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Contributions to the Philosophy of Zoology.

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Part I.—*On the Relation of Species or Race to Genus or Natural Family: a Question of Transcendental Anatomy.*

INTRODUCTION.

ZOOLOGY, to be esteemed a Science, must be based on philosophical principles. True, it is a science of observation and not of calculation; it has to deal with living bodies, and with the mysterious and hitherto undiscovered principle of life, whose laws are not to be explained by numbers, however multiplied, nor by a geometry, however refined. Fluxions avail not here, nor the integral calculus. Nevertheless, some great minds have shown that Zoology has its laws, which, despite difficulties almost innumerable, may be so inquired into as to evolve some truths of more import to man than at first appears.

The observation of nature is no doubt the first duty of every candid observer; next comes the duty of the inquirer into her laws, for the mere observance of a fact is of no value whatever, unless that fact be placed in its relations with all others. Men had observed, and no doubt observed carefully, long before the age of Aristotle, but he alone was equal to the production of the 'Historia Animalium.' He was followed, at a long interval, by Buffon and Linné; last came the immortal Cuvier. The discovery of the true signification of the fossil remains of the organic world by this illustrious and justly celebrated man, was unquestionably the most remarkable step ever made for the advancement of the human mind. The element of research he employed was the descriptive anatomy of the adult or fully-developed individual of all, or at least of most, of the species of animals now occupying the globe. The minute descriptive anatomy of the species, with a view to the rigorous determination of its true nature and position in a natural-history arrangement, seemed to be the ultimatum of all his inquiries; and if he spoke of genera or natural families it was more as a naturalist, or as one by whom generic distinctions were viewed rather as expressions of philosophic arrangement than as realities based in Nature. It was whilst pursuing this inquiry into the existing and living Fauna of the present world that the thought struck him of applying the element of research he then wielded with such dexterity

to the fossil remains of a former world; never since man studied science had a thought so fruitful in great results entered the human mind. By it he dissected, as it were, the globe itself, giving to the lovers of truth in science a key wherewith to read those vestiges of successive animal forms which we, for want of a more correct term, call Vestiges of Creation, and removed from the mental vision of men that dark veil of ignorance which had certainly endured for some thousand years.

As Cuvier pursued his anatomical investigations, for they were strictly so, he classified and arranged the individual animals examined by him into distinct species, according to their anatomical differences; still, adhering to the anatomical method, he only viewed the distinctions as generic when they were wider, larger and quite apparent. Not that he despised external characters, or neglected them; but as an anatomist he felt himself bound to view them as secondary and of infinitely less importance than the anatomical. Moreover, they were wholly inapplicable, or nearly so, to the fossil world, at least to that class, the Vertebrata, in which man is most interested.

If the theory I am about to propose be true, that the young, namely, of every species, represents a *generic animal*, embracing in its structure and natural-history characters the *possible* of all the species, past, present and to come, belonging to the natural family of which it forms a portion, then the natural history of the fossil world might be guessed—might be restored, but not otherwise. The fossil horse was only a horse *generically;* but whether a horse properly so called, an ass, a zebra, a quagga, or none of these, none can now for certain say: the fossil tiger was no tiger, in all probability; nor the bear a bear, appertaining to, or to be classed with, any species now living. The exterior of the fossil world is lost for ever; all that is left of it being merely the fabulous traditions of rude ages, peopling the world with monsters, which the discoveries of Cuvier in some measure corroborated.

When the anatomical method failed in Cuvier's hands, as it often did, the illustrious discoverer was thrown upon the field of hypothesis. The seeming fixity of species was the first stumbling-block he encountered; this led to his theory of successive creations, if that can be called a theory which removes the inquiry at once from all further investigation. By anatomy it was not easy, occasionally impossible, to distinguish species from each other, which, when viewed as clothed with their external attributes, are obviously and notoriously distinct. In this predicament stood the lion and tiger, panther and leopard,

horse, zebra, ass, dog, wolf, fox, jackall, pig, ox, man. The theory of variety, to a certain extent permanent, was next brought to bear on these difficult questions; the influence of domesticity was also invoked, and even the fruitfulness of hybrid races was asserted; so that Natural History fast retrograded towards the silly hypothesis ascribed to Aristotle, who is supposed to have conjectured that the vast variety of animal forms with which Africa abounds is due to the arid nature of the country and its paucity of rivers and springs, thus bringing together animals of many species and genera; hence the varied character of Afric's Fauna.

The inadequacy of anatomy to distinguish species in every case was fully admitted by Cuvier himself. I also admit this practically, but with this reservation, that the minute anatomy of even the osteology of every species differs in a certain degree, however slight, from every other; but such minute differences are not of much importance in the establishment of important principles, nor can they always be depended on. The nasal bones of the horse and ass differ in form from each other, more perhaps than any part of their respective osteology; but how insignificant is this difference, in a natural-history point of view, when compared with those external characters which mark the zebra, the horse, the ass, and quagga! The same remarks apply to the lion and tiger, in respect of these very bones, the nasal, and their relations to the superior maxillary bones; to the white ox of Scotland and to the common domestic ox. The nasal bones, the skeleton of the head, the character of the teeth, do not differ more regularly or constantly, nor to the same extent, in the horse, zebra and ass than they do in the races of man. The skeleton of the head of the Negro and Bosjesman differ much more widely from the white races of man than those of the horse and lion differ from the corresponding structures in the tiger and zebra. I do not, therefore, admit, to the full extent, that anatomical characters ever fail to discriminate species; but I freely admit their occasional inadequacy to characterise or to lead to the determination of species in a practical sense. On the other hand, the facility with which this may be done, by a consideration of the external characters, is known to all the world. Science admits of no exaggeration; Anatomy has done much for Natural History; much for Philosophy; still more for humanity, by purging the human mind of deep-rooted errors, of a gross and scandalous character, of forty centuries' growth. But Anatomy has its limits, notwithstanding, and these limits were admitted and defined by the Great Master himself.

It was not to be expected that a mine of knowledge such as was discovered and first worked by the great Cuvier should continue to be explored by so many vigorous hands, and that all should go smoothly with the labourers: difficulties soon appeared, and they increased so rapidly in number and in strength as to cloud with anxiety for the fate of his great discovery the mind of the immortal author of the 'Ossemens Fossiles.' It seemed as if he were about to survive his own vast reputation. So seemingly unimportant a question as the influence of domestication over animal life embarrassed the great anatomist. The anatomical element of inquiry having failed in establishing specific distinctions in the various oxen which ornament the cultivated earth, Cuvier was forced to imagine them to be like the dog, of one species; Goethe, the transcendentalist, starting from a higher point of view, had arrived at the same conclusion. "The infinite varieties of the domestic ox," observed the sublime author of 'Faust,' "are simply the gift to man of domesticity acting through millions of years." Such also was Cuvier's opinion, omitting the "millions of years." What his real opinions were on the influence of time and circumstances he never, so far as I know, communicated to any one. The monumental records of Egypt, depicting man then as he is now, after the lapse of at least 4000 years, were perfectly well known to him. Still greater difficulties he prudently passed by without a passing notice. And yet his great discovery laid the foundation of Geology, Palæontology, and a true history of life on the globe. Before him these sciences could not be said to exist.

Prior to this eventful scientific era the German school of philosophic anatomists had made an advance towards the same object, but from a different point of view. Anatomy was still the element of research which they employed, but it was the Anatomy of the embryo. At the head of this school was the justly-celebrated Goethe, poet, philosopher, naturalist, mathematician; his genius seemed universal. He it was who first distinctly formuled the law of unity of the organization in all that lives or has lived. The doctrine of "arrest of development" came soon after into vogue, chiefly through Meckel and the German schools of anatomists,—a doctrine based on a superficial and a somewhat incorrect application of facts, curious and important in themselves; to this at last were added the Teratologie of Etienne Geoffroy (St. Hilaire) and the serial unity of De Blainville.

Believing the transcendental in Anatomy to be the only instrument of research at present known by which a correct basis can be laid for the philosophy of Zoology, I have never ceased to study and teach it

since the period (1811) when it first became known to me. To the writings of Vicq. d'Azyr I am indebted for the first hints of its existence. Biassed in favour of descriptive anatomy, I have ever objected to the too hasty adoption of extreme transcendental views, holding it to be a true maxim in science, as well as in social life, that the change or step in advance, in order to be certain and trustworthy, must ever be made with caution, and, if possible, supported by the demonstration of physical materials; or, in other words, the thought which genius submits to the world as an idea must become a physical demonstration before the world can fairly be called on to admit its truth. This is the view I take in the following Memoirs, in some of which it is my intention to apply the transcendental to Natural History as a preliminary to my inquiry into the natural history of man. The true relation of species or race to genus or natural family seemed to me to present a favourable mode of testing the value of the transcendental, not with any idea of testing its truth,—that has been settled long ago,—but of ascertaining its practical value as an instrument of research. The true relation of race to natural family being first discovered, it will then be time enough to apply the transcendental to the relation presumed to subsist between natural families, and, lastly, between these and the universal primæval life of the organic world of this globe.

In selecting the natural family of the Salmonidæ as a subject of research I have been guided by several considerations: I had already made them the subject of extended research, and their external characters offered favourable points of view for such an inquiry. It is chiefly to the exterior that I give my attention in the present Memoirs; the interior will follow. I commenced with the dentition, that natural-history character to which all, whether naturalists or anatomists, ascribe such importance; next followed a brief inquiry into the systems of coloration and proportion. To all these the transcendental applies, or ought to apply, if true. That it is true as a theory I have not a doubt myself, however I may fail in proving it to the satisfaction of others. My immediate object is to prove the existence of a *generic animal*, the product, no doubt, of hereditary descent from a species, but in itself including the characteristics of all the species belonging to that natural family; or, in other terms, proving hereditary descent to have a relation primarily to genus or natural family. By this term I endeavour to explain family likenesses commingling with the generic; the more or less resemblance, for example, of an individual with other affiliated races, to none of

which it belongs by strict hereditary descent. My ultimate aim is to offer a scientific explanation of the appearance, from time to time, of seemingly new species on the earth, and of the extinction of others, thus restoring to legitimate science that branch of philosophy which the theory of successive creations, invented by Cuvier and still maintained by his followers, had clearly removed from it. To prove the unity of the organization, the unity of creation, and the serial unity of all that lives or has ever lived, forms the aim of the first part of this inquiry.

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