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"To the solid ground
Of Nature trusts the mind which builds for aye."—WORDSWORTH.

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PAST AND PRESENT.

JUST five-and-twenty years ago, the Editor of NATURE did me the honour to request that I would write the leading article for his first number. In complying with my friend's wish, I said that I could think of no more appropriate preface to a journal, the aim of which was "to mirror that fashioning by nature of a picture of herself in the mind of man," which is called science, than an English version of the wonderful rhapsody *Die Natur*, which is to be found among Goethe's works,¹ and which had been a source of instruction and delight to me from my youth up.

Whether my estimate of the fitness of these pregnant aphorisms for the place assigned to them was shared by more than half-a-dozen of the readers to whom they were submitted, is very doubtful; indeed, I feel bound to confess that a rumour reached my ears, to the effect that some authorities, apparently of the school of the most noble Festus, in their haste, failing to discriminate between the great poet and his translator, opined that much attempt to learn, if not much learning, had made me mad.

A verdict based on a mistake so flattering to any literary vanity I might possess could be borne with equanimity. Indeed, in view of the general state of opinion among those interested in physical science at the time, I had no right to imagine that a presentation of a theory of the universe based exclusively upon the scientific study of nature—a prose poem, which stands in somewhat the same relation to the

philosophy of Spinoza as the "Essay on Man" to that of Shaftesbury and Bolingbroke—would be intelligible to more than a small minority; or acceptable to more than a fraction of even that fit though few company.

At that time, it was rare for even the most deservedly eminent of the workers in science to look much beyond the limits of the specialty to which they were devoted; rarer still to meet with any one who had calmly and clearly thought out the consequences of the application, in all the regions into which the intellect can penetrate, of that scientific organon, the power and fruitfulness of which, within their particular departments, were so obvious. Though few read, and fewer still tried to comprehend the writings of Francis Bacon, a respectable, almost venerable, tradition bid us glorify him as the guide, philosopher, and friend of science; and more especially held him up as our exemplar in his insistence upon the division of the world of thought into two—an old and a new—but, unlike the corresponding divisions of the terrestrial surface, separated by impassable barriers. In the new, the strict adherence to scientific method was inculcated, and a rich reward of benefits to man's estate promised to the faithful; in the old, on the contrary, scientific method was to be anathematised, while absolute dependence was to be placed on quite other mental processes. Men were called upon to be citizens of two states, in which mutually unintelligible languages were spoken and mutually incompatible laws were enforced; and they were to be equally loyal to both.

People engaged in the ordinary business of life were not much troubled by difficulties which were not forced upon them by their avocations. Nor, among the men of science, did they press hardly on the mathematicians, the physicists, and the chemists.

¹ A better translation than mine and an interesting account of the very curious obscurity which hangs about the parentage of *Die Natur* are to be found in Mr. J. Bailey Saunders' recently published "Goethe's Aphorisms and Reflections."

At one time, the astronomers underwent sundry perturbations, yet these somehow got smoothed over and ignored. But there was serious trouble among the geologists and biologists. However sincerely they might try to shut their eyes, it was impossible to be wholly blind to the fact that for them the two worlds were not separable. On the contrary, it was becoming plainer and plainer that a vast tract, hitherto claimed for the old, was being steadily invaded and annexed by the citizens of the new world.

Fifty years ago the tension was already serious, but matters had not got so far as to seem desperate. It was possible for very eminent and, at the same time, perfectly sincere men, to keep their scientific and their other convictions in two separate logic-tight compartments. Indeed, it was said that some, perhaps too deeply bent on the search after final causes, found a reason for the duplicity of the cerebral hemispheres, in their adaptation to the purposes of this duplex intellection. Conducive to outward and inward peace as might be the convention, in virtue of which science was to be kept grinding at the mill of utility, and (by way of completing the resemblance to Samson) carefully blinded, or at any rate hoodwinked lest glimpses of a nobler field of action should end in an outbreak on the Philistines, the difficulty of observing it, as uniformitarian principles obtained the ascendant among the geologists, became insuperable. Outside the narrow circle of the peace-at-any-price "reconcilers," the *pax Baconiana* was plainly coming to an end in the middle of the century. It was finally abolished by the publication of the "Origin of Species."

The essence of this great work may be stated summarily thus: it affirms the mutability of species and the descent of living forms, separated by differences of more than varietal value, from one stock. That is to say, it propounds the doctrine of evolution as far as biology is concerned. So far, there is nothing new in Darwin's enterprise. So far, we have merely a re-statement of a doctrine which, in its most general form, is as old as scientific speculation. So far, we have the two theses which were declared to be scientifically absurd and theologically damnable by the Bishop of Oxford at the meeting of the British Association at Oxford in 1860.

It is also of these two fundamental doctrines that, at the meeting of the British Association in 1894, the Chancellor of the University of Oxford spoke as follows:—

"Another lasting and unquestioned effect has resulted from Darwin's work. He has, as a matter of fact, disposed of the doctrine of the immutability of species."

NO. 1305, VOL. 51]

And

"Few now are found to doubt that animals separated by differences far exceeding those that distinguish what we know as species have yet descended from common ancestors."

Undoubtedly, every one conversant with the state of biological science is aware that general opinion has long had good reason for making the *volte face* thus indicated. It is also mere justice to Darwin to say that this "lasting and unquestioned" revolution is, in a very real sense, his work. And yet it is also true that, if all the conceptions promulgated in the "Origin of Species" which are peculiarly Darwinian were swept away, the theory of the evolution of animals and plants would not be in the slightest degree shaken.

Ever since I began to think over these matters it has been clear to me that the question whether the forms of life on the globe have come about by evolution, or in some other way, is an historical problem, and must be treated as such. Either there are records of the process, or there are not. If there are not, we are shut up to the devising of more or less probable hypotheses based on indirect evidence. If there are adequate records, our business is to decipher them, and abide by what they tell us. Now, in 1859, there was no doubt about the existence of records; nor any about the fact that they extended over a vast period of time; nor any about the order of succession of the facts they registered. But, there was also no doubt in the mind of any one who looked critically into these records, that, in spite of their seeming copiousness, they were the merest fragments, torn and tattered remnants of the continuous series of documents which once existed. But, very largely in consequence of the stimulus given by Darwin, palæontological research was taken up with new vigour, and with marvellous success. So that, in 1878, I felt justified in writing—

"On the evidence of palæontology, the evolution of many existing forms of animal life from their predecessors is no longer an hypothesis but an historical fact."²

And in 1880—

"If the doctrine of evolution had not existed, palæontologists must have invented it, so irresistibly is it forced upon the mind by the study of the remains of the Tertiary Mammalia which have been brought to light since 1859."³

I am not aware that these statements have ever been controverted; and, in view of the following deliverances of the author of the most authoritative recent treatise on Palæontology, I think they are not likely to be:

¹ British Association for the Advancement of Science, Oxford, 1894. Address of the Most Hon. the Marquis of Salisbury, President.

² "Collected Essays," vol. ii. p. 226.

³ *Ibid.*, p. 241.

"Recent investigations have utterly shattered the belief in cataclysms. The conviction has arisen that the process of the development and metamorphosis of organic beings was gradual and uninterrupted, and that sharp lines of demarcation are to be found only where considerable changes in the conditions of existence, and especially in the distribution of land and water, have brought about great modifications in the world of life or interruptions in the formation of sediment." (Zittel: "Handbuch der Palæontologie." Bd. I. p. 23.)

And, again, in the recently completed final volume of this standard work we read:

"The whole history of the evolution of the mammalia from the Trias to the present day, in spite of all deficiencies in the record, plainly shows that the genetic connection of the several Faunæ, whatever geological disturbances may have taken place, was never completely interrupted; and that each of these associations of animals has arisen by gradual transformation of the constituents of its predecessor, and has furnished the stock of its successor." (Bd. IV. p. 764.)

However often, therefore, thoughtlessness, or polemical dexterity, may confuse issues which are totally distinct, biological evolution rests, in perfect security, on the firm foundation afforded by the study of the remains of the animals and plants, which have successively peopled the world during the untold ages of its past history. The coming into being of the present forms of life has happened so, and in no other way.

And, as I pointed out, sixteen years ago,

"It is only the nature of the physiological factors to which that evolution is due which is still open to discussion."¹

For me, the claim of the doctrine of evolution to be taken into account in all philosophical and other views of the nature of things turns upon whether it possesses a solid foundation in fact or is a mere speculation. No doubt, whenever astronomers universally accept what is called the Kant-Laplace theory of the heavens, a notable addition will be made to this indispensable objective foundation of the doctrine. Whenever chemists accept the evolution of the so-called elements from a *materia prima*, there will be a further grand addition. But, for the present, I venture to suppose that the palæontological base is surest. And, at any rate, so far as the claims of science to be heard in regard to the problems of human life are concerned, it is, far and away, the most important. If man has come into existence by the same process of evolution as other animals; if his history, hitherto, is that of a gradual progress to a higher thought and a larger power over things; if that history is essentially natural; the frontiers of the new world, within which scientific method is supreme, will receive such a remarkable extension as to leave little but cloudland for its rival.

¹ "Collected Essays," vol. ii. p. 226.

Experience teaches me it is by no means impossible that if I were to stop here, what I have said would be represented, and even believed, to be a repudiation of "Darwinism." Yet no conclusion could be more utterly devoid of foundation.

"The combined investigations of another twenty years may, perhaps, enable naturalists to say whether the modifying causes and the selective power, which Mr. Darwin has satisfactorily shown to exist in nature, are competent to produce all the effects he ascribed to them; or whether, on the other hand, he has been led to over-estimate the value of the principle of natural selection, as greatly as Lamarck over-estimated his *vera causa* of modification by exercise."

... "My sons dig in the vineyard," were the last words of the old man in the fable; and though the sons found no treasure they made their fortune by the grapes."

These two paragraphs occur at the end of the critical notice of the "Origin of Species," which I wrote in 1859. The citations I have already given from Zittel sufficiently show what has come of "digging in the vineyard"; there is another (Bd. I. p. 42) much to the present purpose.

"For the naturalist, evolution (*die Descendenz theorie*) offers the only natural solution of the problem of the development and succession of organic beings. But as to the causes which bring about the modification of species, and especially the change in a given direction, opinions are yet greatly divided. That the principle of natural selection, discovered by Darwin, leaves many phenomena unexplained is no longer denied by even the warmest followers of Darwin."

It will be observed that at any rate one of these "warmest followers" has never thought of denying it. On the contrary, he has over and over again brought the difficulties prominently forward. Nevertheless, I doubt as little, now as heretofore, that the probabilities are greatly in favour of our finding a way to the causes of evolution by pertinacious study of variation and natural selection. There are large fields for inquiry open on all sides. How much has yet been done, for example, towards ascertaining the effect of external conditions on the struggle for existence within the organism and the production of varieties as a consequence of that struggle; or towards an adequate experimental study of variation? The supposition that problems such as these, and others that might easily be mentioned, could be finally solved, even in thirty-five years, is one that would not enter the mind of a competent biologist; and the parade of the mutual contradictions and the intrinsic weaknesses of the hypotheses which, hitherto, have been more or less tentatively propounded, as if they had anything to do with the truth or falsehood of the doctrine of evolution, should not be taken too seriously.

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