over it from the head toward the tail, but rough and uneven when passed in an opposite direction. It is a heavy-looking fish, and not easily alarmed by the approach of boats; but the story commonly told of its waiting till the harpoon is pushed a second time into it, is not true; as it usually plunges the moment that it is struck. The liver contains a great quantity of oil. This fish usually makes its appearance on the west coast in May, and leaves it again about the end of July.

The division of fishes to which the sail-fish belongs, though numerous and diversified, and containing some of the most singular inhabitants of the ocean, yet all agree in certain parts of their structure. They all differ from the osseous fishes, or fishes with fibrous bones (of which some slight notice has already been taken) in the structure of their skeletons, in the nature of their integument or covering, and in the mode of their production. The division has this farther advantage, that
the characters by which it is marked are obvious, without any recourse to dissection, or even minute observation. The most remarkable and general characteristic is the gristly nature of the skeleton; and on that account they are called

CARTILAGINOUS FISHES.

They are also called CHONDROPTERYGIOUS; and that name is expressive both of the skeleton and of the covering of the surface, especially the fins of the greater part of the division,—χόνδρος signifying cartilage, and also granulated, and the remainder of the compound name meaning finned. And a considerable number of these fishes have their fins so hard and granular on the surface, that they serve for polishing, like files, while others have spines and shelly knobs. These spines are sometimes very formidable weapons,—as in the serrated spine, which terminates the tail of the sting ray, (trygon pastinaca;) and in those of the common dog-fish, (squalus acanthius;) although the wounds inflicted by these animals are said not to occasion nearly so much pain as those inflicted by the common weever (trachinus draco,) an osseous fish, about a foot long, the wounding weapon of which (commonly represented as being venemous) is the first spine of the dorsal fin. If we were not prepared to meet with all sorts of organizations among the productions of nature, we should be apt to wonder at this production of bony matter, as hard as the most compact teeth, upon the surface of fishes, the internal skeletons of which never acquire any harder consistency
than gristle or cartilage, and of course composed almost entirely of gelatine, without any admixture of those salts of lime to which bones and shells owe their stiffness. But when we come to examine the matter, we find this structure a remarkable instance of contrivance and economy. The absence of lime in the skeleton gives wonderful pliancy to the bodies of these fishes; while the granulated, tuberculated, or spinous surface, is a coat of mail to them against enemies, and not unfrequently a powerful weapon of aggression. Their external bony substances differ a good deal from bone. They contain a portion of carbonate of lime, as well as phosphate, and thus hold an intermediate rank between bones and shells; and place those fishes to which they belong as an intermediate link between the osseous fishes and the shelled mollusca; the latter of which have not even the cartilaginous rudiments of a skeleton, and have their covering chiefly of carbonate of lime. We find a similar gradation in those marine animals that are covered with crusts, such as the crab and the lobster. Their internal bones are cartilaginous, and the external crusts are composed of carbonate and phosphate of lime. On land, we find the same gradation in many of the reptiles. Their bones are cartilaginous, while the indurated matter is accumulated in the external scales and crusts. Generally, however, there is a difference in the composition of those appendages, which shows that each is fitted to the element in which it is to live. The scales and crusts of land animals are horny, or composed almost entirely of gelatine, which, though it can bear the action of the air, and a considerable change
of temperature, would be softened and ultimately dissolved by long maceration in water. Those of sea animals are, on the other hand, composed of what is called mother-of-pearl, from the play of colours usually observable in it. It consists of coagulated albumen and carbonate of lime, in very thin layers; a structure much better fitted for bearing the action of water, than that of the air and variations of temperature.

The breathing apparatus of those fishes is a curious structure. With the exception of the sturgeon, which has some other peculiarities, the gills in all are fixed, and inclosed in a thorax or chest, furnished with cartilaginous ribs, and a cartilaginous diaphragm, and thus capable of being extended and contracted like that of the mammalia. On this account, the romance writers on natural history have described the cartilaginous fishes as breathing with lungs, and being intermediate between the cetacea and the osseous fishes; at the same time that they had gills. Thus furnishing them with two sets of respiratory apparatus, and yet with but one ventricle and auricle in the heart.

Now the fact is, that if we are to consider the animals which most resemble man to be the most perfect, (which, by the way, is a very improper mode of expression, as a lamprey, or even a polypus, which is nothing but a little tube or sac, is just as perfect in its way as a greyhound or a race-horse,)—if we are to use that mode of expression, we must consider the cartilaginous fishes as a degree lower than the osseous, on account of their soft skeleton and their mode of respiration, and also in their nervous structure. They correspond in another particular: those animals which are usually accounted
the least perfect, are the most tenacious of life; and, generally speaking, cartilaginous fishes are much more so than those that have bones.

In those fishes the gills consist of a greater or smaller number of bags or cells, the internal surface of which is covered with fleshy fibres, the same in appearance as the gills of osseous fish, and, no doubt, answering precisely the same purpose, that of affording the blood the oxygen necessary for the purposes of life, by exposing it to water containing that fluid, in an extended tissue of minute vessels. Those gill cells vary in number in different genera,—there being seven on each side in the lamprey, and only six in the hag. The openings which lead from those cells to the surface of the fish, vary even more. The lamprey has seven on each side; the hag only one, but each opening in that communicates with all the cells. At their other terminations, the cells communicate with the gullet, so that they are adapted as a thoroughfare for water, like other gills, and not for alternate respiration and expiration by the same passage, like lungs.

Analogy would lead us to suppose that the water is received by the mouth, conducted thence by the tubes to the cells, deprived of the oxygen of its air by the fibres in these, and then discharged through lateral openings as useless, by the action of the sides and diaphragm of the thorax. Nor can there be any doubt that when the fish is swimming "free-mouthed," this must be the case. But there are some genera, that use the mouth as a sucker, during which time it cannot, consistently with the principle of suction, have any connexion with the breathing apparatus. Sir Everard
Home is of opinion that the water is, in these cases, both received and discharged by these lateral openings; and the vulgar opinion is, that it is received by these and discharged by the nostril. The last opinion cannot be true, as the nostril is not connected with the organs of respiration at all; and even that of Sir Everard is suspicious, as it involves not only a violation of analogy, but a want of skill not to be found in any other production of nature. If the gill-openings are adapted for the ingress of water, they would have this property at all times, and the thoroughfare by the mouth would be useless. But in a fish which, like the shark, swims with great velocity, the entrance of the water by the lateral openings would be accomplishing a purpose by the most difficult means. Those openings are behind rather than before the gill-cells, so that the mechanical action of the animal through the water would prevent that fluid from entering by those apertures, though it would facilitate it in getting out. So obvious is this, upon the very simplest principles of motion in a fluid, that one can hardly imagine the opposite possible; and so much is it the case in osseous fishes, that if they be drawn backward with rapidity, or held by the tail in a current, they are speedily drowned,—strangulated, because the gills will not act. When fishes of this kind are swimming, they must therefore take in water by the mouth, and pass it out by the gill openings, just in the same way as other fishes. Still, the respiration while sucking is a difficulty, though the difficulty does not consist, as Sir Everard thinks, in how the water gets out, but in how it gets in; and that difficulty is not cleared up by his
supposition that the water enters by the hole on the one side, passes through, and escapes by the other; because, unless there were a difference in the two, which could shut the one aperture against the escape, and the other against the entrance of water, it is not easy to see how it could be accomplished, any more than a person could at one and the same time draw in breath by the one nostril, and let it out by the other. If it is found that there is no other ingress for the water of respiration, while the animal is sucking, than the gill openings; the simplest plan would be to suppose that these and the thorax had a power of alternate expansion to receive, and contraction to expel, like lungs; and that is an alternation of motion and position, for which the structure of gills but ill adapts them. If, however, Sir Everard Home has not solved the difficulty, he has found it out, and that, in such cases, is half the labour. There is a general rule in all these cases; the established laws of the matter of which animals are composed, and in or by which they perform the functions of life, must never be violated; and can never be suspended, without the existence of some contrivance sufficient to effect that purpose: and the great beauty of the whole is, that that contrivance is always the simplest possible,—does its office completely, but does nothing more.
CHONDROPTERYGIous SUCKERS.

Of these singular fishes, there are three genera known in the British seas and rivers: the Lamprey, \( \textit{Petromyzon} \); the Pride, \( \textit{Ammocætes} \); and the Hag, \( \textit{Myxine} \). All these have a sucking apparatus surrounding the mouth, by which they adhere to that on which they feed, and also to stones.

Of the Lamprey there are two species; the sea lamprey, which is marbled with brown, yellow, and black. It grows to the length of about three feet, and has the second dorsal fin separated from the fin of the tail. The river lamprey is bluish on the back, and silvery below; its second dorsal fin is continued all the way to the tail, and its length seldom exceeds ten inches. Though the one be called the sea, and the other the river lamprey, the habits of these fishes are very much the same. They both ascend the rivers from the sea in spring, for the purpose of spawning, which they do about March or April, and return to the ocean again about June. When in season, the lamprey is accounted a very delicious fish; and both ancient and modern history record instances of persons having died from eating it to excess. The mouth is a curious structure. The sucker consists of a border without the lips, exhibiting an outside row of papillæ of a conical shape, and two or three rows of fringes within. With this it adheres very firmly, though without preventing the action of the mouth. There are two primary or fast teeth, one with two points above, and one with seven below. There are several rows of moveable teeth
within these, and also smaller ones upon the tongue;—thus while it holds by the sucker, it can abrade and lacerate the surface to which it sticks, so as to get at and extract the nutritive part, even though the covering be tough and hard. The accounts that are generally given about the lampreys fastening on cattle and horses when they pass rivers, do not appear to be very well authenticated. Neither is its food known with much precision, though from the great simplicity of its digestive apparatus, the food must be of a succulent description when taken into the mouth, or else reduced to one there.

The Pride is smaller than the smallest lamprey, not being above eight inches in length; it is barred across with a dusky colour. It contains fewer palatal teeth than the lamprey. It is a mud fish, found in some of the tributary streams of the Thames and some other rivers, and has not been traced in migration, either to or from the sea.

The Hag is about the same length as the Pride; but its body is very glutinous, nearly a cylinder; there are no scales upon it, and it is without eyes. There is a sucker round the mouth, one large piercing tooth upon the palate, and a row of very close ones upon each side of the tongue. The hag has sometimes been confounded with the pride, but they are different in their appearance and some parts of their structure, and also in their habitations; the pride being found only in rivers, and the hag in the sea. The hag is a very voracious fish, and very annoying to the
fishermen on some parts of the east coast. In the white fishing, the lines are often left for a tide floating in the sea; when the fish are caught on the hooks and struggling, the hag enters their mouths, and fastening its sucker, soon drains all the juices, leaving only the skin and the bones, which are called "robbed fish," by the fishermen.

The most singular circumstance about these fishes, is the mode of their production. It had long been noticed, that when the lampreys were in season, that is, while ascending the rivers from the sea, in order to spawn, all that were taken contained roes or eggs—were females, and that a male lamprey had never been observed. The researches of Sir Everard Home have very satisfactorily proved, that in all the three genera that have been enumerated, the male and the female are united in the same individual, and that each deposits its eggs in a state fit for producing young, without any other intervention, though there be a great deal of obscurity about the time and mode of this singular impregnation.

But the peculiarities of structure and habit, even in this single division of the inhabitants of the sea, are so numerous, that even the bare enumeration of them would extend to many volumes; and after all, leave the subject little more than merely begun. One, however, possesses a property, which, though not peculiar to it, is yet too singular for being passed over. That one is
THE TORPEDO.

The lower surface is here represented:—a, the mouth, before which, in the shadow, are the nostrils. b b, the gill holes, for breathing. c c, the places where the electric organs are situated; and where, if the integuments were removed, the under ends of the pillars would be seen like a delicate network. The light spaces outside of c c, are the situations of the cartilages of the pectoral fins, which fins form the dark edges. d, the situation of the transverse ligament which separates the thorax from the abdomen.

The Torpedo, or Cramp-Fish, (*torpedo vulgaris,*) is found on the British coasts, though not very frequently. The specimens that have been met with, have varied very much in size,—some being four feet and a half in length, and more than seventy pounds weight. Linnaeus classed this fish with the scate tribe, under the name of *raia torpedo*, but it has few characters in common with them, except that it is cartilaginous, and the breadth considerable, as compared with the length; but its shape is unlike. The head and thick part of the body form a roundish lump, from which the tail
extends, having two dorsal fins, and one caudal fin on the termination. The mouth, teeth, and eyes, are very small, and the fish does not seem to be fitted for much exertion of any kind.

Its general habits are not much known, but its electric power has been mentioned from very remote antiquity. The fact is mentioned by Aristotle, Pliny, and Appian; and the Arabic name is the "lightning fish," which would tempt one to conclude, that, at some period of their history, the Arabians must have known more of the nature of thunder and lightning than the inhabitants of Europe, down even to a time comparatively recent.

The ancient allegation was, that the torpedo could give a shock capable of numbing the hand and arm of the fisherman; and among that class of persons, the fact appears to have been all along known, though it it did not attract the attention of philosophers till toward the close of the seventeenth century. Reaumur described the phenomena with accuracy, but erred in attributing them to muscular action. Mr. Walsh was the first to investigate the nature of the numbing power in this fish, and Dr. Hunter to examine and describe the singular apparatus by which the shock is given.

That apparatus consists of organs which occupy the surface of the sides, from the fore-part of the animal, to the hind part of the thorax, reaching from the cartilages of the fins toward the centre of the fish. The length of each organ is rather more than a fourth of that of the animal, and they are thicker toward the centre, and thinned off toward the edges. They are
fastened to the parts adjoining, by cellular texture and tendinous fibres; and their upper and under surfaces are covered by the common skin of the fish, while immediately under the skin there is a thin fascia of longitudinal fibres, which are open in many places. Another fascia immediately below this, is formed into a great number of perpendicular sheaths, and these again are filled by angular columns, of various numbers of sides. There are several rows of these columns, and the number appears to increase annually by the addition of new ones at the exterior. The number of columns in one organ of a torpedo, four feet and a half in length, was eleven hundred and eighty-two. The columns are divided across into cells, of which, with these partitions, there are one hundred and fifty in an inch, but they vary with the state of moisture on the body of the animal. The partitions of the columns contain a great number of blood-vessels, which come immediately from the gill cells, in which the blood has been purified by the action of the air. The cells formed by the divisions of the columns are filled with a fluid, which has, upon analysis, been found to consist of albunum and gelatine, and which, therefore, cannot, as was once supposed, possess any electric action, but must merely serve to lubricate the delicate fibrous structure of which the electric organs are composed. Those organs contain a greater portion of nervous ramifications than almost any other animal texture, except that which is an immediate seat of sensation; and as the shocks given by the torpedo appear to be, in a great measure at least, voluntary, there can be no doubt that their production is in some way or other
produced by the action of those nerves. The following are some of the leading facts in the phenomena of the torpedo, as established by careful experiments, made by M. M. Humboldt and Gay Lussac:—

1. "A person much in the habit of receiving electric shocks, can sustain with some difficulty the shock of a vigorous torpedo fourteen inches long. The action of the torpedo below water, is not perceptible till it be raised above the surface of the water. [It does not appear that the shock was tried with both the torpedo and experimenter immersed in water, though that would be necessary, to complete the facts.]

2. "Before each shock, the torpedo moves its pectoral fins in a convulsive manner, and the violence of the shock is always in proportion to the extent of the surface of contact.

3. "The organs of the torpedo cannot be discharged by us at our pleasure, nor does it always communicate a shock when touched. It must be irritated before it gives the shock; and, in all probability, it does not keep its electric organs charged. It charges them, however, with astonishing quickness, and is, therefore, capable of giving a great number of shocks.

4. "The shock is experienced when a single finger is applied to a single surface of the electric organs, or when two hands are placed, one on the upper, and one on the under surface at the same time; and, in all cases, the shock is equally communicated, whether the person is insulated or not.

5. "If any insulated person touches the torpedo with the finger, it must be in immediate contact, as no
shock is perceived if the animal is touched with a key or any other conducting body.

6. "When the torpedo was placed upon a metallic plate, so that the interior surface of its organ touched the metal, the hand which supported the plate felt no shock, although the animal was irritated by another insulated person, and when it was obvious, from the convulsive motion of its pectoral fins, that it was in a state of powerful action.

7. "If a person, on the contrary, support with his left hand the torpedo placed on a metallic plate, and if he touches with his right hand the upper surface of the electric organ, a violent commotion will be felt in both his arms at the same instant.

8. "A similar shock will be received, if the fish is placed between two metallic plates, the edges of which do not touch, and if a person applies a hand to each plate at the same instant.

9. "If, under the circumstances of the preceding experiments, there is a connexion between the edges of the plates, no shock will be experienced, as a communication is now formed between the two surfaces of the organ.

10. "The organs of the torpedo do not affect the most delicate electrometer. Every method was tried in vain, of communicating electricity to the condenser of Volta.

11. "A circle of communication being formed by a number of persons between the upper and under surfaces of the organs, they received no shock till their hands were moistened with water. The shock was equally felt when two persons, who had their right
hands applied to the torpedo, instead of holding each other's left hands, plunged a pointed piece of metal into a drop of water placed upon an insulating body.

12. "By substituting flame in place of a drop of water, no sensation was experienced till the two pointed pieces of metal came in contact with the flame.

13. "No shock will be experienced either in air or below water, unless the body of the electric fish is immediately touched. The torpedo is unable to communicate its shock through a layer of water, however thin.

14. "The least injury done to the brain of the animal, prevents its electric action."

Spallanzani made a number of experiments upon this singular animal, the most remarkable results of which were—that the back of the torpedo always gives a shock when irritated, whether it be in air or in water, but that the action of the breast is neither so uniform nor so violent; that when both surfaces are irritated at the same time, the back gives a shock and the breast not; that when the animal is about to expire, the shocks become more feeble, but are repeated so fast, that about forty-five are given in a minute, and that the sensation which they occasion is very similar to that produced by the pulsations of a heart or an artery; that the shocks are always most powerful when the torpedo is laid upon glass; and that the young, if fully formed, are capable of giving shocks even before they have quitted the eggs.

The difference between the electric action of the torpedo, and that of a jar or battery in the common electric apparatus, was explained by Cavendish, who showed, by very satisfactory experiments, that the
distribution of an equal share of electricity has its action diminished as the number of jars, among which it is distributed, is increased; and upon the very probable conjecture that each column in the organs of the torpedo has the nature and action of a separate jar, it would follow, from the result of his experiments, that a torpedo, containing 1182 columns in its organ would, though equally charged as a single jar, send its energy only through one thirty-second part of the distance, a space much too small for allowing any shock or sound, or any effect upon an electrometer. This, to a very considerable extent, identifies the electricity of the fish with that of the clouds and the electric machine; and that identity is farther rendered probable by the fact that the torpedo does not give a shock till irritated, and till the electric organs have been excited by the friction arising from the motion of the pectoral fins.

It was once supposed, that, as the organs contain a fluid, the action was similar to that of galvanism, and like it, accompanied by some kind of chemical decomposition; but as the substances of which the organs are composed appear to be unfit for any purpose of this kind, that hypothesis has been abandoned, and the action is now considered to be electric. How it is produced is another matter, and one which does not lie within the province of accurate science. That it is intimately connected with the life and health of the animal, is evident, from its ceasing upon injury being done to the brain, and from its becoming feeble and convulsive when the animal is in the agonies of death. In so far, at least, it is also voluntary, as the animal, even when in vigorous health, does not always give a
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shock when irritated, which it would of course do, if the operation were purely a mechanical one. Thus, though the electricity itself be analogous to that which we can produce at our pleasure by other means, the mode of its production is a part of the economy of life; and therefore we cannot reason about it upon the analogies of dead matter; but must, as in all cases involving the singular mystery of vitality, content ourselves with observing its phenomena, and be careful not to extend our theory of its nature and laws beyond these. This is a caution that should never be lost sight of in the study of nature; and the distinction between what can be known and what cannot, is one of the most important departments of sound philosophy, though it is sometimes overlooked both by the learned and the ignorant.

Though it is probable that the body of every animal, and indeed every substance in nature, is capable of being excited by electric action, yet distinct organs for the purpose of producing such action, are found only in fishes, and hitherto but in a very limited number of these. These organs, like other parts of the organic structure, appear to be admirably adapted to the instinct which they serve, and the purpose which they effect; and though, in the different fishes which are furnished with them, there be some difference in their form, there is much resemblance in their substance and structure,—in the same manner as wings, claws, stings, or any other class of organs, of which the existence at once suggests the use. They are quite distinct from the organs of motion, respiration, circulation, digestion, or any other which belongs to their possessor generally
as an animal, or particularly as an animal of a certain class adapted for living in a certain element. They do not, for instance, belong to the torpedo generally because it is a fish, but peculiarly because it is a fish capable of imparting electric shocks; and if one were to find organs of a similar kind in any other animal, whether a fish or not, the natural conclusion would be, that that animal was electric. Although, therefore, we are unable to trace the action of the electric power all the way up to the volition of the fish, we can conclude from the presence of the organ, that the power exists.

The other fishes that have electric powers are all natives of warmer countries, and most of them are found in rivers; and even the torpedo is said to be much more powerful in its action in warmer countries than it is in England. There is, therefore, some probability that the action is, in some way or other, influenced by temperature and light. Indeed it is highly probable that the sun has much more influence in producing the phenomena of nature, than we are in the habit of supposing. We know that colours and tastes and scents are all elaborated by the sun; for when the summer is more than usually cold and cloudy, the flowers are deficient both in beauty and in fragrance, and the fruits in taste; and as we pass into warmer latitudes we find all these qualities increased. Nor is it a mere darkening of the hues, but apparently a greater activity in the structure of the leaf; for the same sunny weather which increases the crimson of the rose, gives more snowy and pearly lustre to the lily. The subject, it must be admitted, is a nice and difficult one; but it does not
appear to be, on all occasions, treated with the attention that it merits. There is probably a little prejudice connected with it: as the ridicule with which attempts to read the history of men and nations in the heavens has been very properly treated, may have had some effect in preventing people from reading in them those lessons which they are capable of affording.

The other fishes that have been observed to possess electric power, are four:—the electric eel of Guiana, in South America, (gymnotus electricus;) the silurus electricus, found in the Nile and Niger; and the tetraodon electricus, and trichiurus Indicus, found in the Indian ocean.

The Gymnotus is found in the muddy places of rivers and in stagnant pools, in Guiana, and the adjoining parts of South America; and from its burrowing in the mud, it is not very easily caught; and indeed the large ones are not very pleasant to kill, except with a missile weapon. They are much more formidable creatures than the torpedo, killing by their shocks not only every other inhabitant of the waters which they haunt, but paralyzing the larger land quadrupeds—so that they are drowned, or even depriving them of life, by the violence of their shocks.

The gymnotus bears some resemblance to an eel, only it is thicker in proportion to its length, and more spindle-shaped. The head and belly occupy only a small portion of its length, the greater part being taken up by the muscles and electric organs; and the under part terminating, along the whole length, except the head and belly, in one strong continuous fin; while on
the back there are two rows of glandular apertures, through which a mucous fluid is discharged, for lubricating the skin. There are two electric organs upon each side of the gymnotus,—a large one near the back and immediately under the skin, and a small one nearer the fin, and beneath the muscular texture by which that is moved. There is also a portion of muscle between the small organ and the large one. Both these organs extend nearly to the extremity of the tail, becoming thinner as that is approached; and they occupy about one half of the mass where they are placed, or more than a third of the whole fish.

The structure of these organs has a considerable resemblance to that of those of the torpedo. They are divided lengthways into tubes or pillars; and then again into cells by transverse partitions. The partitions are very near each other, there being about two hundred and forty in an inch. The longitudinal ones, which are at the greatest distance in the largest specimens, are much further apart, some of them being half an inch or even more. The longitudinal divisions of the small organs are closer, and they lie in curves, but the form of their organization is the same. Thus, while, in their internal structure, the organs of the gymnotus are like those of the torpedo, they seem to consist of the same materials,—albumen and gelatine being the prevailing substances in both. The superior power of the gymnotus may depend partly on the larger size of its organs, and partly upon the larger surfaces of the transverse cells; at least that would be the case if they were batteries of electric jars, which they resemble in some of their phenomena,—though, as is the case with the other
electric fishes, we know of no means by which they can be either charged or discharged, except at the will of the fish. The electricity of this fish, as well as that of the former, has sometimes been conjectured to be galvanic, and some have even pretended that it contains iron, and is magnetic, and that its action may be destroyed, or at least suspended, by keeping it for some time in contact with a magnet; but these, as well as every other attempt to explain the causes of its action, by any analogy drawn from dead matter, have failed; and it is now admitted to be an animal action, which we can no further explain than that it depends on the presence of certain organs.

The accounts of the gymnotus having been found twenty feet long, are probably without foundation; as the largest ones found by Humboldt were only a few inches more than five feet. The scheme to which that traveller had recourse in order to capture these animals was not a little curious. The hook, the net, and all the ordinary means of fishing having proved unsuccessful, Humboldt had recourse to horses. About thirty of these animals were driven into a pond known to contain a number of these gymnoti; and they were made to splash and raise the mud and water, by the shouting and hallooing of a number of Indians, armed with long forks. The eels, thus attacked by hostile hoofs in their native mud, rose in the water, and cannonaded the enemy with great spirit and determination. The horses would have fled at the first onset of those enemies, but they were driven back into the water. Some of the horses were so completely stunned by the blows, that they sunk in the water; and in that way two were
drowned, or killed in a few minutes. The eels appeared to attack in the way best calculated for destroying or impeding the energies of the horses, as they laid their whole length close to the thorax and belly; and it is well known that the shock of the gymnotus is in proportion to the surface which it touches. Thus the blows were communicated directly to the most delicate and essential parts of the horses; and even those that did not sink down, gave every sign of the utmost agony and alarm; and those that made their way out of the water stumbled at every step, and lay down upon the sand as if their nervous energy had been completely destroyed. Their exertions had been very severe to the eels also; for, after it was over, the shock, on drawing them out with a dry line, was hardly perceptible.

The gymnoti destroy all other kinds of fish in places where they are abundant; and they are said also to prevent the multiplying of the alligators, by benumbing the young ones till they are past recovery; and when the Indians find gymnoti and these together in their nets, the alligators are stunned or lifeless, while there is no appearance of a wound upon the others, so that the alligators must have been struck before they could bite. Fishes are stunned in an instant: and in the experiments of Dr. Williamson, when he threw a cat-fish of considerable size, into the vessel of water containing the gymnotus, the eel first took a look at the fish, and retired to a little distance; but it instantly returned and gave the cat-fish a shock, which made it come to the surface motionless, and with its belly uppermost. The death was not instant, however; for if
the fish were immediately taken out of the water that contained the gymnotus, they recovered their powers, though slowly; but if they were allowed to remain in the same water with it, they died.

The shock of the gymnotus is felt most strongly when it is actually touched; and the violence of the shock bears some proportion to that of the touching; being much more violent when it is pressed, than when the hand is simply brought into contact with it. The shock is communicated to a considerable extent through the water, though the violence diminishes with the distance,—a shock at three feet distance being much less severe than one obtained by immediate contact. When the shock is not received by immediate contact with the fish, but through some connecting substance, the violence of the shock is in proportion to the conducting power of those substances; and with a dry glass rod, or silk handkerchief, it may be touched without inconvenience.

Like the action of the torpedo, that of the gymnotus cannot be transmitted in the air, except to very minute distances. If the ends of two wires be as much as even the fiftieth part of an inch asunder, the shock does not pass from the one of them to the other; and along a line it is weak, unless the line be wet.

Though the gymnoti are understood to be very voracious animals, they kill much more than they are able to eat; and in the case of small fish, it is probable that they may kill several with one shock, as the shocks are propagated all round the animal that gives them. We are not aware that any satisfactory observations have been made as to the effects which the
shocks of the gymnotus have upon other individuals of its own species,—though it would only be in accordance with the general law of nature, that it should use them against its own kind as well as against others. Even the exhaustion which it is said to experience after giving repeated shocks, is not very well explained. There is not much muscular effort, to induce the lassitude and exhaustion that take place, and the electric affection is so unlike any other animal exertion with which we are acquainted, that we do not very clearly see what should be the effect of it. The effect upon the muscles, or rather, perhaps, upon the nervous energy of other animals, is very great. Humboldt mentions one place where the direction of a road had to be changed, in consequence of the number of baggage mules that, while fording a river, had been killed by the shocks of the gymnoti. But formidable as the gymnotus is, it is not like the greater number of destroying animals, useless when dead. The electric organs are, indeed, disagreeable, or at any rate insipid; but the muscular parts are very good and wholesome, and much relished by the Indians.

The other electric fishes seem to be much more simple in the construction, and inferior in the power of their organs, to those that have been described; but still the organization, so far as it has been examined, has some resemblance. At all events, there are sufficient data for considering this electric action as one of the natural means, both of attack and defence, with which animals are furnished; and we have occupied the more space with it, on account of the very few, even of the inhabitants of the water, in which it is found.
The habits even of some of those fish with which we are most familiar, and which, in a commercial point of view, are the most important, have been very much misunderstood and misrepresented. The annual value of the whale fisheries, that are fitted out on or from the British shores, is nearly nine millions of pounds sterling,—the nets spread out for the capture of herrings alone would cover almost two millions and a half of square yards; and yet such are the productive powers of fish, that the quantity taken might be augmented a hundred fold, and no perceptible diminution of the number occasioned. It is in the sea, indeed, that we have a proper view of the power of nature in multiplying her productions, and providing for the contingences to which they are exposed. If a hen rears more than a dozen of chickens, we think it an abundant brood, and if a ewe happens to have three lambs, her fecundity is published in the journals of the day; but we never hear one word about the sole, the average of whose progeny at a single birth is one hundred thousand; or of the flounder, that brings nearly a million and a half; or of the cod, with her maximum of almost four millions! and all those vast colonies come from the parent egg, which is hatched in the general bosom of the deep, without any care but that which they are capable of taking of themselves. Every female herring, in those countless shoals which throng round us every season, that escapes the snares of man, and the jaws of larger fishes, prepares little short of forty thousand to increase the shoal of the future year. It is true that there are many casualties and sources of destruction in that element in which those abundant
shoals have their being, yet the resources of nature are mightier than them all; and man may fish away, fully assured that for every fish that he can catch, notwithstanding the utmost endeavours of his skill and his industry, nature will be sure to provide a thousand. So excessive, indeed, is the production,—so full is that pale green expanse, which we in the inaccuracy of our speech sometimes call the "waste of waters,"—so full and exuberant is it of the springs of life, that all which man can win from its stores is not more in comparison than one little pebble from the ample bed of a mighty river; and what man does withdraw has this beautiful adaptation in it, that he takes both the predatory fish and the prey.

We are too little acquainted with the general history and economy of the deep, to be able to say what may be the food of all its animated inhabitants. Some of them may eat its vegetable productions; but in general these seem rather to protect the spawn and the fry, than to be consumed as food; and whatever be the size, form, and habits of the animal, we find it living upon other animals, and not unfrequently on its own kind among the rest. It may be adapted for swimming rapidly through the water, for crawling among the holes of the rocks, or it may be fastened to the rock, and have externally the character of a plant rather than an animal; but we almost invariably find it living upon animal food.

The common sea anemone, (actinia aquina,) which is so common upon most of the rocky shores of this country, appears, when left dry by the tide, to be a little hemispherical lump of jelly, the texture of which
CATCHING A CRAB.

is hardly organic, and which is even more simple and less like a living thing than the common sea-weed; and yet, when it is covered with water, one can see it spreading out its numerous tentacula like the petals of a dull purplish flower, closing them with unerring certainty upon any little shell-fish that the motion of the water brings within their reach, and very soon after ejecting the shell completely cleared of its contents. And not only that, but it can choose its residence,—detach itself from one part of the rock and adhere to another, although the precise way in which its migration is accomplished be not known.

Even those natives of the sea that are defended by crusts, and seize their prey by claws and pincers, like the lobster and the crab, have the same fecundity and the same voracity as the fishes properly so called. As many as twelve or thirteen thousand eggs have been found upon a single lobster, and the number in some of the crabs is probably much greater. Those two species answer some of the purposes of scavengers of the deep,—devouring substances in a state of putridity and decay, though they are very apt to seize any thing that comes within their reach. We have seen rather a small crab marching rapidly with a piece of offal, several times its own size, while smaller ones were at the other extremity holding on, and attempting to divide the prize. Nay, we remember an instance in which, but for timely assistance, the corporation of a royal borough would have been deprived of its head through the retentive clutching of a crab.

The borough alluded to, is situated on a rocky part of the coast, where shell-fish are so very abundant that
they are hardly regarded for any other purpose than as bait for the white fishery. The official personage was a man of leisure, and one favourite way of filling up that leisure was the capture of crabs, which after much care he had learned to do, by catching them in the holes of the rocks, so adroitly as to avoid their formidable pincers. One day he had stretched himself on the top of a rock, and thrusting his arm into a crevice below, got hold of a very large crab,—so large, indeed, that he was unable to get it out in the position in which it had been taken. Shifting his position in order to accommodate the posture of the prey to the size of the aperture, he slipped his hold of the crab, which immediately made reprisals by catching him by the thumb, and squeezing with so much violence, that he roared aloud. But though there be a vulgar opinion, of course an unfounded one, that lobsters are apt to cast their claws through fear at the sound of thunder or of great guns, the thundering and shouting of the corporation-man had no such effect upon the crab. He would gladly have left it to enjoy its hole; but it would not quit him, but held him as firmly as if he had been in a vice; and though he rattled it against the rocks with all the power that he could exert, which, pinched as he was by the thumb, was not great, yet he was unable to get out of its clutches. But "tide waits for no man," even though his thumb should be in a crab's claw; and so the flood returned, till the greater part of the arm was in water, and the ripple even beginning to mount to the top of the rock, which, as the tides were high at that particular time, was speedily to be at least a fathom under water, and destruction seemed
inevitable. A townsman, who had been following the same fishery with an iron hook at the end of a stick, fortunately came in sight; and by introducing that, and detaching the other pincer of the crab, which is one of the common means of making it let go its hold, he restored the official personage to land and life.

There is not a great deal known of the habits of those curious creatures, further than that they are exceedingly voracious, and that as they are betrayed into traps by garbage, they must be possessed of some sense of smell; but it is generally understood that they have desperate feuds at the bottom of the sea; and that many of those mutilations, with which they are found, are obtained in the field of battle. Against such casualties they are much better provided than nobler animals who are subjected to the same loppings in their encounters; for the lost member is restored, at least, at the annual change of the shell; and probably also when not undergoing that change. That animals, which are in common language termed imperfect, should have this power of reproducing mutilated parts, and that it should be wanting in those which are usually considered perfect, ought to be a caution to us how we decide as to the different degrees of perfection in the works of Him, who "in wisdom made them all."

One of the fish whose history and habits have been very much misrepresented, is

THE HERRING.

Of the herring genus there are three species,—the common herring, (clupea harengus,) the pilchard, (clupea
and the shad, (*clupea alosa,* of which the fry has been already mentioned as the white-bait of the estuary of the Thames and other places. The common herring and the pilchard are nearly of the same size, about twelve inches long when full grown; but there are some obvious distinctions between them, both in their appearance and in the places where they are found. Their colour is nearly the same; but the pilchard is more elevated in the back, and rounder than the herring; it is also blunter in the muzzle, and the scales are larger. The most obvious distinction between them, however, is the position of the dorsal fin. In the pilchard that is placed exactly over the centre of gravity, so that if the fish be suspended by it, the body hangs in a horizontal direction. In the herring it is placed further back than the centre of gravity, so that the head droops when the fish is lifted by it. The same distinction holds in the fry as well as in the full-grown fish. The fry of both are taken in great numbers, and known by the common name of sprats. In its locality, the pilchard is a little further south than the herring, being most abundant on the coasts of the British channel, and very rare on those of the north of England and Scotland; while in the latter the herring is found in great abundance. Both fish are, however, a little capricious with regard to the places which they frequent, and the regularity of frequenting them; and no cause can be satisfactorily assigned for their caprices.

When salt was subject to a high duty, and sufficient salt was not kept at those places where herrings make their capricious appearances, great loss was often sustained. This happened occasionally on many parts of
the Scotch coast, but particularly on the north of the entrance of the Firth of Forth. That Firth, as it is deep water, and without any shallow or interruption, is a favourable resort of herrings in the autumn and early part of winter. They come from the deep water in immense shoals or masses, which not only occupy a great surface of the sea, but extend to a considerable depth. For this reason they prefer the deep water, and, generally speaking, avoid the shoal coasts; and when they do get entangled upon one, great numbers are wrecked.

The rocky promontory at the east end of the county of Fife, off which there lies an extensive reef or rock, sometimes has that effect; and there have been seas in which, when the difficulties of the place were augmented by a strong wind at south-east, that carried breakers upon the reef and a heavy surf along the shore, the beach for many miles has been covered with a bank of herrings several feet in depth, which, if taken and salted when first left by the tide, would have been worth many thousands of pounds; but which, as there was not a sufficient supply of salt in the neighbourhood, were allowed to remain putrefying upon the beach, until the farmers found leisure to cart them away as manure. The herring is a remarkably delicate fish, and dies almost the instant that it is out of the water, or gets the slightest injury in it; and these circumstances, while they render the stranded shoals a much more frequent, abundant, and easy prey than if they were more tenacious of life, cause them to putrefy much sooner. One of those strandings took place in and around the harbour of the small town of Crail, only a
few years ago, but before the new regulations were passed with regard to salt. The water appeared at first so full of herrings, that half a dozen could be taken by one dip of a basket. Numbers of people thronged to the water's edge, and fished with great success; and the public crier was sent through the town, to proclaim that "callar herrin'," that is herrings fresh out of the sea, might be had at the rate of forty a penny. As the water rose the fish accumulated, till numbers were stunned, and the rising tide was bordered with fish, with which baskets could be filled in an instant. The crier was upon this instructed to alter his note, and the people were invited to repair to the shore, and get herrings at one shilling a cart load. But every successive wave of the flood added to the mass of fish, and brought it nearer to the land, which caused a fresh invitation to whoever might be inclined to come and take what herrings they chose, gratis. The fish still continued to accumulate till the height of the flood, and when the water began to ebb, they remained on the beach. It was rather early in the season, so that warm weather might be expected; and the effluvia of so many putrid fish might occasion disease; therefore the corporation offered a reward of one shilling to every one who would remove a full cart-load of herrings from that part of the shore which was under their jurisdiction,—the fish being immediately from the deep water, were in the highest condition, and barely dead. All the salt from the town and neighbourhood was instantly put in requisition, but it did not suffice for the thousandth part of the mass, a great proportion of which, notwithstanding some not very successful attempts to carry off a few sloop loads,
in bulk was lost. In the bays or "lochs," on the west coast of Scotland, where the shoals of herrings are very abundant, and apt to be driven ashore and stranded by heavy gales from the north-west, these casualties often occur. But though these occurrences are a great and obvious loss, they do not appear to have any effect upon the supply of herrings, whose numbers do not seem capable of apparent diminution, either by the casualties of nature or the schemes of art.

The habits of this most abundant, and, perhaps, all things considered, most valuable fish, are but imperfectly known; and they have been a good deal misrepresented. Their apparently capricious visits to particular parts of the coast, which did not seem to depend upon any known law, naturally enough led the inhabitants of the places which they thus periodically, but irregularly, visited, to impute to them certain superstitious likes and dislikes. The naturalists, too, or those who took upon themselves that character, publishing their opinions from little observation and less reflection, rendered the delusion more extensive and inveterate; till those who had never seen a live herring, were able to trace its migrations in the deep with as much certainty as they could the motion of the hands upon the dial of the village clock.

The disposition to endow the other animals with that erratic propensity,—that aimless wandering which idle men display, has been a stumbling-block in the path of natural history. The powers of man are placed under his own management, and when he does not manage them properly, he becomes an idler, and wanders or talks, as it may be, without an aim. But
man is the only animal that has the control of his powers; and therefore he is the only one that can be idle; and when all the other creatures are in a state of nature,—that is, when they are not confined, fed, or otherwise restrained by man,—not only have an object in what they do, but what they do is always the best and shortest means to the accomplishment of that object. The preservation of the individual and the race are the only ultimate objects of animals which have not the means of accumulating knowledge; and thus becoming wiser in one generation than in another; and thus all that can be alleged of them must conduce to the one or the other of these ends, otherwise it is a fancy of man, and not a fact in natural history.

The alleged migration of the herring is a very striking instance of man's propensity to people nature with his own whims. As the hordes that overran the empire of the Romans (when its weakness and worthlessness rendered it a piecemeal, and, therefore, an easy prey to people whose numbers were but as a handful to its whole population,)—as those are said, rather romantically, to have issued from the frozen bosom of the north, that became the general origin of all sorts of hordes, whose motions could not be distinctly seen from the very beginning.

Accordingly, in all those books called popular, which pretend to treat of the habits of British fishes, the pilgrimages of the herring have been described as an established fact. Produced by some unknown process in the polar regions, even at a time when the surface there is solid ice and snow, under which the spawn
of no animal could be hatched, they are said to be full-
grown, and on their march to warmer regions as soon
as the weather begins to get warm; indeed just as
the sun begins to decline northward from the tropic of
capricorn. Onward they move through the wide waves
of the spray, followed and feasted upon by sea-fowl;
which, if they obeyed nature, should, at that very time,
be attending to their nests, instead of plundering a
column of herrings on their march across the wide sea.
In the latter end of spring, or beginning of summer,
the herrings come to the Shetland islands, where their
fancied column is divided, and a division passes up
each side of Britain, near the southern coasts of which
they are found in autumn and the beginning of winter.
The same accounts which particularize this progress of
the herrings, mention that they are full of roe in June;
and that the young ones "come to our shores" in July
and August. Such are the outlines of the annual motion
of this fish, as they are detailed by one compiler after
another; and believed by thousands of readers, who
never pause to ask if the tale be true, or even possible.

Let us ask the question. But before answering it,
we must state, that mere criticism of the errors of
others is not our object: our own find us full employ-
ment in that way. The object which we have in view
is to impress upon the reader the absolute necessity of
looking at nature as a whole, and seeing that no general
law is violated by the theory that is given of any parti-
cular part. The migration of the herring was, we be-
lieve, first made a pleasing romance by Pennant, a man
of much merit for industry, but sadly wanting in that
general science, without which no naturalist ought to
proceed one step beyond the fact that he actually observes.

Simply, then, the story cannot be true, because it is impossible. The herrings do not come in myriads from the polar sea, beginning their progress in January, because there are no means of producing them there. Spawn has not been found to animate in any place except floating near the surface, or in shallow water, where both the sun and the air act upon it; and while the polar seas and shores are open to such action, the herrings are not there; they are on our shores, the full-grown and the young. But setting aside the impossibility, the supposed emigration would be without an object: they would not come for food, as they are said to leave the north just when food would be found there; and if they are annually produced in the north, they could not come to our shores for the purpose of spawning, even though they are all obviously in preparation for such a purpose. Beside, there is no animal that migrates southward in the spring; and therefore the theory would require one law for the rest of creation, and another for the herring; that the latter should be chilled by the general warmth of the spring, and warmed by the polar frost. Now, so far is the production of fish from being independent of the influence of heat, that, just as we would be led to infer from the slow progress of the solar beams through the element in which they live, they require the whole, or the greater part of our summer, to mature the germs of their countless broods. Nay, it appears that many, if not most of the species, cannot mature their spawn in the depths of the ocean to which they retire to
recruit their strength; but that they come to the shores and shallows, where the heat of the sun can penetrate to the bottom, and be reflected by it, for the purpose of maturing as well as of depositing their spawn.

We know not, and we cannot know, the secrets of those mighty depths which no plummet can fathom; but we have every reason to believe that there is a profundity where animals, constructed as the fishes that we see are, could not by possibility exist. Imagine the pressure of a thousand atmospheres, or between six and seven tons, upon every square inch of surface, and think of the miracle of muscular power which could give motion even to the smallest fish there; imagine, too, a permanence of state where the air never moves, and the sun never warms; and think what a dwelling for that which must breathe by an apparatus so delicate as the gills of a fish! It may be said, that God is capable of making creatures adapted for living there. We do not deny that he is, neither do we deny their existence; but we deny that the laws of nature are ever violated,—which they would be, were the fishes which we know, able to move under such a pressure, or propagate, so completely excluded from the action of the sun and the air.

The herrings come to the shores and estuaries to mature and propagate their spawn, which they do over a greater range of the year than most other fish; continuing the operation to the middle of winter, and retiring into deeper water after that is done. But there is no reason to conclude, that they have much migration in latitude; or, that they ever move far from those shores which they frequent in the season. The
fry too are found on the shores and in the bays and estuaries frequented by their parents; and they do not go to the deep water till late in the season. They even appear to go farther up the rivers than the old fish, for they may be taken in brackish water, with a common trout-fly.

The habits of the herring are thus a good deal like those of the salmon; and it is probable that there is a great similarity in the whole oviparous fishes; that they all frequent the banks and shoals for the purpose of spawning, and go to some short distance in deeper water to recover their strength. Those which are ooviparous, or bring forth their young hatched, are under no such necessity; though they follow the others, to feed upon them and their spawn or fry; and probably require the influence of the air and heat of the shallow water to perfect the internal hatching of their eggs.

It has not been ascertained whether any of these fish spawn every year; but there are some facts which would lead to the conclusion that they do not. The white-fishing, on the east coast of Scotland, which is principally carried on for the common Cod, (*morhua vulgaris,* ) and the Haddock, (*morhua æglicinus,* ) used to be, in a great measure, suspended during the spring, when the fish had spawned; but, in time, the fishermen found out, that when the fish were neither plentiful nor good upon the shallow banks, they had only to be a little more adventurous, and go into the deep water, in order to be successful all the year round. Now the fish found in the deep water cannot be those which have just spawned, for they are fat and firm, and have young milts and roes in them; and hence, there is
some probability that the cod, and other fish of the same structure, take two years, or more, to produce their immense progeny; and that thus there is not a fish in the sea but which is in season all the year, if its place of residence, and the mode of taking it, were known. It is by these general views, that the particular facts are made to connect themselves with the system of nature, and lead to useful discoveries in the arts.

When the fish are upon the shores and in the estuaries, nay, when they are upon the wide ocean, they have a host of enemies. All fishes seem to be themselves omnivorous—consuming every thing that they can swallow; and the number of sea-birds is perfectly incredible. The numbers that are upon the uninhabited islets in Orkney, Shetland, and the Western isles, as well as at those inaccessible promontories on other parts of the coast, would exceed the belief of any one who has not actually seen them, and yet they are nothing to the numbers found in lonely places, surrounded by more extensive seas. One of the most abundant, and the one which is found farthest out at sea, is

THE STORMY PETREL.

The Stormy Petrel, (procellaria pelagica,) or, "Mother Cary's Chicken," has been found in flocks, which, from the extent that they occupied, and the closeness with which they were serried together, could not contain less than one hundred and fifty millions. It is a bird about five inches and a half long; sooty black on the body, and white on the rump, tail, and wings; but having the principal feathers of these tipped with
The Stormy Petrel.

deep black. It is found constantly on the coasts of this country, and seems to be generally diffused over the world. It lodges and nestles in holes of the rocks, or in burrows which it makes for itself in the earth or sands; but it is a sea-bird, in the strictest meaning of the term, not being found on the land, except in the breeding season, or when it is driven there by the violence of gales. Ordinary gales have not, indeed, much effect upon it. It is small and swift, and powerful on the wing; and in appearance and manner of flight, not unlike the swallow. It seems to take particular delight in storms, probably, because the motion of the water brings to the surface the substances on which it feeds; and it skims along the hollows of the waves, and through the spray upon their tops, with astonishing rapidity, at the rate of sixty miles an hour, as is supposed. The sailors dislike it, and account it the harbinger of storms. That it is an accompanier of them, may be true; but it is more a follower of ships than a forerunner of storms. Oil, of which there is always a considerable quantity floating on the sea, appears to be its favourite food; and it is supposed to collect that upon the feathers of its breast, as it rides on the waters. It is for the greasy substances which are thrown overboard, that it follows in the wake of vessels, and it probably picks up molluscae, in the stormy weather, when it skims the surface. It is very easily tamed, and in that state it has been fed with train oil, in which it dipped the feathers of its breast, and then sucked off the oil with its bill,—which goes far to confirm the mode of feeding on the ocean that has been mentioned. As the oil upon the surface of the
ocean is not, except when some large fish has been mangled in the vicinity, so thick as to be perceptible, it could not well be gathered by the bill of a bird, and therefore, the feathers on the breast of the petrel are so contrived, that it can collect the oil as it swims, and continue that operation until there be enough for being taken with the beak. Both the condition and flesh of the petrel are in favour of this kind of feeding. It is so fat, that the inhabitants of some of the northern islands make a kind of candles, by simply drawing a wick through its body; and its flesh is so rank and disagreeable that even those who in a great measure subsist upon sea-fowl, do not eat it. The little petrel is, therefore, a kind of sea-scavenger, and removes the oil, which, if it were to go on accumulating, would interfere with the two important operations—of the impregnation of the air with water for the respiration and life of fishes, and the evaporation of water for the formation of rain and rivers. Thus we find that there is not a production of nature, or even a function of one of nature’s productions, but which, when we examine it, is essential to the existence of the individual, and at the same time connects the individual with the whole.

One of the most singular of nature’s fishers, and one which forms the best connecting link between sea animals and land animals, properly so called, is

THE SEAL.

The Seal, which, except in external shape, is a perfect quadruped, resembles the otter more than any other British animal in its swimming apparatus, but it is more gentle in its disposition, and more easily tamed;
and though its feet be webbed like those of the water-fowl, they are not so fully developed, and therefore it is not so well adapted for motion upon land. There are two species of seal on the British shores: the great seal, or bearded seal, (phoca barbata,) and the common seal, or sea-calf, (phoca vitulina).

The Bearded Seal is an inhabitant of more northernly regions than Britain, being found in greater numbers in the Greenland seas, where the natives reckon the flesh of it a dainty; but among the remote Scottish isles, there are generally a few to be met with, which bring forth their young in the caves, though at a later period of the season than the common seal. This is another argument against the migration of any sea animals toward the polar regions for the purpose of breeding; as we find those of the same genus that have their habitude farther to the north, two or three months longer in producing their young, which proves that they need a longer continuation of the action of the summer heat to bring them to maturity.

The bearded seal is rather a large animal, being about twelve feet in length, and weighing at least two tons. The hair with which it is covered is brownish, or dark gray, and coarse. The upper lip is divided into two lobes by a furrow, which is black and naked, and upon each of the lobes there are eight rows of strong white bristles, semi-transparent, and curled at the end, from which it gets its specific name. As seals do not swallow their food entire, as is the case with the fishes, and even the cetacea, they are furnished both with incisores or cutting teeth, and molares, or
grinders. The teeth in the bearded seal are by no means formidable, and indeed the whole formation of the animal shows that it is not ferocious in proportion to its bulk. The remote places in which it is found, however, render its habits comparatively little known as a portion of British Natural History. It is much more easy, and probably more interesting, to become acquainted with its congener—

**THE COMMON SEAL.**

The Common Seal is, when full grown, about half the length, and consequently about one-eighth of the size and weight of the former. [We need hardly mention that, as the bodies of animals are solids, having length, breadth, and thickness, two which are of similar shape will have their bulks as the cubes of any one dimension, double the length, double the breadth, and double the thickness, producing, when multiplied together, eight times the volume.] The fore legs of the seal are very short in proportion to the size of the body; the head and neck have a considerable resemblance to
those of land quadrupeds; but the pelvis narrows off like the hinder part of a fish, and the hind legs are nearly united to the body, lie backwards on each side of the tail, and the webbed feet in which they terminate, form with that a very efficient swimming apparatus. The body is covered with fur, which is short and glossy; most frequently of a dark brown colour, but often varied or spotted, and generally supposed to whiten as the animal gets old.

Though a considerable destroyer of salmon and other fish, the seal is a lively and playful animal, very gentle in its manners, but at the same time very watchful and timid. Seals are found in great numbers upon the banks in the estuaries of rivers; but they are not so much to be considered permanent inhabitants there as visiters, following the fish in their migration. They are fond of basking in the sun; and they always sleep upon the rocks or the bank, where at low water they may be seen in hundreds together. But they are never all asleep at the same time; for if one approaches them ever so cautiously, there is always a sentinel at the outside, or on the highest part of the bank, that gives the alarm, and the whole wriggle off to the water much faster than one would imagine. When a part of their march is over a beach of loose pebbles, they get on with a good deal of difficulty, as the loose stones give way to their paws, and instead of helping forward the seal, are flung behind it with some force, and to some distance. This has given rise to the vulgar opinion, that the seal voluntarily throws stones at its pursuers, an opinion for which there is not the slightest foundation. The object of the animal is to
escape, and that would be better accomplished if the stones, instead of giving way, formed a fulcrum, from which it could project itself forward.

When a seal cannot escape, it will bite in self-defence, but it does so only in extremities; and if a blow be aimed at it with a stick, it tries to seize the stick rather than bite the assailant. In this it sometimes succeeds, and then wriggles off to the water, where it swims about with the stick in its mouth, in a playful or triumphant manner.

It is more easily tamed than, perhaps, any other animal; is capable of feeling a great deal of affection; and appears fond of the society of man. During the time that rumoured invasions by the French caused all parts of the coast of Britain to be fortified, a small party on one of the little islands in the Firth of Forth, above Edinburgh, amused themselves by taming a seal. It had all the affection and all the playfulness of a dog. It fished for itself, and (we believe) sometimes for its masters. It fawned about them, licked their hands, and, if it did not accompany those who made an excursion in the boat, it was sure to meet them on their return. It always came to their hut to sleep, and conducted itself as if it felt that it was one of the party. Sometimes it would snatch up a stick or a brush, and scamper off to the water, where it swam about with the plunder in its mouth, often approaching the shore till within reach of its observers, and then it would be off to a distance. But though it seemed to take delight in teasing them in that way, it always ultimately came back with whatever it had taken, and laid it at their feet, fawning and fondling all the while. Indeed, if
they did not give chase, it seldom remained long in the water, but came back apparently disappointed at being deprived of its sport. When they went to Leith for orders or stores, the seal generally accompanied them, swimming all the way at the side or stern of the boat; and when the boat was made fast at the pier at Leith, it took up its position inside, and kept watch till they returned. Fish was not its only food; it could eat many things, and it was very fond of bread and milk. There was no saying how far its training might have been carried, but it fell out of a bed and was killed while young.

The ease with which the seal can be tamed, the playfulness of its manners, and the steady attachment which it has for its home and its human associates, together with the value of its skin and its oil; (its flesh used formerly to be eaten, and there is no question, that the quality could be greatly improved, if a mixture of other food were given along with the fish;) these, and also its disposition to part with a portion, at least, of the produce of its fishing, point out a great probability of advantage that would result from the addition of the seal to the list of domestic animals. Probably it might be found to combine many of the valuable qualities of the ox and the dog, while no rent would have to be paid for its pasture. It so happens also, that the places where seals are now most abundant, are those at which the keep of land animals is most expensive; and the idea that the herd should come from the sea to be milked, or give their carcasses as food, or that a man should go forth a fishing with a pack of seals around his boat, involves
no more of the impossible or the ridiculous, than many things, that are now of every day occurrence, would have involved, if mentioned only fifty years ago.

The female seal generally produces two at a birth, and the time of their production is about Midsummer. She is an affectionate mother, and battles keenly for her young, if she be there when any one goes to annoy them. Her nursery is generally in a cave: and in the large caves, such as those upon the north coast of Scotland, there is often a number in the same. The people frequently enter with torches and clubs, for the purpose of dispatching them, and they are killed by a comparatively slight blow on the nose; but when there are many old ones in the cave, they often upset the intruders in the scuffle, and thus the scene becomes ludicrous if not dangerous. Seals are often caught in rather a cruel manner: iron hooks are placed in the front of the rock or bank on which they are basking, or in a beam of timber placed against it; a person then steals near to the place where they lie, fires a musket, or makes any other loud and sudden noise, at which they take alarm, and, forgetting their usual caution in avoiding dangers, plunge headlong toward the water, and are caught and suspended upon the hooks.

As seals approach more nearly to the nature and character of land animals than any other inhabitants of the water, which are not very well fitted for loco-motion upon land, so they are, like these, subject to epidemical diseases, which often affect them to a very great extent. There have been instances in which the beaches everywhere on the north coast of Scotland, and the islands of Orkney and Shetland, have been covered with the
bodies of dead seals which were cast ashore by the tide; and when that has occurred, the seals that were seen swimming in the water were weak and sickly. The source of these casualties is not known; and no observation appears to have been taken of the particular state, either of the atmosphere or of the sea.

But we must get ashore, and devote a few pages to the phenomena and productions of another and a different scene.
CHAPTER VI.

THE MOOR, OR UPLAND.

The configuration of surface to which the one or the other of those epithets may be applied, has not the grand features of some of those that have been mentioned. Still, it is so far from being barren of interest, that we should have had abundant store of observation though we had had nothing else. Moors admit of more latitude of description than mountains; and, according to their different elevations, they may partake more of the Alpine or the champaign country. They are the favourite haunts of many of our most interesting animals, both quadrupeds and birds; and though the very name expresses a certain character of bleakness, there is a feeling of freedom about it. It is not nature either in the terror of her majesty, or in the tastefulness of her beauty; but still it is nature, where man has not altered her appearance.

We are not sure if there be any place where the heart beats so lightly, and the breathing is so free, as when we enter upon one of those wide expanses; and, whether it be the Alpine table-land, purple with the blossom, or green with the young shoots of the heath, where there is nothing to interrupt the course of your meditations, or chequer the uniformity of the wide
scene, save the white tops of the cat's-tail grass, *(phleum alpinum,)* playing over some little morass, like spray over a rock in the midst of the dark sea, and where the ear catches hardly a sound, save the patting foot-fall of the deer, as he springs buoyant in the invigorating atmosphere,—the booming of a bittern, as he shakes the quagmire in some hollow,—or the croak of the raven, as he limps cold and sullen from behind some stone; whether it be this,—which is wedded to sublimity, and would be sublime if there were not so much of it,—or any of the gradations down to the common, which just rises above the fertile fields, with its green bushes browzed to perfect hemispheres, and its cowslips and wild hyacinths, with the twitter of the little birds,—the chirp of the grasshopper, as he dances careless from flower to flower,—or the tinkle of that sheep-bell, the least musical of metallic instruments,—one stands in doubt which the most to admire; and can resolve it only by admiring them all. They are admired in turn, according to the mood of the mind; or rather, each one has the power of raising the mind to that mood which is best adapted to its own admiration.

When we come to consider those elevated and seemingly barren portions of the earth's surface, with a proper reference to that by which they are surrounded, we find that, though they be apparently unproductive themselves, they are the causes of productiveness. The flat summits, which are kept cold by moss and damp, attract the air, and by the condensation arising from their cold, make it part with its humidity; and thus lay up a store of water,
which would spoil vegetation if it fell wholly upon the cultivated plains, and cause overwhelming floods, if it fell upon the narrow tops, or steep sides of mountains. Thus, though a moor be the least like a lake of any of the broad features of a country, it serves some of the most important purposes of one. Moors are very generally composed of beds of gravel,—far more generally than of any thing else. They are the waste of mountains collected together by causes which we cannot explain. This gravel is porous to a great depth in some places, and to a smaller depth in others; and there are some in which it is made retentive by clay, or rendered so by the accumulation of moss. Thus it answers as a set of reservoirs, placed at various elevations, from which springs are given out all along the slopes that descend from it; and those clear fountains and crystal streams, which add so much to the beauty and fertility of the little sheltered glens and dells with which the slopes from an elevated moor abound, owe their existence to the apparent sterility of its surface. The heath, with the mosses and lichens with which the spaces between the roots of the heath are usually filled, prevent the water from running off the surface, even where the obliquity is considerable; and while the mosses and lichens retain as much of it near the surface as suffices for the nourishment of themselves and the heaths, the roots of the latter penetrate farther into the ground, and serve as conducting pipes to the more porous strata. The heath also shades, from the action of the sun and atmosphere, those more lowly plants which arrest a portion of the humidity in its motion downward; and thus there is little waste
of water by evaporation. The chief plants upon a moor have, in fact, the power of satisfying themselves with abundant humidity for life and growth; and at the same time laying up a store for the vegetation lower down, in such a way as that it is regularly distributed. Thus that which at first sight seems only a wasteful heap of rubbish, is a powerful instrument of good in the hand of all-bountiful and all-beneficent Nature.

When one leaves the highest fields of the cultivated ground, where the crops, though admirable in quality, are scanty in bulk, where moss creeps over the surface, and a bush of rushes, or a sprinkling of heath upon the old lea, puts man in mind, that if he will have even a grassy pasture for his cattle, he must manure and plough again; and when you have cleared the last rude fence of dry stones, and feel under your foot the soft elastic sod of hassocky grass, rather harsh and hard for being eaten,—the foremost to salute you with an apparent welcome, though, in reality, it is a species of coquettling to divert you from what she fears is your purpose, is
We have never seen the lapwing playing its singular evolutions in the air, or even sitting sagacious on a stone, or tripping lightly among the grass and heath, without being impressed with the belief that it is the most beautiful bird that this country produces:—we say, "produces," because, though it be a migratory bird, it first finds its being upon our moors, and its migrations seldom extend out of the country. Many birds have more gaudy plumage, and a few may have more graceful forms; but taking the two combined, we can recollect none that we ever so much admired, as the lapwing. Then it has evidently more mind—more speculation in it—than belongs to the majority of birds. Without being at all disposed to eat what it kills, it fights with the greatest bravery. The hooded or carrion crow, whose shapeless carcass and dull hue render him deserving of even a worse name, flies
and hops prowling about in the moors, uttering his hoarsely-whispered croak, and preying upon the eggs of all the birds that nestle there, without mercy or discrimination. But woe be to him when the lapwing catches him in the air. She wheels in curves so mazy, that instead of a carrion crow, not the best mathematician could determine the form of her orbit, so as to know where she is to be at the end of the next second of time. She is above, below, on every side, all in the same instant, you would think; and the poor crow (for one pities even a carrion crow in such company) is quite bewildered. Well, so he may; for the lapwing hits him a bang on the one side, and before he can turn his lumbering neck, to find out where it came from, or how to avoid another, bounce comes her strong wing against the other side of his head, with so much force that you may hear it at a considerable distance. He generally attempts to get down upon the ground for safety; but the lapwing, though no match for him on foot, so stoops at and works him even there, that there is an end to his egg-sucking while she has him in charge.

The Lapwing (vanellus crestatus) is a bird about fourteen inches long, and more than thirty in the expansion of the wings. The bill is about an inch long, slender, and thickened a little at the point. The legs, which are of a dull orange colour, are slender; but the figure is remarkably compact; and the plumage is as smooth on the surface as if it were one polished body. The crown of the head, and the crest, in which the nape terminates, as well as the breast, are of an intense glossy black. It is a curious black, however, being
iridescent, and giving a play of colours, for some of which you cannot find any adequate name. Some of them one would feel disposed to call bronze, and others green; but while they put one in mind of those colours, they retain the depth of the most intense black. The back is of an iridescent green, alternating, as most greens in the colours of animals do, with burnished gold,—it is composed of very minute dots of intense blue and golden yellow. The sides of the neck, the belly, and the bases of the tail, are of the most brilliant white. The principal feathers of the tail are white, with black tips; the tail-covers and vent are of a russet or rusty colour. The principal wing quills are black, with a white spot on the tip of each of the first four; and the second ones are white for half their length from the root, and black for the other half. There is a great deal of harmony, both in the arrangement and proportion of the different colours; and altogether, the bird is certainly a beauty. Though of considerable expanse, and powerful wings, it is but a light bird, seldom weighing more than eight ounces.

The wailing cry from which the lapwing has got the English name of "Peewit," is the alarm cry in danger, and is habitually uttered by the female when endeavouring to decoy invaders away from her nest. The male also utters this cry when disturbed. He has another, however, a sort of love-song, which he carols to his mate; but only when he is unobserved. That note is a kind of whistle, but very subdued and soft.

They repair to the moors in the spring; and there is often a good deal of rivalship and fighting among
the males, before the pairing be satisfactorily adjusted; when that is done, all animosity ceases, and they combine in beating off formidable enemies, when such come upon their ground. The nest is on the dry surface, but generally not far from some pool or marsh, in which a supply of food may be found. It is very simple, merely a little bed of the withered grass which has been bleaching in the storms of winter; but the simplicity of the nest, and the resemblance of its colour to that of the ground on which it is placed, conceal it better than a more artificial structure; and what with that, and what with the manoeuvres of the parents, there are, perhaps, fewer lapwings' nests robbed than of any other birds. The eggs are four, of an olive colour, with black spots; and they are very neatly arranged, with the small ends, which terminate nearly in points, all in contact at the middle of the nest. While the female is sitting, the male, when not occupied in finding food, and that is chiefly got in the evening, acts as sentinel, and very artfully decoys boys or dogs, and as boldly drives away birds, from the vicinity of the nest. If he should not be in the way, the female herself is abundantly vigilant; spies the intruder a good way off, and if he be coming in the direction of her eggs, goes off to meet him. She does this as fast and silently, and as far from the nest as possible; but still it is done with a great deal of art and tact. She does not go in a straight line, but works traverses, like a ship beating to windward, or a besieging party approaching a fort; and "puts about" whenever she thinks she has been observed. When she gets sufficiently far from the nest, and near the visitor, she springs up in fluttering
alarm, as if she were just driven from her nest; and as she wheels round him, often dashing the wind in his face with the sweep of her wing, she tries to wile him away in another direction. If she fail by her manœuvres in the air, she has recourse to stratagem on the ground. She lights very near, and hops as if crippled in the legs and unable to fly; but if she be pursued, which is very often the case, from her apparent lameness and the consequent ease with which she may be caught, she always contrives to keep at the same distance, till she be so far from the nest, as to be sure that that is safe; then she again takes to the wing; and when she has wheeled and screamed a little longer, takes her departure, but alights at some distance from the nest, and works back to it on the ground, in the same manner that she left it. She contrives to practise these arts till the young are able to fly; but the lapwing, which will thus come close to and hover about an unarmed person, or a dog, alters her tactics if a gun, or even a large stick, be presented at her. She appears to know the danger of weapons, and the instinct of providing for her own safety gets the better of that which prompts her to protect her offspring. Rooks, and many other birds that frequent places where there is much shooting, have this dread of fire-arms; and when one is near them, they appear to know the difference between a stick and a gun: we know that to be fact, for we have tried it several times. When the rooks were at a considerable distance, they rose indiscriminately, whether the object pointed at them was stick or fowling-piece, but when very near, they did not heed the stick; and when they were scattered over a
field, we have found the distant ones rise at the pointing of the stick, while those that were nearer did not. Even upon shifting a stick from the usual way that a walking stick, or a stick merely carried in the hand, is carried, to that in which a sportsman carries his gun, the rooks do not like it, and fly off to a distance. The habits of the lapwing afford stronger instances of sagacity than one would be led to expect; and they are evidence that, with proper care, it might be added to the number of domestic birds.

It has, indeed, often been partially tamed, and kept in gardens for the purpose of clearing them of worms and other insects. A case mentioned by Bewick throws a good deal of light upon the habits of the bird: Two were presented to a clergyman, who put them in his garden for the purpose above mentioned; but one of them died in the course of the summer, and the other remained shy and distant till the cold weather set in, and its supply of food in the garden began to fail, when it came to the door of the back-kitchen and sought admittance by uttering its cry of peewit. As the winter advanced, it gradually became more familiar, and ventured to visit the kitchen; though it was at first very cautious, as a cat and dog were in possession. When it found, however, that these were not disposed to be hostile, it made companions of them,—came to the kitchen every evening, and sat with them, enjoying the warmth of the fire. It continued to do this during the winter; but when the summer came, it abandoned the house, and betook itself to its insect-hunting in the garden. When the winter again set in, it returned to the house; but without any of the caution that it had
observed at its first approach in the former season; for it marched boldly into the kitchen at once and joined the cat and dog, and took more liberties than it had done the preceding year. Lapwings are particularly cleanly in their habits, and wash themselves very often in water; but though there was a bowl in the kitchen, out of which the dog drank, the lapwing did not, during the first winter of their acquaintance, offer to avail himself of it. The second year it did so frequently; and showed a good deal of impatience if either the cat or the dog offered to interrupt its ablution. The progress of domestication in this interesting bird was cut off; by his attempting to swallow something that he had picked up in the kitchen, too large for his gullet.

When we meet with lapwings on the moors, we may be very apt to suppose that they live upon very little food, as during the day they are almost perpetually upon the wing, or running along the ground; but in summer their principal feeding-time is in the evening, when the worms come out of their holes. They show a good deal of art in this, for when they come to earth that is newly cast up by a worm, they instantly remove it; and if the worm be too quick for them, and has disappeared in the earth, the lapwing begins beating with its feet, and agitating the ground, till the worm again makes its appearance, when it is instantly seized and drawn out. In this way it catches a great deal of prey in a short time, and thus it is enabled to remain on the wing during the day, for the protection of its nest.

The young, which are hatched in the space of three
weeks, are able to run about a day or two after they leave the egg; but they are unable to take the wing till they be nearly full-grown, so that the period of nursing and watching is longer than that to which some other birds are subjected. This protracted maternal care answers very well with the lapwing, which finds its food in the greatest abundance in the latter part of the summer, when the young birds have increased the flock. When the frost begins to set in, the lapwings collect in flocks, and betake themselves to the marshes and brooks of the low parts of the country, or to the shores of the sea, which are the common resource of all birds that live upon insects, when the severity of the frost prevents them from obtaining any upon the land.

From the number of birds that inhabit the moors, or resort to them for the purpose of nidification, they become the haunts of many ravenous birds,—as these can there carry on their hunting with less chance of interruption than in the woods or inhabited places. There are not many of these spoilers that actually breed in the open uplands, as birds of prey usually make their nests in places that are not easily accessible; but as they are birds of powerful wing, they make hunting excursions over the open heights. All of these are formidable to the smaller birds, as well as to the young of the larger, and of hares and rabbits, though these last are by no means common on elevated plains; but almost the only one which is a match for the lapwing in fair combat in the air, is
THE GOSHAWK.

The Goshawk (falco palumbarius) is, after the golden eagle, the boldest and the most destructive of the British birds of prey; and, like that bird, it is much more frequently seen in Scotland than in England. It does not, indeed, appear that it ever bred in England, though its nest has been often found in Scotland. Like the eagle, the goshawk does not stoop to ignoble quarry, and therefore the smaller birds are safe from it; but it pursues the larger ones with great activity. The female goshawk is about two feet in length, and five in the expansion of the wings; and the male about a third less in each dimension. The goshawk builds its nest indiscriminately, on the tops of lofty trees or in the clefts of rocks; but it always chooses a situation which, while it
is both retired and inaccessible, is so chosen as that there shall be plenty of game at no great distance. The female lays from two to four eggs.

The colour of the goshawk varies so much at different ages, and even at the same age, that it has been called by a number of names; but in the times when falconry was a favourite sport, the goshawks were the "gentil falcons," which were trained for flying at geese, cranes, and other large birds. When on the wing, the bird cannot be mistaken by those who have once been acquainted with its size, its boldness, and the straightness and rapidity of its flight, together with the unerring certainty and deadly power of its stroke.

Among rapacious birds, the hawks stand in nearly the same relation to eagles, that the canine species do to the most powerful of the feline among quadrupeds. The lion and the tiger spring, the eagle darts down upon her quarry; and when any of them miss, they do not course the prey. The hawks, on the other hand, start their prey, run it down on the wing, and strike it to the earth; and the majesty with which they shoot through the air is very great; at the same time one can see that there is an effort so to drive the game, as that it may not reach the ground, or escape into bushes. The goshawk dashes through the trees of a forest with great vigour; but in such situations, her prey often escapes; and therefore, when she can find a proper place for her nest in the vicinity, she daily beats a considerable distance of the moor, more especially if it abound in
GROUSE.

The two distinct kinds of grouse that inhabit the moors and wilds of the Alpine parts of Britain, are among the most famed of its feathered tribes; and one of them, the

Red Grouse (lagopus Scoticus) is almost peculiar to this island; or, if those continental birds which have been called by the same name are of the same species, they are different varieties, occasioned probably by difference of food and climate. It is rather singular that these birds, which are so rare in Europe as not to have been known to Linnaeus as any thing else than a supposed variety of the ptarmigan, should have been met with in Tristan d'Acunha, a lonely island in the opposite hemisphere, between St. Helena and the Cape of Good Hope.

In this country they are found in the open heaths only; so that the names of heathcock, which they get in England, and moorcock, which they get in Scotland, are strictly apposite. So fond are they of heath, that they are very seldom met with in the grassy parts of the moors; and they quit a planted moor as soon as the trees make any considerable appearance, even though the heath should have been improved by the planting, which it generally is until the pines—the trees most generally planted on heaths—have grown so large, as to exclude the air, and destroy the heath with their falling leaves. We knew one large heath, the centre of which was once very thickly stocked with grouse; but after it had been planted for a few years, the birds entirely
forsook it, and betook themselves to the outskirts, though those were so near the cultivated lands that the birds had previously avoided them, unless when forced from them by the severity of the winter. In passing along the side of the young wood, in the evenings of April and May, we have every where heard the cry of the heathcock on the outside, but never once within the wood; even though there were wide openings between the trees, and none of them above eight or ten feet in height.

Many circumstances lead to this habit in the red grouse: the heath is, at all seasons, nearly of their own colour; as when there are not purple flowers upon it, the old leaves, which are falling in the summer, are brown. On an open moor the heath is short and firm, and the birds can run amongst it; while, when sheltered, it gets long and lank, and makes a very bad pathway even for a hare. The open heath is also dry and fragrant; and the buds, which are the principal food of the grouse in the breeding season, are sweet; while in the shaded places it is damp and rank. The superiority of the path, (for grouse do not get on the wing till their running be unavailing,) and also of the food, are, therefore, inducements to prefer the open heath.

But the instinct of preservation leads them to the same places. Trees, the shade of which would be inconvenient to grouse, afford shelter to animals that would prey upon them; not to predatory birds only, but to weasels, martens, and foxes, which would prowl about and destroy the eggs during the day, and the old birds in the night. Thus the necessity of food, and the desire of life, equally confine these birds to situations
which have, comparatively, few other inhabitants; and while they do this, they place the birds in the very situation where man can preserve them most securely from other destroyers.

The grown-cock is about fifteen inches long, and twenty-three in the expansion of the wings; but as the majority of those that are bagged by the sportsmen in the season, are poults or young ones, the full-grown bird is not often met with, except "on whirring wings," as Burns most accurately expresses it, on his native heather. The general colour is a very red chestnut brown, barred and spotted with black, with a circle of white round each eye, and a spot of the same at the root of the lower mandible. The carbuncles on the eyelids are prominent, of a very bright scarlet, and fringed along the upper edges. The feathers of the tail are black, but the four middle ones are finely banded with red, and the lateral ones are tipped with rich reddish brown. The quill feathers of the wings are of a dusky colour, and there is about the whole covering of the bird that rich gloss, by which gallinaceous birds are so generally characterised. The tarsi, and even the toes, are covered with ashen-coloured feathers, as fine and delicate as hair. The hen-grouse is rather smaller in size, and has the colours less bright, and the gloss less brilliant, with the carbuncles on the upper eye-lids small and pale; and the poults are much lighter in their colours than the full-grown birds, and not unfrequently mottled with white.

As soon as the pairing season commences, for, contrary to the habits of the black grouse, they do pair, the cocks make the moors ring with their amorous
noise; and though the sound which they utter cannot be considered as a song of any description, it is still very lively; and as it is heard in lonely situations, and over wastes of brown heather, the peasants listen to it with pleasure. It is a sound not easily expressible in words, but it is one which, when once heard, there is no danger of forgetting. Perhaps the nearest approximation that can be made to it in writing, is *curr-rrrr-rrr—bec-bec-bec*, the *r's* being prolonged and strongly aspirated, and the last syllables gradually shortened and lowered. This cry is so loud, that it seems to proceed from a much larger bird than the heath-cock; and, probably, it may have other uses than being a mere love-song. It must, indeed, have for it is continued after the female has begun to sit upon the eggs, and even after they are hatched. While the hen is performing her incubation, and while she is sitting upon her infant brood in their young state, the cry, which the cock repeats at intervals during the night, is obviously the cry of a watchman. This cry is never uttered in the immediate vicinity of the nest after the female has begun to sit, but always from some spot at a little distance, as if it were intended to draw off any spoiler of the night, that may then be prowling about. Neither, in so far as we have observed, is it twice uttered from the same spot; for after the cock has sounded his watch-note on one side of his charge, he runs quickly and silently past the nest, and sounds it on the other side, and thus continues till he has made sure that there is no enemy in the neighbourhood.

The nest of the grouse is very rude and simple, consisting only of a few twigs of heath, and leaves of
withered grass; and the place chosen for it is some elevated mossy sod, concealed by tall heath, there being, in all birds that build on the ground, an instinctive caution against rain. The eggs are never fewer than eight, and rarely more than fourteen; they are of a dull yellowish white and straw colour, marked with minute rusty spots, with large blotches toward the small end. The brood continue with the hen till winter; and when the cold sets in, a number of families unite in a flock. It is late in the season before they come to their full power of wing, though they grow rapidly in size; and after they have assembled in flocks, they are so very shy and vigilant, that the best sportsmen can with difficulty get within shot of them. When they are in families only, they are much more easily shot. They lie close in the heath, until they be approached very near. Then the cock is the first to spring, which he does in one direction with much noise and motion of his wings; and the hen and brood run a little way upon the ground, and then take their flight in a direction a little different; but when they have got out of reach of the danger, they again unite, and after flying in various circles, as if to bewilder their pursuers, alight again, but run a considerable way, and generally in an oblique direction toward the sportsman, before they are again at rest. Grouse-shooting is a very favourite sport, especially in the Scottish mountains; not, however, on the lofty summits, but on the lowest uplands and slopes, that are covered with heath. The shooting is most successful in the commencement of the season, and before the birds have begun to flock; but the birds are in better condition afterwards. As is the
case with salmon, grouse is the more wholesome and finely flavoured, the more recent it is; though fashion has led to the using and even praising of it, and all sorts of game and venison, in being in the finest condition when in a state of incipient putridity. In all cases that taste is, of course, a vitiated one, and most likely has arisen from the circumstance of food of that kind not being attainable, in a recent state, in large cities. In a matter so very capricious as taste, we by no means give an opinion; but we have eaten grouse, with the coarse and plain cookery that it got in the open air on a mountain side, within less than an hour of the time that it had been on the wing, and having done so, we never had any wish to taste it when in the state which is called "high." Chacun à son goût, however; and if people will prefer rotten food, nobody has a right to quarrel with them.

If grouse is to be kept for any length of time, or carried to any distance, it should be drawn as soon as killed; as it very soon begins to putrefy internally, and draws round it a number of flies, which deposit their eggs, and, in brief space, have it full of maggots. One would not, at first, suspect this in a bird which feeds on substances that resist putrefaction so long as the heath-buds and heath-berries, upon which the grouse lives; but yet it should seem that this hard food is the cause of the rapid putridity. The gastric juice of the bird must be more powerful than that of animals which live upon food, which is softer and naturally more assimilated to the animal structure; and a very short time elapses before the juice begins to act upon the coats of the stomach; and, though this action prevents any
further production of the juice, yet, when putridity has once begun, it proceeds irresistibly; not only in that which otherwise would have kept for a long time, but even in living substances. One apple, or one potatoe, that has begun to rot, will, in a short time, produce rottenness in all the heap; gangrene of the smallest member of the body, will occasion dissolution; and the puncture of a needle which has passed through the substance of a putrid body, will occasion gangrene and death, even though the quantity of putrid matter upon it should be so small as not to be discernible.

Though the grouse, from being pursued with so much avidity by man, is a shy and warly bird, it will breed in confinement; and thus we do not doubt that, with a little attention, it might be added to the list of domestic poultry, and probably improved both in size and in flavour. Indeed this might, in all probability, be done with most of the gallinaceous birds, more especially those, of which the family continue together till the end of the season.

The descent of the grouse from the uplands to the margin of the cultivated fields, is a certain indication of a storm. In September, 1807, we started a flock of grouse upon the edge of a field of oats, distant at least a mile and a half from the moors; and upon mentioning the fact to the owner of the field, he shook his head, and wished that all his crop had been gathered in. The day was more than usually fine for the season. There was not a speck of cloud in the whole expanse of the sky; the sea (the Moray Firth it was) lay motionless as a mirror; the extent in the offing seemed interminable, and the outlines of
the surrounding objects were as firm and well defined in the aqueous reflection, as in the terrestrial reality; the ground was everywhere glittering with the snares of the little field-spiders, and thousands of them were navigating the atmosphere in their silken balloons. The night continued serene till we had retired to rest, and we thought not of the fear of the farmer. About midnight, however, the wind sung in those melancholy murmurs which are always the signs of some rapid change for the worse in the state of the atmosphere; and in the morning, the ground was white with snow to such a depth, that it concealed both the standing corn and the shocks. It lay for some time, and was followed by heavy rain and black frost, which completely destroyed the potatoe crop, and reduced the poor, who depended principally upon that, to a state closely bordering upon famine.

When the grouse leave their upland haunts, and even in these, in some instances, especially if there be rocks or woods at no great distance, one of their destroyers is
THE KITE.

**THE KITE** (*milvus vulgaris*) belongs to a division of rapacious birds, different from any of those that have been mentioned. Its organs of flight being much greater, in proportion to its organs of destruction; and while it is one of the most ravenous of birds, it is also one of the most cowardly. The smallest of the hawks puts it to flight; one lapwing, or two rooks, more than match it; and when it comes to the poultry-yard, it will not dare to take any of the chickens from a vigilant hen, but hovers about till she be off her guard; and then steals; but when it succeeds in getting prey, it becomes so intent upon the satisfying of its appetite, that it forgets every thing else. Advantage is often taken of this, in order to destroy the bird; and one chicken is sacrificed, in order to save the rest. When the kite is hovering about, a chicken is put in its
sight, and a person with a club is set to watch. The moment that the kite spies the chicken, down it pounces, and as the chicken is purposely left in a retired place, the feast is instantly begun. While it is luxuriating, the peasant comes in the rear of it, and aims a blow at its wing, which generally takes effect,—indeed, if the bird be not hit at all, a second blow may be given,—and the kite is soon dispatched, and nailed on the wall in terrorem to all future kites. This is often accomplished in so short a time, that the chicken, though killed, is not mangled. This attention to its meal, on the part of the kite, has procured it the adjunct of "greedy" to its provincial name of "glead." Nor is its absorption by the feast taken advantage of by man only; for though we have never seen an instance, we have heard it often stated that the pole-cat, and even the common weasel, will set upon and dispatch the kite while it is feeding, and then eat up both the preyer and the prey.

Though thus cowardly and rapacious, the kite is both a large and a handsome bird. When full-grown, the length is nearly two feet and a half, and the extent of the wings five and a half. More of the length is taken up by the tail, than in the case of eagles and hawks; so that the kite is not so heavy in proportion to its extent, its weight being generally under three pounds. The beak is weaker and more slender in proportion; and the tarsi are thin and scaly, and the claws weak, and not very much hooked; but still, from the nature of its food, and the fact of its killing nothing on the wing, as the eagles and hawks do, but pouncing its prey on the ground, and attacking it with beak and
claws at the same time, the assistance of each compensates for the weakness of the other; and greater strength in either would have been superfluous.

The motion of the kite is remarkably graceful. It sweeps along in curves, which it is enabled to describe by using its long forky tail as a rudder; and there is a considerable interval between the times at which it gives a single jerk to its wings. Its flight is low, compared with that of the eagle; but it is higher than that of some other rapacious birds that beat the ground.

The size, or even the condition of the prey, is no consideration with the kite, so that it is not a creature that offers resistance. The young of hares, rabbits, and all sorts of game—those young that cannot fly, especially—very young lambs, carrion, mice, snakes, worms, insects—all come alike to the kite. Thus it has a great range of food, and is in consequence fitted for a number of situations. It is not so much a moor bird as a prowler about woods, fields, and farm-yards, and even the vicinity of towns; but it often takes an excursion over the moors, even to a considerable extent, if it meet with a peculiarly fine day.

It is in fine weather only that the kite beats the ground gracefully. The objects of which it is in quest are smaller than those on which the eagle preys; and it requires, in consequence, greater light. On the fine sunny days too, young heath-poults, partridges, or chickens, according to the nature of the place, lie basking, or even asleep, in more exposed places than when the sun is clouded and the air cold. Thus the sailing kite, though certainly not a harbinger of fine weather, is a concomitant of it, because then its prey
is most in sight, as well as most easily seen. There is not any thing majestic in the stoop of the kite,—it rather sneaks cowardly down, like a thief. In stormy weather, or rather in that warning before storms, when the air is dark and the birds take to their coverts, the kite, when it does appear, is clamorous; and hence it has been said that its noise presages bad weather. That it does precede bad weather is true, for we have often observed it; and therefore there is no more harm in taking it as an omen of the weather, than there is in predicting thunder and rain when the sky is full of thunder-clouds. But still the crying of the kite has no reference to the weather that is to come, for it refers to the existing state of the atmosphere. The kite is more than usually hungry, or it would not hunt in such weather: the state of the air keeping the birds at rest, they are difficult to be seen, and the kite screams to rouse them to motion, and make their attempts at securer concealment the means of their more easy discovery.

Considered merely in itself, no phenomenon or event is an indication of the future, though there is not one that may not be made so by due observation; and the principal distinction between superstition and philosophy consists in this,—that philosophy looks carefully into nature, and finds what is the future event or phenomenon that follows a present one; while the superstitious person either overlooks the succession of the phenomena of nature altogether, or connects with the present a future event, which has no natural connexion with it. All knowledge is founded upon this observation, and all ignorance arises from the want of it; nor is there any occurrence, however apparently trifling and
simple, which would not bring us a lesson, if we would but wait and watch for it. But we are so apt to attend only to the great events which are striking, and force themselves upon our notice, that we lose the connexion by not heeding those minor ones, which are the cement by which the whole succession is bound together, and without which the insulated partitions are of comparatively small value.

The kite usually builds in trees, its nest is formed of twigs and lined with wool. The female lays, generally, three eggs, of a dirty white, and occasionally blotched with rusty brown at the thick end. The eggs are larger than those of the domestic hen. The young are produced early in the season; and, on the continent, the bird is migratory, proceeding southward to Greece and Italy, or even to Africa in winter, and returning as far as the shores of the Baltic in the summer; but in Britain they do not leave the country; they descend toward the sea, where, though they do not appear to catch living fish, they prey upon dead ones and aquatic insects, and, when they can come upon them unawares, sand-pipers and other birds. The kite is only an occasional visitant in the bleak and northern parts of the country; and it is rather a rare bird, except in some particular districts. It is far from being the most destructive bird that beats the moors, and other places where there are gallinaceous game: a much more formidable destroyer is

THE HEN HARRIER.

The Hen Harrier (circus cyaneus) is like the kite, not a regular inhabitant of the moors, but it makes excursions there, and is very bold and destructive. It
is not so partial to woods as the kite, and often makes its nest in rushes, or among long grass or autumn wheat; but it also occasionally builds in trees. It is a small bird compared to the kite. The length is about a foot and a half; and the breadth about forty inches. Its tail is long, like that of the kite, but it is not forked. The general colours of the male are, gray above, and white on the under side; and those of the female, brown above, and white below, and in both places more or less marked with orange. The colours vary a good deal, however, both in the individual and with age; and that has led to the bestowing of more names upon this than upon almost any other bird.

The hen harrier flies very low, with a swift and smooth motion, and few birds or small quadrupeds escape its fury. It is said even to attack deer and sheep, especially at the season when they are weakly, and to prevent their escape by striking them blind with its beak. Of all the birds of prey that are known in this country, it is the most destructive in the poultry yard, and also in all places where there are game. It is an extensive rover, and wherever it roves it is certain of success. Though it has none of the cowardice of the kite, it has the same extensive range of feeding,—making prey of every thing that it can muster, and eating garbage when it can find no food to kill. The hen harrier is easily distinguished from all other hawks by the length of the ear feathers, that form a complete ruff round the neck, which in the female is white and very stiff. Notwithstanding the hen harrier produces more eggs than the kite, it is not much more common, though it is more generally diffused over the low parts of the
country. It is never found upon the mountains, and but seldom on the higher Alpine moors; yet it is pretty general upon those that lie low. One pair seem, however, to require an extensive range of pasture, as they are thinly scattered at any one place.

There are two other species, the moor-buzzard, (*falco rufus,* ) and the ash-coloured harrier, (*falco cinerarius,* ) the first, larger every way than the hen harrier, and the last exceeding it in length and extent, though very much lighter. They have the same general habits and structure, but they are more exclusively confined to marshy places, and their peculiarities will come in with more propriety, when we notice a few of the leading inhabitants of those situations.

Though the red grouse be now the prevailing bird of the Alpine moors of this country, there is an extinct species, of which both naturalists and sportsmen have some cause to regret the extinction; the more so that it has, in all probability, been occasioned by an indiscretion which has been otherwise very injurious to the country. We allude to the cutting down of the woods, without planting others for a succession, which was the general practice to a period comparatively recent, and which is still done in all new countries colonized by the British. They find woods ready grown by nature; they never think of the time that has been taken to produce them; thus they take the hatchet and cut away; and that which was a sheltered forest—riches in itself and rich in living productions, becomes an unprofitable bog, or a bleak desolation of black surface and stunted heath, according to the situation. Ireland and Scotland have both suffered very
much in this respect, the former having been, to a very
great extent, converted into unprofitable and unwhole-
some bogs, and the latter, even where the roots of the
large trees still stand bleaching on the surface, being
for many miles, black mud, with water almost equally
as black, and not producing as much, even of heath, as
would pasture one grouse an acre.

Among the other losses, has been that of the Great
Grouse, cock of the wood, or cock of the mountain,
(tetrao urogallus, Linnaeus). That bird, which grows
almost as large as a turkey, was once met with in the
remote parts of Ireland and Scotland; the last found
specimen was killed in the latter country about fifty
years ago, and before that time it had been extinct in
Ireland. The severity of the climate cannot have been
the cause; for the bird is still met with in places that
are colder, as among the mountains of Norway, Sweden,
Russia, and Siberia, and high upon the ridges of the
Alps and Pyrenees. But the forests that afforded it
shelter are gone; and both the vegetable and the insect
food, which the shelter of these also afforded, have been
swept away by the bleak winds that now play over the
exposed surface, and hurry all that is moveable, and
consequently all that is fertile of it, into the valleys
where it is not wanted, or the lakes and rivers, where it
is lost.

For these reasons we can notice this superb bird
only as one of the departed wonders of the British
Fauna, until some patriotic proprietor shall introduce
it again into one of those planted forests with which
the spirit of recent times is clothing the bleak moun-
tains, and labouring (sometimes with but little success,
because the operation has been delayed till the soil is useless) to hide the shame of former ages.

The prevailing colour in the male is dusky, waved with cinereous on the upper part of the body, the breast of a deep glossy-green, marked with bronze colour, and the tail black, with two white spots on the tip of each feather. The female is ash-coloured, and variegated and barred with black. The male is two feet nine inches in length, and three feet in the expansion of the wings, and has been met with weighing as much as thirteen pounds, though it does not generally weigh more than eight. The female is considerably smaller, and not above half the size. Both are compact and rather handsome birds, the hen being not unlike the ptarmigan. The legs and tarsi of both are feathered down to the toes, and these are well protected by plates on the upper surfaces, and adapted with knobs on the under for taking hold.

On the continent there are several species of these birds; those in the woods of Sweden are large, and there are smaller ones in Norway and Lapland, as far north as the shores of the Arctic ocean.

These birds are properly birds of the woods; but they come out to the sheltered moor-lands between the woods in the morning and evening, and retire into the silent depths of the forest during the heat of the day. They scratch the earth for insects and their larvae, and swallow pebbles in the same manner as domestic poultry. The breeding season begins about the middle of April, at which time they remain much upon the trees. The gestures and love-song of the male are both singular. The middle of the song is like the cry of a
drake, or rather the sharpening of a scythe, and the beginning and end are a kind of explosion, as if a quantity of air were shot from the beak, with a sound that is not easily described. During the time that he is thus agitated, he becomes insensible to danger; and though at other times a vigilant and wary bird, may be shot, or even knocked on the head. The nest is formed on the ground among the natural moss, and is very simple in its construction; the eggs vary from eight to sixteen, about the same size as those of the common hen, but blunter at the ends, and of a yellowish white, irregularly spotted with yellow. The flesh of these birds, which acquires a peculiar pungent taste from the juniper berries on which they feed, is highly prized; and it is so little disposed to putridity, that, in the winter months it may be brought fresh from Norway to Britain; the eggs too are highly valued, and accounted more valuable than those of any other bird. All circumstances, indeed, conspire to make one regret the loss of so valuable an animal; but if it ever again should be restored to the country, it must be in the wild state; for even in those countries where it is abundant, it has never been brought to live in a state of domestication. Hybrids which are barren, and thus prove, independently of other evidence, that the species are distinct, have been produced between these birds and the
BLACK GROUSE.

The Black Grouse, *black game*, or *black cock*, (*tetrao tetrix,*), though inferior in size to the cock of the woods, is still a bird of considerable dimensions, being much larger than the red grouse; and when full-grown, larger than the pheasant. The black cock is a very handsome bird; the general colour is black, but it is iridescent, and in certain positions of the light shows a very fine purple. The tail is very much forked, the outside feathers curled, and the lower part, toward the base, white. Upon the throat there is a kind of down, but no long or regularly-formed feathers. The length of the male bird is about twenty-eight inches, and the extent of the wings nearly three feet; and the weight between three and four pounds. The female is a much smaller bird, and has not the curled feathers in the tail.

Though the places at which the black grouse is found are not quite so elevated—so near to the summits of the mountains as the habitations of the ptarmigan—it is yet a bird fond of wild and secluded spots; and its numbers in these islands are very fast declining. What with improvements of land, and improvements in the arts of its destruction, it is not nearly so abundant in England as it was formerly; though it be still met with in the more elevated and secluded places in the south of England, in Staffordshire, in North Wales, and generally where there are high and lonely moors. In the Alpine parts of Scotland it is more abundant, though the introduction of sheep, generally,
upon the mountains, is said to be diminishing the numbers. The black cocks are more frequently found in the woods than the red grouse, though the moors, with a difference of elevation, be the favourite abodes of both. Their food is also similar; consisting of mountain-berries, the tops of heath, and the buds of pine and other Alpine trees. Though they seek their food in the open places during the day, they, where they have the accommodation of trees, perch during the night, like pheasants. It is chiefly during the winter months, however, and the early parts of spring, when all food, save the tops of the pines, is hidden under the snow, that they do that; for when the breeding season commences, they assemble on the tops of the mountains and highest parts of the moors, but never higher than they can find heath; the young shoots and embryo blossoms of which are at that time their principal food.

Some parts of their character resemble that of common poultry. They do not pair; but when the breeding season commences, the cocks ascend to the tops of the mountains, and clap their wings and crow; to which call the females answer, by making their appearance, and uttering a sort of clucking sound. War immediately ensues among the males, as each is anxious to have in his train as many females as possible. Their heels are armed with spurs: their mode of fighting is the same as that of game-cocks, and they enter upon the strife with the same devotedness. Although upon other occasions they are among the shyest of birds, they are then so intent upon the victory in their own battle, that they do not heed the
approach of strangers. Not only may all that are within the spread of a musket-shot be killed at one shot, but they may be struck a second time with a stick, so eager are they for victory among themselves. The nests, like those of most of the gallinaceous birds, are rude; the eggs are usually six or seven; they are of a yellowish white, dotted with very minute ferruginous specks; and about the size of those of the pheasant. The young are produced rather late in the season, but as there is then plenty of food, they grow rapidly. In their early stage they follow the mother, and nestle under her wings in some safe place during the night; but after about five weeks, they have acquired so much strength and use of their wings as to be able to perch along with her. As the winter sets in, the different families leave their mothers, and the whole assemble in flocks like the red grouse. They are never, so far as our observation has gone, found, like those, even in the margins of the cultivated fields, but continue in the mountains during the winter; finding, as is supposed, their food under the snow, and being also often found in their retreats by beasts and birds of prey.

When the snow begins to fall heavy, the black grouse betake themselves to the shelter of tall heath, juniper, or any other plant, that will afford them cover while the violent wind with which falls of snow are usually accompanied in Alpine districts lasts; or they roost under the thick branches of the pines, in situations where they have access to these. Even upon the pines, the snow forms a close canopy, which lasts for a considerable time, while below there is a sufficiency of
air for the breathing of the bird. In the shelter of the bushes they are obliged, like the white hares and other inhabitants of the mountains, to open breathing holes for themselves; and while they are pent up in their habitations of snow, the tops of the heather, or leaves of the bush, find them in food. When the surface becomes hard [which it does in no great length of time after the fall of snow is over, in consequence of the softening of the surface by the action of the sun, and the congealing of it again at night, till it is converted into a crust of smooth ice, and reflects off the greater part of the solar heat obliquely, as the rays then fall upon the surface] those breathing holes often betray their inmates to the ravages of predatory birds and quadrupeds. The mountain-eagles and hawks then fly over the snowy surface, and beat it in the same manner for these holes, as they do for the birds themselves when there is no snow upon the ground; and the four-footed ravagers, that then find an easy passage along the hard surface, join in the spoil. Man sometimes also takes a part in it, but much less frequently, because there are concealed holes and precipices under the snow, which are full of danger.

But the winds by which the falls of snow in the Alpine countries are accompanied, though they render these formidable to the animals, whether quadruped or bird, while they last, and fatal to man if he be overtaken by them late in the day and far from his home, have yet their uses, and tend in some measure to the preservation of life. Some portions toward the windward are left bare, or at any rate with the tops of the heath and other plants above the surface, and the
vigorously find their way to these, and subsist on them till other parts of the surface be clear. When, however, the snow falls in continued storms, and especially with the wind from opposite points during the different falls, the sufferings of the creatures are extreme; first, those that live on vegetables, perish through suffocation or of hunger; and then the carnivorous ones, which can in general subsist longer without food, follow in their turn; and when the snow clears away, the raven comes to enjoy the spoils of both.

These are but a few of the inhabitants of the moor; but moor means so many different kinds of country, according to the situation in which it is placed, that there is no possibility of including in a short space the characters that are common to all. There are comparatively few quadrupeds peculiar to such situations, and the number of insects is not great; the plants, too, though more abundant and more numerous in their species, are not those that are the most striking in their appearance, or the most interesting in their properties.

Alpine hares are sometimes found in the more elevated parts of the higher moors, and the common hare in the lower parts of those that are near the cultivated grounds; but the only quadrupeds which can be considered as natives, and permanent inhabitants of the moors in any part of Britain, are deer; and they properly fall into the description of a more limited and peculiar description of scenery. We must, therefore, even though the subject be merely begun, close our account of this division of the surface of our country. There are other circumstances connected with it in common with
other places, to which we can afterwards advert with more effect. What has been mentioned will tend to show that, even in one of its departments, that portion of the earth's surface which, on account of its flatness and its sterility, is the least pleasing or promising, is yet fraught with lessons of the greatest importance, if we would only pause and read them. Nor even when the moor has advanced one step further, and become a desart in the burning climate, or a peat-bog in the cold and marshy one, can we dare to say, that it is without its usefulness. The peat-bog is the coal-field of future times, and the waste of Zahara must have its use, or it would not have existence.
CHAPTER VI.

THE BROOK.

The greatest charm about the works of nature is, that, however they may vary in extent, or in the kind of emotion that they excite, they never fail to be interesting; but when we have wearied ourselves in the study of one, the change to another one destroys the incipient lassitude, and we turn to the new with the same freshness as if we had come at once from rest to labour. If we have become giddy with the contemplation of lofty summits and wave-lashed shores,—if the broad-rolling tide of the river has ceased to please,—if the brown moor has moulded the mind to its own dusky monotony,—nature has still something to charm us; and when we have contemplated one part of her works till we are weary, and our eyes ache, and our temples throb,—if the voice of another call but, "come and see," the mind is up, and the momentary weariness of the body is forgotten.

Even the human body is so constituted and constructed, that indolence, or even rest, is not the only means by which it may be recruited. Change will do the work. If the burden has been on the one shoulder till pain is felt, shift it to the other, and not ease
merely, but pleasure is the result. If we have been walking upon level ground till the limbs are stiffened, let us ascend or descend a steep, and we are at once vigorous. Even the sluggard, who has lain dozing in bed till the weight of his own flesh and bones has pressed the vessels and stopped the circulation of the one side, feels ease, and even pleasure, as he turns himself with slowness and hesitation to the other side. If the sight has become pained and dim to the perception of one colour, nature has another, in her wonderful beam of radiance, which will not only give relief to the aching eye, but absolutely, a clearer perception of the new colour, and a keener admiration of its beauty, than if the former one had never been seen. All the senses have this power; the most luscious taste palls upon the tongue, and the sweetest perfume offends in the nostril, when the one or the other is borne too long; and the organ and the feeling equally demand that change which brings relief.

Now if the members of the body, which are merely the earthy tools with which the mind works, perform their offices so much better by a change in their objects, how much more must it be the case with the mind!—That grasping and comprehensive energy, which, taking tangibility from one sense, colour from another, sound from a third, scent from a fourth, and sapidity from a fifth, moulds all their combined reports into one idea of existent substance, distinguishes that from all other substances around, however fine their shades of difference may be, finds out what has been its past states of existence, the uses to which it may be turned, and the rank that it holds in the general scale of being—
how much more must it exalt and find delight in those transitions with which the study of nature abounds!

The bodily pleasure, and the mental delight, which we feel in changing from one posture and one study to another, are given to us for the most wise and beneficent purposes; they are among the most powerful incitements to study; and were it not that we are apt to dissipate and misapply our faculties, we should never think of being idle, but during those hours when the body needs refreshment or sleep, and them we should make as few as possible.

Of those scenes which are alike calculated to bring us down from over excitement, or rouse us from the exhaustion of lassitude, none is better than the margin of a brook. There is not an indication of anything either disposed or fitted to destroy: those elevated banks, with their alternating glades and coppices, forbid the action of such winds as sweep the hill-side and the heath, lash the shore in sounds like thunder, make the lake curl its white crusted billows, and even the river run foaming to the sea. That small and gentle stream, now stealing unseen under beds of the sweetest wild flowers, which, like a kind modest friend, it nourishes in secret and in silence,—now curling round the large pebble, as if it would not disturb the repose of even a stone,—then gliding away into some stagnant angle, where it woos the wild plants to come and quench their thirst, and seems more a garden of herbs, than even an appendage of running water; and yet again, as if it would not derange the little bank of gravel which has found a resting-place in its bed, it broadens out into a little pool where the gentle water-fowl may swim in
safety, the songsters of the neighbouring trees perform their ablutions, the small quadrupeds drink, and the insect tribes spend their brief hours in joy;—that gentle stream is the cause of no inundation, tears up no soil, and hardly bends a rush or drowns a fly. There is no din of wings, no shadow of the eagle, no rushing of the hawk, not a death-doer, or a death-cry, from all unreasoning nature in this little place; and if man come not in with his snare, or his weapon, he may make it, or rather have it, the very Eden of innocence. How easily can we trace it upward to the fountains, or downward to the point at which it blends its waters, and loses its name in the river. The well under the hawthorn, by the base of the rock, the depth of whose sources defy the heat of summer and the cold of winter, and which, for virtues more valuable than those for which modern idols are worshipped, the simple people called by the name of their favourite saint; and, for the health that the draught of liquid diamond had given them, hung with garlands and other votive offerings, as they hymned him in their grateful hearts;—that shining and sainted well is the farthest source of our little brook. And though the brook apparently loves to linger in the shade of its little grove—where the willows, whose rough stems are the parents of fifty generations of osier twigs, and are as likely as ever to enrich the peasants with fifty more, stand rooted in the water among lofty reeds and glowing iris, and sport the soft glory of their green and silver in the waveless pool;—where, too, the alder and the elm blend their passage, and all is so still that the fluttering leaves of the aspen, ever in motion in other places, are here still—as if the zephyrs themselves
had forgotten to breathe.—Though it thus lingers and broadens, the fountain is not at the distance of an hour's walk; and that walk is across little swells, fragrant with the vernal grass, the white blossom of the creeping trefoil, the wafted sweets of the wild hyacinth, or the more powerful perfume of the bean-blossom, according to the season. And the inhabitants of those little cottages, as one passes along to the foot of the mountain, and which are so pleasingly simple, with their thatch and their white walls, and their trailing briars and their clustering roses, with here and there a pœony or a tulip—when the horticultural skill and pride are more than common—they are as innocent as they look. They are in happy ignorance, both of the grandeur of the world and of its grievances. The storm that unroofs the cottage, or sends the swathes of hay or the sheaves of corn coursing each other over the field—the fine day that follows, and permits all to be recovered and safe—the revolving year—the sun, the moon, and the stars in their courses—the weekly prayer and the weekly sermon—the noise of the mill, and the noise of the "smithy"—these are the world to them; and to their minds and their desires, they are more than the conquest from Rhodope to the Indus was to the monarch of Macedon.

Those who have not visited such scenes, and known such people, have something yet to learn—something which is one of the most delightful parts of natural history. Simple as those people are, there are in them the germs of all the arts and sciences, and fineries and blandishments of life. The gold is there, and we want only the coiner with his stamp, to make them pass current among those whose superior value in exchange
depends far more upon the impress than upon the bullion.

The human heart is as warm there, and the feelings are as true, as where every sentence is "cut to model," and every attitude ordered by the posture-master. The evening walks of lovers are as enchanting there as the evening medleys in the fashionable world: eyes are as bright, when the star of eve or the moon of night is their only rival, as when they have to contend with the glitter of jewels, and the glare of angular crystal and coloured glass. Neither is the music less fascinating, or less in melody with all around, that it comes without purchase from the feathered tribes, than if it warbled in all the wild meanders of German harmony. All are well in their own places; and the nuptial songs of the birds are just as much in accordance with the plans of those rustic youths and maidens, who have chiefly to consider how they shall best construct their nests and rear their broods, as the exhibitions of splendour are to those of whom splendour is the idol and the joy.

There is something about a brook which leads one more insensibly, but more irresistibly, to the contemplation of rustic life, than any thing else in rustic scenery. It is not germane to wildness and desolation, and it is no kin to greatness. There is life and productiveness about it; but it is life which is simple and unexpanded—a shelter and repose from the sweep of the elements and of time. Every thing in the place itself, and in all the accompaniments of the place, proclaims that here is a fulness of life, and of life that knows no enemy, unless when man steps in to play the
fowler. But when we come to examine it, we find that it is only the exuberance of production; for nature is everywhere true to her economy, and the consumption of life is the means of life as much on the margin of a peaceful brook as in the haunts of the most formidable destroyers. Still all is redolent of life, and it is of little consequence whether you turn your attention to the air, the earth, or the sky. Of the earth, one of the most singular inhabitants that you meet with in such places is

THE MOLE CRICKET.

The Mole Cricket (*gryllus gryllotalpa*) is one of the most singular insects which Britain produces. We have one upon our table at this moment, (Nov. 2,) that was brought us in the morning enclosed in a mass of moist sandy clay, which, when we divided it, was
found to be perforated in all directions, by the subterraneous passages of the insect. These passages intersected each other at short distances, where they formed chambers, in some of which a quantity of white silky matter remained, but we could find no appearance of eggs; at certain places the passages were shut by little heaps of loose clay, which the cricket appeared to be able to move almost as fast as we could open a door; though these would no doubt have formed an effectual barrier against any insect not accustomed to burrowing.

The insect was found at the depth of about a foot, not in the chamber but in one of the passages. There were some roots of aquatic plants passing through the lump of clay, but there was no sign of a store of any kind of provision, and the insect appeared in rather a dormant state. It was not, however, in a state of hibernation, or any thing approaching to it, for it moved immediately on being placed upon a plate; and when an inverted jar was placed over it, it ran rapidly round the inside, alternately in the direction of the head and the tail; and so hard are the long claws upon its fore legs, that the sound of them tapping the receiver, and also the China plate, was distinctly audible.

Upon placing a lump of the clay in which it was found under the receiver, the cricket ceased to make any further attempt at escape by the sides of the receiver, but instantly began burrowing in the clay with so much vigour, that it had a portion, equal to the half of its body, in motion in an instant; and in a few minutes, a passage, in which the cricket could run easily, was made all round where the clay touched the receiver. When disturbed by agitating its abode,
its motion was backwards with considerable rapidity, and it kept tumbling down the clay after it, with its burrowing paws as it proceeded. The motion of those paws is rapid; and the articulation to the thorax seems to be by a sort of universal joint, as it can instantly make a semicircle with them in any direction outwards. The claws are semi-transparent, very sharp at the points, and moderately hooked, and they have a lateral motion as well as one of opening and shutting. In those parts of the clay that were friable, from containing much sand, the claws were spread out wide, and as much was pulled down at one effort as covered the head of the insect; but when it came to a part of more consistency, the claws were narrowed, so that the mass attempted to be moved was still proportioned to its strength. The eyes of the mole cricket, which are large and prominent, seem very sensible to the action of light; for when brought near an argand lamp, though the eye gleamed like a little gem, the insect retreated with great rapidity backwards, and hid itself on the shady side of the mass of clay; but when turned with the other extremity to the light, it did not retreat by the head, but rather in the other direction, until its eyes encountered the light; and even then it seemed to prefer the backward motion. It is by no means improbable, that this backward retreat may be intended for showing front to insect foes, as well as getting more rapidly out of the way; but it offered no hostility to any thing with which we could irritate it. The specimen alluded to was about half-grown, and the elytra or wings were not fully developed.
The precise age to which mole crickets live, is not accurately known; but it is probably much longer than a year. The earth is their constant abode in the winter. It is understood to dig downwards, so as to elude the penetration of the frost; and we have traced in its burrows in loose soil, something like a drainage. As the heat of the spring augments, it comes nearer to the surface; and is understood to come out and fly abroad in the night, in order to pair; but the fact has not been well ascertained.

The female prepares a nest for her progeny in clay. It is excavated near the surface; and though the passages generally contain a quantity of loose mud, the inside of the depository for the eggs is smooth and beaten, so that the young may not suffer in their helpless state. The eggs are hatched by the heat of the sun, but the mother remains near, to defend them from insects: but we have heard, though we have had no opportunity of verifying the fact, that they and she often fall a sacrifice to her half namesake the mole; which is now ascertained to be, what its structure always led one to suspect, one of the most voracious little animals in nature.

The mole crickets do not pass through what can strictly be called a larva state; and they have no abstinent, or chrysalid state at all. Their first form resembles the last, with the exception of the wings and the thorax, which are not developed till the insect has attained a considerable size. The wings are what Linnaeus calls hemipterous, or half-winged; the upper part consisting of two short, parchment-like cases, under which the membranous wings, which are very
delicate, long and pointed, are folded when the insect digs its way in the earth.

As soon as the young ones leave the eggs, they begin to burrow along below the surface of the ground, and when they are numerous, not only disfigure it much, but are injurious to hosts of young plants. These habits are not perfectly known, but it is not impossible they may be of some service in return, by destroying something that is as injurious as themselves. It is possible that some may get their wings the first year, which they do after successive scalings of the skin; but there are at least some which do not have the means of flight till they come abroad upon their amorous voyage in the spring, upon which occasions the bats are understood to lay them under heavy contributions. Though a singular insect, both in appearance and in habit, the mole cricket is by no means unhandsome. The shape is rounded off to both extremities, so that it can easily make its way. The antennae and palpi are remarkable for their sensibility and power of being bended; the down upon the body is of extraordinary gloss and closeness, though not of gaudy colour; and with the exception of the harm that it does by its burrowing, it appears to be an inoffensive insect.

All insects which are met with about a brook, are not, however, of that disposition. One of the most remarkable of these, both for the rapidity of its motions, and the havoc that it occasions, is
THE GREAT WATER-BEETLE.

This insect (*dytiscus marginalis*) is a more constant inhabitant of the water than the mole cricket is of the earth, remaining there in all the stages of its existence, even after it has become winged, and only, as is supposed, using that apparatus for enabling it to range from pool to pool, in quest of more abundant prey. Its flights are generally in the twilight or during the night. Whether it may or may not capture land insects during its flight, has not been ascertained, but it bites lustily when an attempt is made to keep it prisoner in the hand. From the rapidity with which it dashes from the surface of the water to the bottom, it has got the name of the "plunger." It is a large beetle, flattish and broad for its length, and of a very compact form. The head is rather small, compared with the body, but the mandibles are strong, hard, and have a powerful articulation; the eyes are placed so prominently in the head, that the insect can readily see in all directions; and its motions in the water along the bottom, and even into the mud, are almost all as rapid and vigorous as its plunging.
Properly speaking, it is an inhabitant of stagnant waters, rather than of brooks; but when a brook forms a stagnant nook, where moss and mud are deposited, that is a favourite spot for it, as larvæ and insects are always brought down by the current. It watches for these with the greatest attention, and we have seen it catching the larvæ cases of the phryganæa, and shaking them till it could get hold of the inmate, and plunging into the mud after those of the ephemera. It is a very indiscriminate devourer, and will attack not only its insect neighbours, but the very young tadpoles of frogs, and fry of fishes; nor is it confined to animal food, for we have seen it catch small crumbs of bread before they reached the bottom, with so much apparent relish, that there was little doubt that it ate them.

The young plunger has the elytra or horny covers of its wings nearly transparent; but as it gets to maturity, they become of a deep olive green, inclining to black. They have not the brilliant gloss of the elytra of some insects, but they are very hard and strong, and supplied with a kind of oil or varnish, by means of which the water is repelled, and the insect kept constantly dry. This beetle may easily be known from the colour, and also from the margin of dull reddish orange with which the body is surrounded, and which has given it its specific name of marginalis.

As is indeed the case with most insects, especially those that inhabit the water, the economy of the plunger is but imperfectly known. It has been stated that the female encloses her eggs in a cocoon of coarse silk. But we have never been able to find any teats or nipples, similar to those found upon ordinary spinning
insects, whether in the perfect or the larva state, and such a practice would rather be an anomaly in the case of insects that deposit their eggs, or have their early stages of life in the water. The threads are always discharged from the body of the insect in the state of a viscid fluid, which acquires consistency the moment that it comes in contact with the air; and, therefore, until it is actually seen, we are not prepared to admit that a similar operation could go on in the water. The plunger is, indeed, so far analogous to the **coleoptera**, that inhabit the land, that it cannot remain under water without coming up to breathe; but even that would not justify for it the imputation of a power which was to be exercised in the water, and which yet was not in accordance with the general laws of the inhabitants of that fluid.

Upon most subjects, the only danger of gross error lies in too hasty a generalization; but in the study of natural history, and in no part of it more than the adaptation of creatures to the element in which they live or find their food, there is an opposite danger—generalizing too little. This is too much the case in the history of insects. The particular creature, or the particular habitus, taken apart, and one insulated fact is put in succession to another insulated fact, not only without any direct observation of the fact of invariable sequence, but against that which appears to be a general law. In the inhabitants of the air, including those that cannot fly, as well as those that can (for the air is the medium in which they all live), we find a certain uniform organization, varied much in form, no doubt, but uniform in principle. So very uniform, that
not one of those creatures that have it, can remain in
water unless they are suffered to come to the surface
and breathe. This holds in the case of the plunger
now under notice, as well as in all the insects and
larvae which are not, through the whole succession of
their changes, to be confined to the water; and any
one who waits by the side of a stagnant pool, during
those warm months when all is activity and life, may
notice the incessant ascent of larvae and full-formed
insects to the surface, for the purpose of that aeration
which is essential to life. On the other hand, the
animals, be they large or small, which are furnished
with apparatus that can separate oxygen at once from
water, cannot live in the air, but must get to the water
in order to breathe; and it is quite as correct to say
that a water animal is drowned in the air, as that a
land animal is drowned in the water.

And whatever specific difference there may be in
their structure, there is a generic form of organs for
each class. The land animal,—that which breathes
"free air," or air without the admixture of water,
whether it inhale the air by nostrils or by pores in
the skin,—always receives it into cells, and after a
little time discharges it again; while those that breathe
air in conjunction with water, and have a double sepa-
ration to make,—first the air from the water, and then
the oxygen of the air from the nitrogen,—receive the
water in a passing current; and perform the double
chemical operation by the delicate fringes of gills of
some description or other; over the surface of which,
the minute vessels of the circulating system are rare-
fied.
Thus these two distinct sets of processes, by which this important and essential function of animal life is performed, have a distinct set of organs for each, adapted admirably for that, but not for the other. There is no instance of an organization that can perform both operations, though the frequency with which the performance is necessary varies very much, according to the habits of the animal, and the place and manner in which it finds its food. It has been said that there is a change in some cases, from the one of these organizations to the other, in those animals which spend their infant states in the water, and their mature ones alternately in the water and the air, or wholly in the latter; that the gills, with which they are furnished in the first state, change to lungs when they assume the last. The fact has not been verified by the actual observation of one of those animals at every instant, from the time of its being deposited in the water as an egg, to that of putting on the form and habits in which pulmonary breathing is unequivocal, and, therefore, the better evidence is that of the uniformity of the laws of nature; more especially, as all the creatures alluded to are furnished with apparatus for enabling them to ascend to the surface, and many of these have no other apparent use. The germ in nature, be it that of plant or of animal, contains the whole elements of the future being, and there is no well-established instance of any such change, as that from breathing air to breathing water, or the reverse.

That insects in their chrysalid state may remain under the water, though both the larva and the perfect insect should have to come to the surface at long or at
short intervals, is nothing to the purpose. The necessity that animals have for breathing, depends upon the quantity of food that they take, or, which is the same thing, upon the rapidity with which the matter of their bodies is changed. In those animals which pass the cold months in a state of torpidity, breathing and feeding are nearly equally suspended, and as the animal intrudes toward its state of quiescence, the breathing becomes interrupted. But the greater part of chrysalids are in a dormant state, and therefore they may remain under the water without breathing, in the same manner that a dormant marmot remains under the earth.

But though the process of breathing differs so much with the two fluids breathed, that it seems contrary to the usual law of nature, that the one should be changed to the other, yet the result and purpose of the operation are the same in both cases. The result is the separation of a certain quantity of oxygen. It was long supposed that this oxygen was an aliment, and that it was taken into the blood, and thence into the structure of the animal; but that did not agree with the fact that the blood is always exhibited to the organs of respiration after it has gone its circuit for the nourishment and repair of the system; and that a substance in nature should be made fit for its purpose only after that had been accomplished, really seems contrary to the wisdom and design that pervade the works of nature in operations ten-fold more complicated than this, so that one cannot help being a little surprised that it should ever have been entertained. It must have arisen from that disposition to look at, and draw con-
elusions from, the particular fact, instead of the general induction, which existing men sometimes call philosophy in themselves and their contemporaries, but quite another thing in those men that lived two hundred years ago; and it shows how careful even the most accurate observers and the most sagacious reasoners should be, that the statute with which they are going about to augment the code of nature, does not run counter to another, which is more general. Had they put the question to the merest clown, whether the agents of nature should be made fit to do their work before doing it, or after, he would have had no difficulty in pointing out the absurdity involved in the hypothesis of imparting the oxygen to the blood of animals in any other way than as an instrument for taking up some matter which the blood had received in its circulation, and which had become unfit for the purposes of life.

The precise time that the oxygen may remain in contact with the blood, and whether the whole, or only part, and if any, what part of each inspiration is given out again at the following expiration, is not within the range of accurate experiment; but we are certain that the volume of expired air is very much the same with that inspired, and that it comes out of the lungs not deprived of the oxygen, but with oxygen, (either its own or that of former inspirations,) combined with a new substance, which is known in a separate state only as a solid. That substance is carbon or charcoal, which, when combined with oxygen, forms carbonic acid; the combination in which the oxygen of air, that has been taken into and decomposed by the respiratory organs of animals, is discharged from those
organs. The discharge, too, appears to be in proportion to the air that is respired; the same whether the solution be performed through the operation of lungs or of gills, and whether these belong to an elephant, a whale, a water insect, or a mite.

Whatever may be the mysterious principle, or fact, or whatever we may name it, that we call life, and which, like the mind of man or the Maker of the universe, can be seen and known only in that which it does, there is in the functions of life, a wonderful resemblance to the operation of fire as combustion,—they are both a consuming, and carbonic acid,—charcoal united with oxygen, is produced; and the production of that substance is in both cases in proportion to the intensity of the operation. In the dormant animal there is little consumption of oxygen and production of acid, just as there is in the smouldering fire; and violent muscular exertion is accompanied by a correspondingly increased consumption of oxygen and production of acid. Before results are so uniformly the same, we are warranted in concluding, that there must be some uniformity in the process; but in what that consists, the present state of information does not enable us to say.

In these remarks we have rather diverged from the simple assertion, the truth of which we were led to question; but still they are proofs of the uniformity of the laws upon which nature acts, and should lead us not to receive as truth any departure from that uniformity, of which the fact and the reason have not been carefully observed. That should teach us, that when we cannot find a reason for the fact, which yet seems a violation of the observed laws of nature, we
must be mistaken; and that, if we attempt to reason from foundations of that kind, we are umpires, and not philosophers.

The usual way in which water insects, and indeed aquatic animals of all kinds, take, to fasten together protection for themselves or their progeny, is not the spinning of threads, but cementation by some fluid; which, though it holds chips, straws, grains of sand, or other solid substances together, and resists the motion of the water, when used in small quantities as a mortar, does not seem capable of resisting that action when in the state of a slender filament, however well such a filament may resist the action of the air; and unless we actually see an aquatic animal deviating from that general habit, and actually spinning a cocoon, we have a right to contend that such is never the case.

The hatching of the eggs of the plunger has not, as we have said, been observed through every stage of the process. When, however, the larvae make their appearance, they are not to be mistaken, either in their form or their habits. They are well adapted both for running and for swimming. The body is about double the length of that of the full-grown beetle, formed into joints or rings, the last of which tapers to a point, where the body of the animal is formed round, not unlike the tail of an eel; there are six legs, which have crooked claws at the extremities, and are beset with spiny fringes, so that they answer the purpose either of feet or of fins. The most remarkable and formidable part about it, however, is the head, which is large, flat, and strong, and furnished with a very powerful pair of forceps, each in shape not unlike the tooth of an elephant, but more
hooked. These it can close with great force, and if they meet with no resisting substance too hard for them to penetrate, they can cross each other. It takes a very firm hold with them; for when a pond was in progress of being cleaned, we have seen those larvae drawn out, hanging by the pincers to an iron shovel.

It is possible that the larvae of the plunger are more voracious than the full-grown beetle; for they eat every thing that they are able to seize; and no sooner have they sucked the juices of one victim than they assail another. A portion of stagnant water, in which these and other insects and larvae are contained, when exhibited by a good solar microscope, is a singular spectacle, and with only the difference of size, records one of the ravages of a lion in a flock, or that of a shark or grampus in the ocean. Indeed it is much more a scene of slaughter; for the quadruped and the fish, after they have gorged themselves full, must pause and allow some time for digestion and the assimilation of the solid matter of the prey with that of their own bodies; and in the case of the lion, at least, that is a work of labour and lassitude. But the larva drains only the juices which appear to pass to its own substance without any after process of assimilation; so that one victim only whets its appetite for a fresh one. The microscope, of course, magnifies the velocity in the same ratio as the size, and thus while an apparent length of three or four feet, and a correspondence of breadth is given, the assailant shoots from side to side of the field of view in the microscope, with the rapidity of lightning; and when he seizes and shakes his victims, the size, the distance, and especially the
velocity of the motions, are all more terrible than the shaking by a lion; and forgetting the magic power of the optical instrument, one shrinks back, and listens to hear the yell of victory, and the shriek of death. All is quiet, however, and one soon recollects that this fell destroyer is a little insect, not two inches long.

Those who have not otherwise access to a solar microscope, and happen to be in London, may see this contest very well exhibited by the powerful solar microscope shown at Carpenter's Microcosm in Regent-street; where, on a fine sunny day, the sight of this and many much smaller creatures, magnified to giants, and consequently moving with apparently incredible swiftness, the wonders of the minute of nature, may be contemplated with considerable advantage; and though these exhibitions be but mere sights, they are sights which make one wish to see a little more, which is no inconsiderable matter in the study of nature. That study wants only a beginning, and the size or habit of the production with which we begin, is a matter of no difference, so that it excites the desire that is to urge us on. It must be admitted, however, that a study which requires microscopes, or any other apparatus, is not the one best adapted for the great body of the people; and, fortunately, it is not the one most useful.

The insects which are found on the margin of a brook, or living in its water, or skimming along its surface, are very numerous, and they vary much with the situation, of the brook and its elevation above the level of the sea. It is this plenitude of insect life that makes the water of brooks impure and disagreeable; and which, for culinary purposes and for drinking, causes
it to be so inferior to the water of springs. When allowed to stand in reservoirs, that water may let fall the earthy substances that it holds mechanically suspended; but nothing, except filtration through a bed of sand or some other substance, that can completely keep back the feculent eggs or larvæ that can float in it, will preserve it from putrefaction if it afterwards be allowed to stand for any length of time. It is the same whether these animal impregnations live or die. If they live they are unseemly, they prey upon each other; and whether they do or not, they leave their exuviae behind, when they change into the fly or imago state, and sport their new wings in the air; these putrefy,—a decomposition takes place,—some of the water is decomposed, mixes with sulphur, and the odour is offensive. Boiling, if the water be allowed to settle afterwards, gets the better of those impurities; but they are got rid of at an expense; the water is deprived of its air—of that very carbonic acid with which the respiration of the little things impregnated it; both its sparkle and its sharpness are gone, and it is flat and insipid—a vehicle merely, and not a stimulant.

Situations which abound so much with insect life both on the wing and in the water, as brooks and their borders, of course, supply food for numbers of insectivaous birds. Of these, a portion are adapted for wading, and preying upon their insect food in the shallow water, while others course it on the wing; and in both descriptions, but more especially in the latter, there are some of the most extraordinary contrivances in nature. Of the waders in brooks, one of
the most peculiar to such situations, if not the most interesting in itself, is

THE RAIL.

The Rail, or king of the quails, or velvet runner, (rallus aquaticus,) is very frequently met with running along with great velocity under the banks, or in the half-dry channel of brooks, and often engages village boys and village curs in successless chase, which is the more annoying that the bird, though never taken, seems always within reach. This bird has considerable resemblance to the land-rail, or crake, (rallus crex,) and has sometimes been confounded with it, or believed to be a sort of transmutation of it. In their habits, however, they are altogether different. The land-rail is a summer visitant; at which season the peculiar note of the male fills the corn-fields with music, though the musician be very seldom seen. When its brood is reared, it retires altogether from the colder districts of the British isles, though a few are met with during the winter, in the south of Ireland, and also occasionally in England. It never frequents the water, but prefers dry, though low and warm, situations. Its gizzard is strong and muscular, as is the case with all birds that feed upon entire seeds, and swallow little pebbles for assisting them in bruising the husks.

The food of the water-rail is understood to be insects, larvae, and the fibrous roots of aquatic plants. It is a lively and beautiful bird. The plumage on its back is of a rich black, with an olive brown border to each feather; and it is on account of the gloss and beauty
of those feathers that it gets the name velvet, while runner is characteristic of its motion; as, though it can fly tolerably well, it seldom has recourse to that operation. In some respects it is the most singular runner among British birds. It runs through bushes that seem perfectly closed with grass; it runs up the stumps of old trees; it runs along the leaves of water-lilies and other aquatic plants; it runs from plant to plant on the surface of the water; and sometimes it dives and runs along the bottom. The front plumage of this bird, and also of the land-rail, is ingeniously contrived for enabling a passage to be made through reeds and bushes without ruffling the feathers. The shafts of the feathers in front are without webs at the points, and each ends in a little knob or weight, by which the feather is kept down.

The rail measures about ten inches in length, and sixteen in the expansion of the wings, and it weighs about a quarter of a pound. The nest is carefully concealed among the tallest aquatic plants, or in beds of willows; and it is said to take particular care that there shall be openings as paths past its nest, in all directions, but none leading straight to it. The eggs vary from six to ten, are rather larger than those of the blackbird, generally of a pure white at first, but becoming covered with spots, or otherwise changing their colour, in the course of the incubation.

The rail is wonderfully safe from the attacks both of quadrupeds and birds; and if it have sufficient cover, it generally exhausts them by its doublings and evolutions, without requiring to take to the wing. When reduced to that necessity its motion is slow, and its flight re-
markably short; and it flies with its feet hanging down, in readiness to run the moment that they touch the ground. All its practices, indeed, point out that its wings serve the purpose of balancers in the uneven paths along which it runs, rather than as organs of prolonged motion. Thus it is remarkably well adapted for hunting for its food in the rough channels of brooks, though not for seizing of any thing which is at a considerable elevation above the surface. But there are other birds equally well adapted for that purpose; and perhaps the one of these that evinces the most wonderful power of wings in a little creature, is

**THE SWIFT.**

The Swift, (cypselus murarius,) perhaps, passes over more space than any other living creature, and evinces powers, both of eye and of wing, which are probably greater than those of the eagle. The flights of the eagle are powerful, but they are only occasional, and strong as she is, she seems exhausted; but the little swift continues on the wing for sixteen hours every day, and moving with velocity, and with evolutions that are equally rapid and graceful. The vision of the swift is also wonderful; for it has been ascertained, that it can easily discern, at more than a hundred yards distance, an object not half an inch in diameter. Notwithstanding the great powers of the swift in the air,—its incessant flight during the summer, and its days' journey to tropical climates in autumn, and back from them in spring—it can hardly walk, but crawls along the ground. In passing through holes and crevices it
is, however, remarkably adroit; its claws are well adapted for holding, and it can move edge-ways, or, in fact, almost in any direction. The nest is constructed much in the same manner as that of the common swallow, but the swift prefers more elevated and retired situations, such as lofty precipices, steeples and towers, and beneath the arches of bridges. The materials of it are very diversified. Grass, moss, bits of threads, feathers, (which they sometimes pull very dexterously from other birds,) in short, any light substance, animal or vegetable, that can be soaked, and cemented to the mass of the nest, by that viscid substance secreted in the throat and bill of the bird. They defend their nests with great bravery, return instinctively to the same ones for successive summers; and if the swallow, which generally comes a little earlier, should venture to take possession, they drive her off the instant that they come. They even take possession of the nests of swallows, though the building by these birds is not accounted close and fine enough for their purposes, until the interior has received a coating of their own cement. The female swift sits very patiently upon her eggs, and never leaves them during the day, as then they would be exposed to depredators; but dashes forth at dusk, hunts for her supper with great rapidity; and then returns to her charge. The young swifts remain in the nest for five or six weeks, during which time both parents attend to them with the most constant affection, and feed them regularly five or six times a day. In the course of this, the parent-birds are greatly exhausted, and fall off very much both in their flesh and their plumage. When they first arrive they are
of a glossy black, with only a white spot under the throat; but before the season is over they are of a dirty brown.

The swifts do not appear able to endure the greatest intensity of the summer heat; for, on very warm days, their hunttings are confined to the mornings and evenings; when, in places that abound with insects, they may be seen darting about in all directions. Like swallows, they drink on the wing, sipping the surface of pools and brooks, and also dew-drops from the leaves of plants. They have different hunting times, and lay all descriptions of insects under contribution. In the morning their chief prey consists of day-flies; in the evening they pursue the moths; and during those hot gleams at mid-day, when the dragon-flies are beating the sedges along a brook for moths, the swifts may be seen coursing and capturing the spoilers with equal assiduity. By a brook, those bright hours are particularly interesting, and one is at a loss to determine whether most to admire—the ingenuity displayed in the production of life, or that displayed in its extinction.

If the course of a brook is through rich, cultivated lands, in a warm situation, a singular insect is sometimes met with near its banks. That insect is

**THE DEATH'S-HEAD MOTH.**

Moths, though often very beautiful, always indolent, and, as compared with some other insects, harmless to man, have, like bats and owls, got some prejudices raised against them on account of the time at which they are most upon the wing. Their wings are closely
feathered; their bodies heavy and unwieldly; and their motions in consequence slow; so that they offer a prey to birds which is easily seen from its size, and which has difficulty in escaping. Were they, therefore, to appear during the day, they would be almost sure to fall a sacrifice: the larger to birds, and the smaller to dragon flies and other predatory insects. The night, therefore, is their favourite time for being abroad; and thus they have come in for a share in those imaginary terrors which ignorance always has, and most likely always will, associate with darkness; and it is one of the evils of those prejudices, that, as there is no reason for their existence, they cannot be removed by reasoning.

The Death's-head Moth (*sphinx atropos, Linnaeus*) comes in for its full share of this prejudice; and wherever it is found, except by an insect-fancier, who knows or cares nothing about its habits, but merely
transfixes it with a pin, and sells or shows the carcass, it is regarded as an insect of evil omen.

In this country it is not often found,—at least, it is one of the rarest of the moths, and found only in warm places. It also selects particular flowers on which to alight; such as the potatoe, the wild solanums, and the jasmine. Its size, its solitary habits, and, above all, its peculiar markings, have procured it the vulgar name. But yet it is an elegant insect: its feathers are peculiarly soft and glossy; and its colours are arranged with very fine effect. Like the rest of the moth family, it has four lepidopterous—scaly, or rather, feathery wings. Of these, the upper pair are of a rich dark gray, marked with orange and white; and the under ones are of a rich orange, with irregular black bands; the upper part of the abdomen is orange barred with black; and there is upon that of the thorax a large black spot with white markings, which a moderate degree of imagination might regard as a sort of resemblance of a death's-head and cross-bones; which last representation is the cause of the greater part of the apprehension and dread with which the appearance of this harmless and handsome insect is regarded.

There are concurrent causes for the superstition: the moth comes very seldom, being comparatively scarce in all countries; and when it does come, it comes as "a warning voice;" and as it carries the markings of the hatchment and the hearse upon its back, that voice can warn of nothing else than a preparation for the tomb.

Now, if a warning of that sort had the proper effect,
—that is, if it made people do better in this world, it would matter but little who were the messenger; whether moth, or monitor of a more rational kind: but the mischief is, that those superstitious admonitions, whether they proceed from moth or man, do harm instead of good,—cause the alarm, but not the amendment, and therefore they ought, upon all occasions, to be exposed. From this insect they are not prevalent in this country; for, to the knowledge of naturalists at least, the death’s-head moth is comparatively recent, as well as rare.

On the continent, it has been longer and better known; and there are instances in which its appearance has excited great alarm. Reaumur mentions an instance where, at the entrance of one, by the window of a convent on a fine summer’s evening, the whole of the sisterhood were thrown into an alarm of instant mortality; but whether the warning was attended with the requisite preparation for the event—whether they called upon the fathers to double their diligence in the hour of peril—has not been recorded; and, therefore, cannot now be known. Consequently, we are left to consider the sphinx atropos simply as an insect, in which character it is at least, as an object of curiosity, entitled to rank at the head of British moths.

The unfrequency of the appearance of this moth is a proof of its delicacy, rather than of any deadly power. It seems, indeed, to be much more difficult to rear than any of the other kinds that we have; as the winged insect is often unknown, in places where the larvae are met with. That mature insects must
have been in such places is clear, otherwise there could not be larvae, but the habits of the creature are so retiring that it seuls under the leaves of its favourite plants, and thus may exist in many places where it has not been seen.

When the larvae is met with, it occasions nearly as much alarm as the moth, though the alarm be of a different kind. The peasantry, and even a great number of persons who have had considerable advantages of education, are ignorant of the changes that take place in insect life; and therefore, every caterpillar of an unusual size or shape portends something. We have more than once known one of the death's-head larvae excite the dread of a plague of locusts, of which ignorance and fear set it down as the pledge and harbinger. True, it is far from being like a locust; but they who felt the alarm knew just as little of a locust as they did of the change of the caterpillar to a moth; and thus the unusual shape and size of the young death's-head made it every way a locust to them.

The caterpillar is, indeed, an unusual one; and both in size and beauty has few equals in the country. The length is between four and five inches; the eyes and antennae are conspicuous, and the colours are bright. The prevailing colour is a brilliant yellow, with a row of stripes on each side, of azure and violet. These are transverse; the ends of them toward the back are pointed, and there are black dots, which are considered by the country people as eyes.

The sound which this moth utters, must, like the chirping of some other insects, and the notes of birds,
be considered as a kind of love-song, when it is in a state of nature and free; but it emits a cry of the same kind when captured, upon occasions when fear must be the prevailing passion.

The noise which this, or indeed any other insect, emits, is not a cry or voice of any kind, as those terms are understood among mankind,—that is, produced by the action of certain organs upon the breath, emitted by the animal in respiration, for insects have no such organization. The sounds which they produce arise from the action of some part upon the external air, and are effected generally by the rapid vibration of such part of their bodies or their wings, or the rubbing or striking of one part against another. The sound of the common death-watch, which has been so often and so foolishly considered as counting up the moments of human life, is practised by the insect drumming upon wood with its hard and stiff mandibles, in order that its mate may answer to its call. Sometimes the sounds are produced by grating against each other the horny edges of the elytra or wing-covers; in a few instances the insect is provided with a natural drum, or elastic plate drawn over some hollow, by which a vibrating motion is given to the air, and sound produced; and in the case of the death's-head moth, Reaumur found out that the noise which it makes when confined, proceeds from the friction of the palpi against the mandible, which, though a sound originating in part in the mouth, yet can, in no sense of the word, be considered as voice. Voice, or not voice, this sound is obviously intended to answer only insect purposes, though how it affects them has not been clearly ascertained; because, with the exception of the
sense of seeing, and that which is usually called touch, the senses of insects have not been referred to any particular organs.

The structure of insects is altogether a very curious matter, at least, a matter different from those animal structures with which we are the most familiar, and which we are, in consequence, too apt to take as our standards. They are all annulose animals, that is, have their bodies divided across into a greater or smaller number of rings or segments. They are without a spine, or any thing like an internal skeleton, and thus the insertions of all the muscles, by which their parts are moved, are on the external covering, which is to them at once both skin and skeleton.

That skin, though it do not contain, even in those that have it the hardest, carbonate of lime, like the crusts of crabs and lobsters, and the shells of oysters and snails, is yet more like a horny substance than the skin of those that we call the more perfect animals. The substance in the skin of the more perfect animals, which the covering of insects the most nearly resembles, is the epidermis, or scarf-skin; and there is no appearance of vessels in its structure, or of a mucous net or true skin. In its composition, it is a good deal like horn, though it is not fibrous, like that substance. It also varies more in hardness, being in some as hard as horn, and in others as flexible as leather; in some, too, it is elastic, and may be bent considerably and resume its form, while in others it is exceedingly brittle. The pincers, stings, claws, mandibles, and all the grasping, cutting, and piercing organs of insects, are formed of the same substance, though thickened and hardened.
where necessary, and also softened into pads and suckers where these are required; as on the feet of those insects which retain their hold upon polished surfaces, and those that are perpendicular or inverted, without the aid of claws. All these, even to the minute hairs with which the bodies of insects are covered—as in those that form the fur of the mole cricket, are, without any insertion of new substance, merely elongations of the general covering, by which means the delicate structure of the insect is kept together; and those that burrow in the earth, or bore into wood or stone, for the purpose of a dwelling for themselves or a nidus for their offspring, never have the most delicate hair—even that which requires the assistance of a powerful microscope before it can be seen—abraded by the hard substances which they have to encounter. Those which burrow in the mud, too, even though their bodies be furry, seldom have the mud adhering to them; and those that are smooth have so exquisite a polish, that they are nearly proof against the action of water. We are not aware, indeed, of any surface so perfectly smooth as that of the covering of some insects. This substance, also, admits of every degree of colour and transparency. The horny coats that protect the fixed eyes of insects from external injury, are, in some instances, as colourless as the air itself; while in other parts of them we meet with hues, which not only defy all the imitations of art, but are quite unrivalled among the works of nature. We also meet with an iridescence or play of colours, arising from the light being differently reflected; but, generally speaking, that is mere difference of reflection from the sur-
face, and not of refraction from the inner parts of the covering. It is the varying colour of the pigeon's neck, or of shot silk, and not that of a mother-of-pearl shell or an opal,—it arises from minute surfaces of different colours intermixed, and not from laminæ or plates, of different texture and transparency, placed the one over the other. In short, it is probably the most plastic, and therefore the most curious substance in nature, being of all hues and all consistences, and adaptable to all purposes; and yet in its composition always the same. It forms—the fine down or feathers upon the moth and butterfly, the large nervous wings of the dragon-fly, the sting of the bee, the crust of the beetle; and it is very doubtful whether it does not also form the web of the spider, and even the cocoon of the silk-worm.

But there is a further uniformity of purpose in the muscular structure of insects—in those organs that move their little feet, their wings, their jaws, and their wonderful antennæ or feelers. Those muscles, downward as far as the microscope can follow them, are of the same fibrous texture as the muscles of large animals; but as they do not, like these, move over internal fulcrum bones, they are without tendons, and have their fibres inserted immediately into the covering or crust.

The body of an insect was, by Linnaeus, regarded as made up of three parts,—the head, the trunk, and the abdomen; but as the middle part, or trunk, consists of two distinct portions, more modern naturalists have considered the whole body as made up of four,—the head, the thorax, the breast, and the abdomen. The relative proportions of those parts, and also the mode
and magnitude of the articulations, by which they are jointed to each other, differ much in the different species. The articulation of the head with the thorax can always be determined, and so can the division of the others, if not by the articulation, at least by the annuli or rings. Whatever may be their dimensions, or the mode in which they are joined together, the first ring behind the head is the thorax, the second the breast, and all the remainder, however many rings there may be, the abdomen.

The head, as is the case with other animals, contains the mouth and the organs of the senses: the only ones of which the functions or the plan is known with certainty, are the eyes, and the antennæ or feelers, which last are conceived to be more particularly organs of touch. The muscles that move the head, take their rise near the abdominal extremity of the trunk, and have their insertion within the occipital opening. They are inserted in the direction toward which they move the head, and have their origin at the opposite side of the trunk, so that they cross the trunk inside diagonally; and they produce their motion by contraction, the same as the muscles of quadrupeds. In most insects the muscles that move the head downwards, are more powerful than those that move it in any other direction.

The thorax occupies the first ring of the trunk. It is in some species very small; but generally the centre of the under part of it is formed into a prominent sternum, or keel, and the fore legs are articulated to it—one on each side; and the upper part sometimes terminates backwards in a spine, with which the insect is capable of inflicting a wound.
The breast forms the second and generally the largest ring of the trunk; but sometimes it and the thorax are so united, that only the depression between the two can be traced; and sometimes they are so loosely articulated, that the breast seems part of the abdomen. The upper part of the breast, which is that in which the principal muscles are inserted, is covered with a shield or scutellum, of a horny consistency. The imaginary death's head and cross-bones are the bearings upon this shield in the *sphinx atropos*. The under part of this has a sternum or keel, as well as that of the thorax; to the sides of that, the two remaining pairs of legs, the middle and the hind ones, are articulated, and it sometimes covers the articulation and part of the first joint of the legs, and sometimes shields part of the abdomen. The wings are articulated to the breast, at the sides of the scutellum,—immediately to the sides of it in those that have not elytra or wing-covers, and in those that have, the wings and wing-covers are articulated to the abdominal edge and angles of the scutellum—so that when the wing-covers are raised, they separate from the scutellum as well as from each other at the middle.

The abdomen occupies the rest of the body. It consists of a greater or smaller number of wings, according to the genus of insect; and the muscles by which it is moved are inserted in the breast, the same as those that move the head, and they pass diagonally in the same manner. Thus the trunk, and usually the breast, or second ring of the trunk, is the general fulcrum of motion for the whole body.

The wings of insects are worthy of attention, not
only from the beauty of their structure, and the nicety with which they are adapted to the other habits of the animal; but as they are a very convenient means of classing the animals.

Most winged insects have four wings, though in all, the four are not of similar structure, or equally developed. The wings, which are the proper organs of flight, are constructed of a delicate network, of the horny substance which has been alluded to, upon which is spread a thin membrane of the same. Frequently those membranous wings are covered over with feathers or scales, which also sometimes, as in the sphinx-moths, cover other parts of the insect.

The two upper wings are often horny and not adapted for flying, but they serve as a protection to the others. These are the elytra; and the insects which have them,—beetles, as they are indiscriminately called in common language, are in the habit of creeping into places where membranous wings would be in danger of being torn; or diving in water, where they would be rendered unfit for the purposes of flight. Even the membranous wings of insects, however strong in every thing but the scales with which some of them are covered, are much less liable to injury than one not acquainted with them would be apt to imagine.

Sometimes the upper wings are only half the length, and adhere to the membranous ones that are below; and in many, the two under wings are not developed, but form a slender stalk behind each wing, ending in a knob. These organs are called halteres or balancers. It is doubtful, however, whether these ought, in all cases, to be considered as the rudiments of the second
pair of wings, because they have been found wanting in some two-winged insects, and present in some four-winged ones, as in the *dytiscus marginalis*.

The legs of insects consist of nearly the same distinct parts as those of larger animals. They are:

1. The hip, (*coxa,* ) which is immediately articulated to the side of the sternum.
2. The thigh, (*femur,* ) which is articulated to the hip.
3. The leg, (*tibia,* ) which is articulated to the thigh.
4. The foot or toe, (*tarsus,* ) which consists of several joints, the first of them articulated to the leg, and the last to
5. The claw, (*unguis,* ) which terminates the organ.

The form and articulations of these are often exceedingly curious; but we find in them all that perfect harmony of organization and use, which can be so clearly traced in all the mechanism of animated nature, and which indeed forces itself upon our notice, whether we attempt to trace it or not. Thus, if the insect has only to walk and not to leap, the thighs are slender; but when it has to leap, they are swelled out in breadth to afford room for the action of the muscles; and the swelling always takes place in that direction which is best calculated for giving ease and force to the motion. The articulation of the femur is equally well adapted to the habits of the insect. In some, the motion is most easy forwards, in others backwards, and in a considerable number it answers equally both ways.

The tibia, too, is made to answer all the purposes of a simple leg; or it is lengthened, flattened, and fringed, that it may serve as an oar; or yet again it is made
compact and firm, and toothed in the edge, so that it may form an engine for digging and cutting.

The tarsus, or foot, varies very much, and exhibits a wonderful deal of mechanical contrivance, and a very nice adaptation of parts to the office that the organ has to perform. There is generally, whatever may be the number of joints or articulations in the part of the limb, a very strong flexor or contracting muscle, by means of which it is enabled to attach itself firmly to any substance.

The claw is equally varied in its structure. Sometimes, as in the case of the mole cricket, it is in the form of a rake, for hewing down and drawing along mud; at other times there are hooked claws, all bending in the same direction, by means of which it can suspend itself; sometimes again the claws act opposite to each other like a hand; and at other times there is but a single claw, to which a little protuberance on the tarsus serves as a thumb.

Such are the outlines of the merely mechanical structure of insects. The other parts are equally curious, even those that are general to the class, and have no reference to the peculiar habits of any one. The nervous system, which is ramified from the brain contained in the head; the singular formation that often is displayed in the mouth, which is at one time a pump, and at another a pair of scissors; the complicated contrivance of cells and tubes, by which the blood is aerated; and, above all, the way in which nature has provided for the continuation of the species, with the long probation and the singular changes through which many of them have to pass before they can enjoy the day or the hour.
which is given them to wanton in the beams of the sun. Taking them, diversified as they are among many genera and species,—they form, even in one corner of the smallest province of nature's kingdom, ample and delightful study for the most active mind, through the most prolonged life.

We are apt, because we cannot move from one part to another without labour, to associate interest with magnitude,—measure power with a line, and reckon wisdom by the tables of chronology; but when the work is His, "with whom a thousand years are as one day, and one day as a thousand years," we find also that space is not an element of the wonderful in His works; or, time of the wisdom with which they have been made.

END OF THE FIRST VOLUME.