

PREFACE.

EXPERIENCE in teaching has made me feel how useful a philosophical zoology would be at the present time. By this I mean a body of rules and principles, relative to the study of animals, and applicable even to the other divisions of the natural sciences; for our knowledge of zoological facts has made considerable progress during the last thirty years.

I have in consequence endeavoured to sketch such a philosophy for use in my lessons, and to help me in teaching my pupils; nor had I any other aim in view. But in order to fix the principles and establish rules for guidance in study, I found myself compelled to consider the organisation of the various known animals, to pay attention to the singular differences which it presents in those of each family, each order, and especially each class; to compare the faculties which these animals derive according to its degree of complexity in each race, and finally to investigate the most general phenomena presented in the principal cases. I was therefore led to embark upon successive inquiries of the greatest interest to science, and to examine the most difficult of zoological questions.

How, indeed, could I understand that singular degradation which is found in the organisation of animals as we pass along the series of them from the most perfect to the most imperfect, without enquiring as to the bearings of so positive and so remarkable a fact, founded upon the most convincing proofs? How could I avoid the conclusion that nature had successively produced the different bodies endowed with life, from the simplest worm upwards? For in ascending the animal scale, starting from the most imperfect animals, organisation gradually increases in complexity in an extremely remarkable manner.

I was greatly strengthened in this belief, moreover, when I recognised that in the simplest of all organisations there were no special organs whatever, and that the body had no special faculty but only those which are the property of all living things. As nature successively

creates the different special organs, and thus builds up the animal organisation, special functions arise to a corresponding degree, and in the most perfect animals these are numerous and highly developed.

These reflections, which I was bound to take into consideration, led me further to enquire as to what life really consists of, and what are the conditions necessary for the production of this natural phenomenon and its power of dwelling in a body. I made the less resistance to the temptation to enter upon this research, in that I was then convinced that it was only in the simplest of all organisations that the solution of this apparently difficult problem was to be found. For it is only the simplest organisation that presents all the conditions necessary to the existence of life and nothing else beyond, which might mislead the enquirer.

The conditions necessary to the existence of life are all present in the lowest organisations, and they are here also reduced to their simplest expression. It became therefore of importance to know how this organisation, by some sort of change, had succeeded in giving rise to others less simple, and indeed to the gradually increasing complexity observed throughout the animal scale. By means of the two following principles, to which observation had led me, I believed I perceived the solution of the problem at issue.

Firstly, a number of known facts proves that the continued use of any organ leads to its development, strengthens it and even enlarges it, while permanent disuse of any organ is injurious to its development, causes it to deteriorate and ultimately disappear if the disuse continues for a long period through successive generations. Hence we may infer that when some change in the environment leads to a change of habit in some race of animals, the organs that are less used die away little by little, while those which are more used develop better, and acquire a vigour and size proportional to their use.

Secondly, when reflecting upon the power of the movement of the fluids in the very supple parts which contain them, I soon became convinced that, according as this movement is accelerated, the fluids modify the cellular tissue in which they move, open passages in them, form various canals, and finally create different organs, according to the state of the organisation in which they are placed.

Arguing from these two principles, I looked upon it as certain that, firstly, the movement of the fluids within animals—a movement which is progressively accelerated with the increasing complexity of the organisation—and, secondly, the influence of the environment, in so far as animals are exposed to it in spreading throughout all habitable places, were the two general causes which have brought the various animals to the state in which we now see them.

I have not merely confined myself in the present work to setting forth the conditions essential to the existence of life in the simplest organisations, and the causes which have given rise to the growing complexity of animal organisation from the most imperfect to the most perfect of animals; but, believing that there is some possibility of recognising the physical causes of feeling, which is possessed by so many animals, I have not hesitated to take up this question also.

I was indeed convinced that matter can never possess in itself the property of feeling; and I imagined that feeling itself is only a phenomenon resulting from the workings of an orderly system capable of producing it. I enquired therefore what the organic mechanism might be which could give rise to this wonderful phenomenon, and I believe I have discovered it.

On marshalling together the best observations on this subject, I recognised that for the production of feeling the nervous system must be highly complex, though not so highly as for the phenomena of intelligence.

Following out these observations, I have become convinced that the nervous system, when it is in the extremely imperfect condition characteristic of more or less primitive animals, is only adapted to the excitation of muscular movements, and that it cannot at this stage produce feeling. In this particular stage it consists merely of ganglia, from which issue threads. It does not present any ganglionic longitudinal cord, nor any spinal cord, the anterior extremity of which expands into a brain which contains the nucleus of sensations and gives origin to the nerves of the special senses, or at least to some of them. When the nervous system reaches this stage, the animals possessing it then have the faculty of feeling.

Finally, I endeavoured to determine the mechanism by which a sensation was achieved; and I have shown that nothing more than a perception can be produced in an individual which has no special organs, and moreover, that a sensation produces nothing more than a perception whenever it is not specially remarked.

I am in truth undecided as to whether sensation is achieved by a transmission of the nervous fluid starting from the point affected, or merely by a communication of movement in that fluid. The fact, however, that the duration of certain sensations is dependent upon that of the impressions which cause them, make me lean towards the latter opinion. My observations would not have thrown any satisfactory light upon the subjects treated, if I had not recognised and been able to prove that feeling and irritability are two very different organic phenomena. They have by no means a common origin, as has been supposed; the former of these phenomena constitutes a

faculty peculiar to certain animals, and demanding a special system of organs, while the latter, which does not require any special system, is exclusively the property of all animal organisation.

So long therefore as these two phenomena continue to be confused as to their origin and results, it will be only too easy to make mistakes in proffering explanations of the causes of the general phenomena of animal organisation. It will be so especially in making experiments for the purpose of investigating the principle of feeling and of movement, and finally the seat of that principle in the animals which possess these faculties.

For instance, if we decapitate certain very young animals, or cut the spinal cord between the occiput and the first vertebra, or push in a probe, there occur various movements excited by the pumping of air into the lungs. These have been taken as proof of the revival of feeling by dint of artificial respiration; whereas these effects are due partly to the irritability not being extinct, for it is known that it continues to exist sometime after the death of the individual, and partly to certain muscular movements which can still be excited by the inhalation of air when the spinal cord has not been altogether destroyed by the introduction of a long probe right down its canal.

I recognised that the organic act which gives rise to the movement of the parts is altogether independent of that which produces feeling, although in both cases nervous influence is necessary. I notice that I can work several of my muscles without experiencing any sensation, and that I can receive a sensation without any movement resulting from it. But for these observations, I too might have taken the movements occurring in a young decapitated animal, or in one whose brain had been removed, as signs of feeling, and I should have fallen into error.

I think that if the individual is disabled by its nature or otherwise from giving an account of a sensation which it experiences, and that if it only indicates by cries the pain which it is made to undergo, we have no certain sign for inferring that it receives sensation except from knowing that the system of organs which gives it the faculty of feeling is not destroyed, but retains its integrity. Muscular movements excited from without cannot in themselves prove an act of feeling.

Having fixed my ideas on these interesting objects, I gave attention to the *inner feeling*, that is to say, that feeling of existence which is possessed only by animals which enjoy the faculty of feeling. I brought to bear on the problem such known facts as are relevant, in addition to my own observations, and I soon became convinced

that this inner feeling constituted a power which it was essential to take into consideration.

Nothing in fact seems to me so important as the feeling which I have named, considered both in man and in the animals which possess a nervous system capable of producing it. It is a feeling which can be aroused by physical and moral needs, and which becomes the source whence movements and actions derive their means of execution. No one that I know had paid any attention to it; and this gap in our knowledge of one of the most powerful causes of the principal phenomena of animal organisation rendered all explanations inadequate to account for these phenomena. We have, however, a sort of clue to the existence of that inner power when we speak of the agitations which we ourselves are constantly experiencing; for the word *emotion*, which I did not create, is often enough pronounced in conversation to express the observed facts.

When I had considered that the inner feeling was susceptible of being aroused by different causes, and that it then constituted a power capable of exciting actions, I was so to speak struck by the multitude of known facts which attest the actual existence of that power; the difficulties which had long puzzled me with regard to the exciting cause of actions appeared to me entirely surmounted.

Admitting that I had been fortunate enough to alight upon a truth in attributing to the inner feeling of animals which have it the power which produces their movements, I had still only surmounted a part of the difficulties by which this research is hampered. For it is obvious that not all known animals do or can possess a nervous system; consequently, all animals do not possess the inner feeling of which I am speaking; and in the case of those which are destitute of it, the movements which they are seen to execute must have another origin.

I had reached this point when I reflected that without internal excitations plant life would not exist at all, nor be able to maintain itself in activity. I recognised the fact that the same consideration applied to a large number of animals; and as I had very frequently observed that nature varies her means when necessary in order to attain the same end, I had no further doubt about the matter.

I think therefore that the very imperfect animals which have no nervous system live only by the help of excitations which they receive from the exterior. That is to say, subtle and ever moving fluids contained in the environment incessantly penetrate these organised bodies and maintain life in them, so long as the state of these bodies permits of it. Now this thought is one which I have many times considered, which many facts appear to me to confirm, against which

none of those that are known to me seem to conflict, and finally which appears to me obviously borne out by plant life. It was therefore for me a flood of light which disclosed to me the principal cause which maintains movements and the life of organised bodies, and to which animals owe all that animates them.

I combined this consideration with the two preceding ones, namely, that which concerns the result of the movement of fluids in the interior of animals and that which deals with the effects of a change that is maintained in the environment and habits of these beings. I could thus seize the thread which connects the numerous causes of the phenomena presented in animal organisation, and I soon perceived the importance of this power in nature which preserves in new individuals all the changes in organisation acquired by their ancestors as a result of their life and environment.

Now I remarked that the movements of animals are never directly communicated, but that they are always excited; hence I recognised that nature, although obliged at first to borrow from the environment the *excitatory power* for vital movements and the actions of imperfect animals, was able by a further elaboration of the animal organisation to convey that power right into the interior of these beings, and that finally she reached the point of placing that same power at the disposal of the individual.

Such are the principal conclusions which I have endeavoured to establish and develop in this work.

This *Zoological Philosophy* thus sets forth the results of my studies on animals, their characters both general and special, their organisation, the causes of their development and diversity, and the faculties which they thence derive. In its composition I have made use of the bulk of the material which I was collecting for a projected work on living bodies under the title of *Biology*. This work will now remain, so far as I am concerned, unwritten.

The facts which I name are very numerous and definite, and the inferences which I have drawn from them appeared to me sound and necessary; I am convinced therefore that it will be found difficult to replace them by any others.

The number of new theories expounded in the present work are likely to give the reader an unfavourable impression, if only from the fact that the commonly received beliefs do not readily give way to any new ones which tend to contradict them. Now, since the predominance of old ideas over new favour this prejudice, especially when there is some contributory personal interest, it follows that, whatever difficulties there may be in the discovery of new truths in nature, there are still greater difficulties in getting them recognised.

But these difficulties, arising from various causes, are on the whole more advantageous than otherwise to the general progress of knowledge. By means of a rigorous hostility to the admission of new ideas as truths, a multitude of more or less specious but unfounded ideas which appear, soon after fall into oblivion. Sometimes, on the other hand, excellent opinions and solid thoughts are for the same reasons discarded or neglected; but it is better that a truth once perceived should have a long struggle before obtaining the attention it deserves, than that all that is produced by the ardent imagination of man should be too readily received.

The more I meditate on this subject, and particularly on the numerous causes which may bring about a change in our opinions, the more am I convinced, that except for the physical and moral facts¹ that no one can question, all else is but opinion or argument; and we well know that arguments can always be met by others. Thus, although it is obvious that there are great differences in the probability and even the value of the opinions of different men, it seems to me that we should be wrong to blame those who refuse to adopt our own.

Should we recognise as well founded only those opinions that are most widely accepted? Experience shows clearly enough that persons with the most developed intellect and the highest wisdom constitute at all times an extremely small minority. The fact can scarcely be questioned. Authorities in the sphere of knowledge should weigh one another's worth and not count one another's numbers, although indeed a true estimation is very difficult.

Seeing how numerous and rigorous are the conditions required for forming a sound judgment, it is still uncertain whether the judgment of individuals who have been set up as authorities by public opinion is perfectly sound on the topics on which they pronounce.

There are then few positive truths on which mankind can firmly rely. They include the facts which he can observe, and not the inferences that he draws from them; they include the existence of nature, which presents him with these facts, as also the laws which regulate the movements and changes of its parts. Beyond that all is uncertain, although some conclusions, theories, opinions, etc., have much greater probability than others.

We cannot rely on any argument, inference or theory, since the authors of these intellectual acts can never be certain that they have taken into account the true data, nor that they have admitted these

¹By *moral* facts I mean mathematical truths; that is to say, the results of calculations whether of quantities or forces, and the results of measurements; since it is through intelligence and not through the senses that these facts become known to us. Now these *moral* facts are just as much positive truths as are those relating to the existence of bodies that we can observe.

only. There is nothing that we can be positive about, except the existence of bodies which affect our senses, and of the real qualities which belong to them, and finally the physical and moral facts of which we are able to acquire a knowledge. The thoughts, arguments and explanations set forth in the present work should therefore be looked upon merely as opinions which I propose, with the intention of setting forth what appears to me to be true, and what may indeed actually be true.

However this may be, in giving myself up to the observations from which my theories have arisen, I have obtained the pleasure which their resemblance to truth has brought me, and I have obtained also the recompense for the fatigues entailed upon me by my studies and meditations. In publishing these observations, together with the conclusions that I have drawn from them, my purpose is to invite enlightened men who love the study of nature to follow them out, verify them, and draw from them on their side whatever conclusions they think justified.

This path appears to me the only one that can lead to a knowledge of truth or of what comes nearest it, and it is clear that such knowledge is more profitable to us than the error which might fill its place. I cannot doubt therefore that it is this path which we must follow.

It may be noticed that I have dwelt with special pleasure on the exposition of the second and especially of the third part of this work, and that I have been greatly interested in them. None the less, the principles bearing on natural history which I have studied in the first part should be looked upon as possibly the most useful to science, since they are in general most in harmony with the opinions hitherto received.

I might have considerably extended this work by developing under each heading all the interesting matter that it permits of; but I have preferred to confine myself to such exposition as is strictly necessary for the adequate comprehension of my observations. I have thus spared my readers' time without exposing them to the risk of failing to understand me.

I shall have attained my end if those who love natural science find in this work any views and principles that are useful to them; if the observations which I have set forth, and which are my own, are confirmed or approved by those who have had occasion to study the same objects; and if the ideas which they succeed in giving rise to, whatever they may be, advance our knowledge or set us on the way to reach unknown truths.