

Preface

The evolution of ideas has much in common with that of living things. Ideas are usually born as humble thoughts hidden among long-standing concepts, and they may remain inconspicuous as they slowly develop because they are not distinguishable from their progenitors. Little by little, some will take on a character of their own and continue to grow stronger until they can survive and evolve alone. They then go on to engender other new ideas that may follow a similar course.

All the members of a single family of ideas do not necessarily share the same destiny. Some perish without having played any role whatever; they exercise no influence and provoke no change. Others that initially differ little from those that are destined to fail may go on to make important contributions to human thought. Everyone then thinks that these ideas are self-evident and that they recognized their importance long before they became widely accepted – even to the degree of claiming to be their parent. This is why it is almost impossible to write a history of ideas that everyone would consider impartial. It is why everyone who thinks he has an idea that is a new contribution to the store of human knowledge immediately finds himself assailed by the outcries of countless self-styled precursors to whom he had failed to give credit for early insights that supposedly played a role in fostering the development of these ideas.

For this reason, I have refrained from attempting to make this little book a complete survey of all the varied concepts to which zoologists have been led in their studies of animals. I have benefited from comments of fellow members on the staff of the Jardin des Plantes who have read some of the following chapters, but I leave it to historians to chronicle the minor events I may have neglected and to biographers to record the lives of the great men whose ideas I discuss. I have also deliberately avoided discussing all the nebulous, ill-conceived ideas that have left little if anything to posterity. I have chosen instead to focus more closely on those strong, vigorous ideas that have made lasting contributions to what has become modern zoological philosophy. I have discussed these ideas in the context of the times when they first became innovative intellectual concepts. This, I think, is the only way I could write a short book that would be clear, concise, and useful.

A few misguided French scientists have criticized French science and belittled the important role it has played in the splendid flourishing of biology that now radiates everywhere, even into the thinking of our political leaders. Despite what some may say, France has not – thank God! – remained isolated from the important developments in zoological philosophy. Few other countries have furnished so many scientists who have been able to lay out general concepts with clarity and exactitude. I have had the agreeable task of recording the manner in which this progress has been achieved, and I hope that I have done so with total fairness and impartiality, not only with regard to scientists of other countries but also to those of my contemporaries with whom I have had occasion to discuss these philosophical principles.

In dealing with the Philosophy of Zoology before Darwin, I have had to trace the ways in which many of our present ideas have grown out of earlier ones. This has led me to review the broad trends of modern biology, the aims it pursues, and the methods to which it must adhere to attain them. Some of these methods have yet to become guiding principles of modern biology.

Even if the general acceptance of transformism is accomplishing a profound revolution in the direction that naturalists aim their research and in their way of interpreting the significance of their observations, this revolution is still far from complete. Too often, the older method, which physicists have referred to a bit disdainfully as the *method of naturalists*, continues to introduce discord over fundamental principles and the corollaries ones derived from them. In studying the works of famous naturalists, one is struck by the great differences between their methods and those of physical scientists. These differences reside much less in the use of subjective observations instead of objective experimentation than in the customary practice of physicists who go from the simple to the complex in their efforts to relate effects to their proper causes. For many years naturalists confined themselves to *comparing*, while physical scientists were striving to *explain*. This has changed, however, and naturalists are now trying to explain the phenomena they observe. They have finally given up their endless appeals to metaphysics in the *natural science* they cultivate and, by a strangetwist of fate, they have ceded its true name to other sciences from which it has derived the methods from which it should never deviate. Until very recently, the unfortunate term metaphysics has been used in reference to the general principles underlying the relationships between living creatures. When Aristotle introduced his *principle of final causes*, which Cuvier made the central focus of all his work, he caused naturalists to search for the ways in which an external will had brought harmony into the world. Leibnitz's *principle of continuity* was used by Cuvier and his disciples, Linnaeus and Bonnet, who seemed to see no relationship between cause and effect in the phenomena they were trying to explain. To them, the inherent continuity and gradational variations between related organisms is simply a reflection of the intelligent design of the universe. Similarly, Etienne Geoffroy Saint-Hilaire could offer no reason for the *uniform plan of composition* that he saw in the animal kingdom other than some sort of mysterious relationship between living creatures and their

creator. Cuvier did not challenge this; he strayed even further in this line of reasoning when he proposed the four basic branches to which all animal life could be assigned. As soon as he tried to go beyond the observed facts, he found himself drawn to the doctrine of final causes or to the hypothesis that the essential forms of animals pre-exist in the germ cells carried in their bodies. When Cuvier's closest disciple, Richard Owen, laid out his *theory of archetypes* and Louis Agassiz developed his ideas about *species* and *classification*, there was nothing mysterious in what they proposed: natural history was for them nothing but a record of the will of God.

As soon as one accepts this hypothesis - or any other form of metaphysics - it becomes very difficult to entertain any other view of the living world. The belief in the *fixity of species* came at a time when very little was known about the animal kingdom, and the knowledge we have since acquired has demolished this belief by showing that the idea of fixed species can no longer be sustained. The hypothesis is no longer consistent with the essential features of living forms nor with the relationships of these forms to their environment, and it can not be explained in terms of the simplistic generalizations naturalists used in the past. Dugès' *law of organic conformity* and Steenstrup's *law of alternating generations* were metaphysical statements of this kind; they defined the principles nature follows in perfecting its works. Even H. Milne Edwards, who rejected the idea of immutability, built his brilliant work on the so-called *division of physiological work* which implied that nature has effective means to transform creatures gradually into increasingly complex forms.

In the first half of this century, naturalists vainly hoped to avoid the discredited metaphysical processes by invoking a vague being they called *Nature* to explain the features that they described so beautifully. Some of the articles they wrote for encyclopedias and dictionaries were devoted specifically to this supernatural being. Nature is the Universe, it is God, and if it is not that, it is nothing. This Nature that was said to prevail everywhere offered no real explanations in the sense that physical scientists understand the word.

Explanations of the variations in related forms of life reveal a simple element that all share in common, and they show that these variations can be attributed to identifiable causes. In zoology, any scheme that takes man or any of the vertebrates as a point of departure from which other organisms have descended fails to offer an adequate explanation for these modifications. To try to "explain" the lower groups of the animal kingdom by means of concepts derived from studies that included only vertebrates is to retreat from the principles of modern experimental science. All the difficulties we still experience in defining the *individual* or *species* are artificial in the sense that they are of our own making. They result from a failure to abandon narrow concepts based entirely on earlier studies of animals or the higher forms of plants.

Thanks to improved means of investigation, it has now become possible to reduce living things to the elements that they have in common, namely their cells, and these, in turn, are defined in terms of the fundamental substance they have in

common: protoplasm. Thus, it has been possible to establish a continuous chain between organisms composed of a single cell and those with millions. Embryogenesis demonstrates that even the most complex forms result from multiplication of a single initial cell, the egg. Thanks to improved methods of investigation, true explanations appear to be forthcoming, just as they have for physicists and chemists.

We may be justified in hoping that it will some day be possible to present the history of living creatures in an instructive form appropriate for the experimental sciences. I have taken a first step in this direction in my book, *Les colonies animales et la formation des organismes*, published in 1884. But to achieve this we must be confident that the origins of natural organisms can be found in their present form and strive to find evidence of the causes that relate complex phenomena to simpler ones. This method will enable us to find links between more extensive assemblages, and we should not be deterred by critics who attempt to make a hypothesis seem faulty by pointing out something it leaves unexplained or explains in a way that does not include every possible relevant fact.

I hope that this account of earlier thoughts will contribute to progress by showing where the true path to understanding may be found.

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