The Open Court

A MONTHLY MAGAZINE

Devoted to the Science of Religion, the Religion of Science, and the Extension of the Religious Parliament Idea

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THE SO-CALLED TOMB OF DAVID.

Of this building tradition asserts that it contains the *Cœnaculum* or the chamber where Jesus partook of the Last Supper, and that here also took place the pouring out of the Holy Ghost on Pentecost.

Frontispiece to The Open Court.

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DARWIN'S CONTRIBUTION TO EVOLUTION.

BY C. STUART GAGER.

THE announced title of this paper would have sounded strange indeed to the average reader of thirty or forty years ago. Darwin's contribution *to* evolution! Why, Darwinism *is* evolution: it is *all* Darwin. Such was the almost universal popular impression.

This confusion of ideas has not entirely passed away to-day, and we are all accustomed to see the words "evolution" and "Darwinism" used interchangeably in newspaper articles and popular magazines.

Not only were these two words used synonymously, but with a special and restricted meaning which did violence to both of them. "Do you believe in evolution?" is the first question put by the layman; and when the man of science answers "yes," he is asked with unfeigned surprise, "Why, do you believe that man came from a monkey?"

I would not presume to instruct this audience as to what evolution is, but a statement of it will be a fitting preliminary to what I have to say, and serve to give a clear definition to the subject.

If we consider that the universe has not always existed as it now is, we may conceive at least two possible theories to explain its present condition: First, it was made as we now find it by an act of creation; second, the present order of things has come to be, by a series of gradual processes operating throughout long periods of time. Huxley avoided rubbing the fur of the theological cat the wrong way by calling the former the Miltonic hypothesis. The latter is the conception of evolution.

According to the Miltonic hypothesis, events are unrelated, ex-

[1] An address delivered before the Scientific Association of the University of Missouri, at the exercises commemorating the one hundredth anniversary of the birth of Charles Darwin, and the fiftieth anniversary of the publication of the *Origin of Species*, February 12, 1909.

cept in point of time. One event may have occurred either before or after any other, or they may all have occurred at the same moment. But they have no logical connection. We may not interpret the present in the light of the past, nor infer the future. Hitherto nature may have followed a certain recognized order, but we are not at all justified in concluding that such will hereafter be the case. Science becomes a mere pastime without any ultimate goal. We may describe the facts and sequences of natural phenomena as one may catalogue the titles and shelf-numbers of books in a library, but with reference to the past or the future, no inference may be drawn from the former any more than from the latter. The librarian may at any moment intervene and capriciously change the entire content and arrangement of the library. God made it: there is nothing to explain.

Evolution, on the other hand, tells us that events have followed in orderly sequence; they bear to each other the relation of cause and effect; the present configuration of the material universe is the logical sequence of the one preceding, and a clear understanding of it would enable us to predict the one to follow. The caprice of a *Deus ex machina* gives way to the uniformity of nature, and science becomes something more than mental gymnastics. Knowledge of the past enables us not only to understand the present, but also to predict the future, and to order our lives accordingly. If God made and now controls the universe, then evolution merely describes His method of work. We know that He does not play tricks with us. He has not made us to mock us. The universe is the revelation of himself, and our intellects were meant for something more than blind belief.

This, in brief, is evolution. Creation is not an act, but a process, and still in progress. Merely for purposes of convenience we may divide this process into two phases, inorganic evolution, and organic.

Now, it is quite superfluous to state here that the conception of inorganic evolution was old before Darwin was young. It began to take form in men's minds when Æolus and Boreas gave way to convection currents and barometric pressure, and when Aurora fled before the reality of axial rotation.

We make only a passing reference to the fact that the idea of evolution obtained among the ancient Greeks and Hindus, and even among the Algonquin Indians of North America, and recognize that its introduction into modern science dates from the proposal of the nebular hypothesis independently by Swedenborg and Kant, in the middle of the eighteenth century, and its further elaboration by La-Place fifty years later.

Thus the universe as a whole was properly launched, but the principle was not extended to the details of geological processes until the preliminary work of Hutton and Playfair and the publication of Lyell's epoch-making *Principles of Geology,* in 1830-33, established the notion of uniformitarianism. We see that the idea of inorganic evolution was thus carefully worked out by the time that Darwin was getting disgusted with the Greek and Latin classics, and also with geology, in Edinburgh University. We must seek for his contribution, then, in the realm of organic evolution. What the contribution was is not as self-evident as one, at first thought, might suppose.

Let us first endeavor clearly to state what is meant by the expression organic evolution.

If all organisms, living and extinct, plant and animal, including man, could be assembled in one place, it would be possible so to group them as to show their relationship to each other. A survey of the individuals thus grouped would disclose the fact of a gradual increase in complexity of organization throughout the ages, culminating in the dominating types of the present. A more careful observation would bring out the fact that no two individuals, however closely related, are exactly alike. In other words, we would recognize descent with modification.

The individuals would naturally fall into groups of successively higher orders. In sequence these would be Kingdom, Division, Class, Order, Family, Genus, Species, Variety. Under Genus would be grouped all those plants which might properly be referred to by the same non-scientific, or "common" name, for example, the oaks. Now, it is a significant fact that all "common" names of plants are *generic* names—rose, apple, primrose, willow, maple, etc., all refer to genera. Hereby hangs a tale.

Previous to the work of the great classifier, Linnæus, it was quite customary to refer to plants by only one scientific name, but the scientist used his Latin jargon and said, *Rosa, Malus, Salix, Acer,* instead of rose, apple, willow, maple. What did the systematist mean by *genus*? Precisely what the word implied, *kind.* For is it not clearly stated that, on the third "day of creation," "God said, let the earth bring forth grass, the herb yielding seed, and the fruit tree yielding fruit *after his kind*," i. e., after his genus (*"juxta genus suum"*)? Genera, therefore, were the units of creation, and this was the very general belief of systematists up to the time of Linnæus.

The critical observation of Linnæus, however, soon detected that the genus-group was composed of smaller subdivisions; thus,

for example, there was the Carolina-rose, the long-leaved willow, the sugar-maple, and Linnæus called them *Rosa Carolina, Salix longifolia, Acer saccharinum.*

It should not be inferred that Linnæus introduced the binomial nomenclature into science. No misconception is more widespread nor more erroneous. Herbals, with binomials employed throughout, were published a century before Linnæus. What Linnæus did was to recognize that the genus-group was far too large to express nature accurately. Genera could not be regarded as the lowest taxonomic units, and so he took the binomial method of naming, gave it precision, systematized it, and used it uniformly in naming plants and animals. The subdivisions of genera are called *species*, meaning *particular kind.* Then the species came to be regarded as God's immediate handiwork. Thus we see, if Darwin had written his *Origin* before Linnæus's time, either it would have been called the "Origin of Genera," or, if its present title had been given, the book would have attracted no more attention than the *Systema Natura* of Linnæus, and would have aroused not a particle of religious furor. What a salutary tonic and corrective it is continually to orient one's ideas and conceptions in the light of historical perspective! If De Vries had preceded Darwin and the theologians remained consistent, we would have had the battle waged over the question as to whether or not the garden-varieties of vegetables originated by a natural method or by special acts of divine interposition.

But, to return to the text, the work of Linnæus ultimately resulted in shifting theological attention from genera and focusing it upon species. The latter were now to be safeguarded from the onslaughts of materialism and infidelity. With genera and varieties we could do as we liked.

Now, so far as the system of the great Swede disclosed, he was entirely innocent of any concept of the kinship among either plants or animals. The basis of his classification was wholly artificial. God made the species. Those nearest alike, structurally, were placed in the same genus, plants having the same number of stamens in the same class, and those having the same number of pistils in the same order; but the idea of a genealogical tree for all living things was yet to be introduced into taxonomy.

The history of the development of this idea of descent is too long and too technical to be attempted here. It may be traced as an undercurrent back some four or five centuries before Christ, to Anaximander, and Empedocles. The latter is called by Osborne "the father of the evolution idea." But, notwithstanding the later

writings of St. Augustine, who definitely rejected the notion of special creation in favor of evolution, the works of Leibnitz and Kant, and the contributions of Erasmus Darwin, of Treviranus, of Lamarck, and of the author of the "Vestiges of the Creation," the great fact of descent remained largely a philosophical speculation. With Spencer, who elaborated the idea in 1852 in his essay on "The Development Hypothesis," it was only a deduction from *First Principles*. The establishment of its validity by direct appeal to the facts may be mentioned as the first and fundamental contribution of Darwin to evolution.

When the *Origin of Species* appeared in 1859 (only an abstract of a larger work, its author said), the scientific world was amazed at the breadth of observation, the wealth of facts, and the masterful way in which they were marshaled for the author's purpose. It was a triumph of inductive logic. In his pocket note-book for 1837, he wrote: "In July opened first note-book on transmutation of species. Had been greatly struck from about the month of previous March on character of South American fossils, and species on Galapagos Archipelago. These facts (especially latter) origin of all my views."

Erasmus Darwin, Goethe, Saint Hilaire, Treviranus, Lamarck, and Chambers, the probable author of the "Vestiges," all *believed* that species were not immutable and the products of special acts of creation, but the question was still debatable. A candid consideration of the evidence compiled by Darwin, however, made it practically impossible for any unprejudiced reader to reject the inference of derivation. The question was no longer debatable. Special creation is indeed thinkable, but there is not the slightest evidence for accepting it. Every living thing, so far as we have any evidence, originates by natural birth. The dicta, *omne vivum ex ovo, omne vivum e vivo* explain not only the origin of living things to-day, but also the derivation of the different kinds of living things. "Consistent uniformitarianism," said Huxley, "postulates evolution as much in the organic as in the inorganic world. The origin of a new species by other than ordinary agencies would be a vastly greater 'catastrophe' than any of those which Lyell successfully eliminated from sober geological speculation." Furthermore, while special creation is perfectly capable of producing the present order, it is not incapable of producing some other order. It cannot be proved to be the *vera causa* of the present order.

This, then, is Darwin's first contribution to organic evolution; he established the validity of the hypothesis of descent, namely, that,

in the words of the *Origin,* "the innumerable species, genera, and families of organic beings with which the world is peopled have all descended, each within its own class or group, from common parents, and have all been modified in the course of descent." (*Origin,* 1st ed., p. 457). This is the fundamental doctrine of the book.

The immediate success of the evolution idea, as set forth in the *Origin,* is often explained by the statement that the scientific world was ready for it. Darwin himself never concurred in this view. "I do not think," he says, "that this is strictly true, for I occasionally sounded not a few naturalists, and never happened to come across a single one who seemed to doubt about the permanence of species. Even Lyell and Hooker, though they would listen with interest to me, never seemed to agree. I tried once or twice to explain to able men what I meant by 'natural selection,' but signally failed. What I believe was strictly true is that innumerable well-observed facts were stored in the minds of naturalists ready to take their proper places as soon as any theory which would receive them was sufficiently explained."

There were exceptions, however, to Darwin's view. The question of origin had been raised by many investigators. Thus Huxley often discussed it with Spencer, and states that the latter failed to convince him, (1) because he offered no evidence in support of his views; (2) because he failed to demonstrate the adequacy of any known cause to produce transmutation. "That which we were looking for, and could not find," said Huxley, "was a hypothesis respecting the origin of known organic forms which assumed the operation of no causes but such as could be proved to be actually at work. We wanted, not to pin our faith to that or any other speculation, but to get hold of clear and definite conceptions which could be brought face to face with facts and have their validity tested. The *Origin* provided us with the working hypothesis we sought. Moreover, it did the immense service of freeing us forever from the dilemma. . . . Refuse to accept the creation hypothesis, and what have you to propose that can be accepted by any cautious reasoner? In 1857 I had no answer ready, and I do not think that any one else had. A year later we reproached ourselves with dullness for being perplexed with such an inquiry. My reflection, when I first made myself master of the central idea of the *Origin* was, 'How extremely stupid not to have thought of that!' I suppose that Columbus's companions said much the same thing when he made the egg stand on end. The facts of variability, of the struggle for existence, of adaptation to conditions, were notorious enough; but

none of us had suspected that the road to the heart of the species problem lay through them, until Darwin and Wallace dispelled the darkness, and the beacon-fire of the *Origin* guided the benighted."

Now, organic evolution has two natural subdivisions: First, the evolution of the individual; second, the evolution of the organic world taken as a whole. It was due to the influence of Harvey, that the conception, held centuries previously by Aristotle, of the formation of the individual by evolution (*Entwickelung*, development), in the modern sense of the term, was firmly established, and the doctrine of preformation permanently supplanted by that of epigenesis. In addition to this, there were the following "well-observed facts stored in the minds of naturalists ready," as Darwin said, "to take their proper places as soon as any theory which would receive them was sufficiently explained": (1) the observation of gradations in structure from simple to complex; (2) observation of the analogy between ontogeny and phylogeny, first clearly recognized by von Baer; (3) the observation of anatomical homologies; (4) the influence of environment; (5) the facts of geographical and geological distribution.

But antedating these, and more fundamental than they, was the elaboration, by Descartes, in 1637, of the idea that the universe, inorganic and organic, is a mechanism, and therefore explainable on the principles of physical science. This was the great intellectual besom that swept away the light-excluding cobwebs of theological speculation. Scientific progress and the confusion of final and efficient causes are mutually exclusive. The science of agriculture, for example, could never have developed so long as Ceres continued to satisfy men's craving for an explanation of the mysteries of crop-production. The great mathematician Leibnitz was unable to accept Newton's theory of gravitation because it appeared to substitute a physical force for the direct action of the Deity.

The elaboration, then, in the *Origin*, of the theory of natural selection as a causo-mechanical explanation of the method of descent found the scientific public well supplied with a fund of favorable apperceptive ideas. The establishment of this theory is Darwin's second contribution to evolution.

We have seen that Darwin did not discover the fact, so also, we cannot crown him as the discoverer of the method of evolution. Every one now clearly recognizes that there is probably more than one method; there are most certainly several factors in the process. One of these factors is natural selection, and natural selection is Darwinism.

Attention has just been called to the truth that the discovery of the fact of organic evolution was a triumph of inductive logic. "I worked on true Baconian principles," said Darwin in his Autobiography, "and without any theory collected facts on a wholesale scale." Now the discovery of natural selection was reached by an entirely different method. It was a triumph of deductive logic.

"I soon perceived," says Darwin, "that selection was the keystone of man's success in making useful races of animals and plants. But how selection could be applied to organisms living in a state of nature remained for some time a mystery to me.

"In October, 1838, that is, fifteen months after I had begun my systematic inquiry, I happened to read for amusement 'Malthus on Population,' and being well prepared to appreciate the struggle for existence which everywhere goes on from long-continued observation of the habits of animals and plants, it at once struck me that under these circumstances favorable variations would tend to be preserved, and unfavorable ones to be destroyed. The result of this would be the formation of new species. Here, then, I had at last got a theory by which to work."

But this idea of natural selection, more or less well defined, occurred to other men before Darwin. It was stated by Wells, in 1813, and still more clearly by Matthew, in 1831, as Darwin himself has pointed out. The writings of these men were not known to Darwin until sometime after the publication of the *Origin,* so that he was truly an independent discoverer of the idea, though not the first to propose it. Why, then, is it universally called Darwinism? For the same reason that mutation is associated by everybody with the name chiefly of Hugo de Vries. Darwinism made clear the survival of the fittest in the struggle for existence, but it did not explain the origin of the fittest. Several investigations from time to time suggested saltation, or discontinuous variation. Even Darwin himself considered the idea. But no one conceived the hypothesis so clearly, stated it so definitely, worked it out so carefully, illustrated it so fully, or showed its application so forcibly as did De Vries. So it was with Darwin. His conception of natural selection was clear and definite, his statement of it was positive and full, his demonstration of its adequacy as one factor of evolution compelled assent, his evidence was a wealth of fact that commanded, not only the attention, but the unbounded admiration of the scientific world. It was said of Voltaire, "He expressed everybody's thoughts better than anybody." This is what Darwin did with reference to the entire problem of organic evolution.

The poet Lowell has said:

> "Though old the thought, and oft express'd,
> 'Tis his at last who says it best."

For this reason we very properly call the theory of natural selection Darwinism. Darwin made it his own by expressing it better than anybody else. Nobody ever seriously proposed calling it Wellsism, Matthewism, Spencerism, nor even Wallaceism.

Thus, while in a very real sense the theory belongs to Darwin, I would not name the formulation of it as his second important contribution to evolution, but rather the fact that he compelled men's attention to the theory. Not only did he, like his predecessors, get the idea; the idea got him, and he forced the scientific world to reckon with his theory. He said, "I had at last got a theory by which *to work*." This was what all investigators recognized,—that they had a *working* hypothesis, the most powerful instrument of scientific research known to man. They could test it, they could interpret with it, they could predict by means of it, they could advance with it by rapid strides. It was one of the "clear and definite conceptions," for which Huxley and others were looking, and which Darwin showed could be "brought face to face with facts," and have its validity tested.

Furthermore, it appealed to scientists because it was the product of investigation. Other men had said, "See how plausible the hypothesis is." Darwin said, See how the hypothesis grows out of the facts, and agrees with the facts, and explains the facts. See also, said Darwin, the possibilities of research which it opens up. In his note-book of 1837 he wrote, "My theory would give zest to recent and fossil comparative anatomy. It would lead to study of instincts, heredity and mind heredity, whole metaphysics, it would lead to closest examination of hybridity and generation, causes of change in order to know what we have come from and to what we tend." And in the Conclusion to the *Origin* he wrote: "Much light will be thrown on the origin of man and his history."

Ay, but there's the rub! This last statement proved to be a bomb in dynamite. The orthodox looked on in the calmest unconcern so long as nothing but suns, and mountains, and fossil fishes, and plants were concerned, but when the baneful hypothesis began to stretch out its tentacles over the lords of creation, then it was high time for the Church militant to buckle on its armor. The declaration of war was made by Wilberforce, Bishop of Oxford, at the Oxford meeting of the British Association in 1860. The

Bishop spoke "for full half an hour with inimitable spirit, emptiness, and unfairness." "In a light, scoffing tone," says one who was there, "florid and fluent, he assured us there was nothing in the idea of evolution; rock-pigeons were what rock-pigeons had always been. Then turning to his antagonist with a smiling insolence, he begged to know, 'If anyone were to be willing to trace his descent through an ape as his *grandfather*, would he be willing to trace his descent similarly through his *grandmother*?'"

At this ungentlemanly remark Huxley turned to Sir Benjamin Brodie, who sat beside him, and, striking his hand on his knee, exclaimed, "The Lord hath delivered him into mine hands." The full import of this remark was not understood by Sir Benjamin until Huxley had finished his now famous rejoinder.

No one has ever agreed as to the exact words of Huxley's reply, but the substance of the last paragraph of it was: "I asserted—and I repeat—that a man has no reason to be ashamed of having an ape for his grandfather. If there were an ancestor whom I should feel ashamed in recalling, it would rather be a man—a man of restless and versatile intellect, who, not content with success in his own sphere of activity, plunges into scientific questions with which he has no real acquaintance, only to obscure them by an aimless rhetoric, and distract the attention of his hearers from the real point at issue by eloquent digressions and skilled appeals to religious prejudice."

The effect is described as tremendous. Ladies fainted and had to be carried out. But this tilt of words marks the beginning of the most thorough intellectual house-cleaning the world has ever known, and I regard the result of it as one of Darwin's greatest contributions, not only to evolution, but to the intellectual advancement of the world. It marked the end of any effective throttling of truth by ecclesiastical authority. Had it not been for this incubus, the idea of evolution might have been received in the 17th century, for Descartes clearly outlined it in 1637. This philosopher, however, was contemporary with Galileo who had just suffered the penalties of the Inquisition, and decided it were better, all things considered, to formally reject the idea, after taking several pages to elaborate it clearly!

The battle is not wholly won as yet, but scientific advancement is not likely to be again seriously handicapped by theological opposition. It is more and more clearly recognized that there cannot be any conflict between two truths.

The philosophical aspect of Darwin's work is apt to obscure

the very feature that won attention and confidence in his ideas; namely, the prodigious body of fact upon which the hypotheses were based. No other author ever approached him in his grasp of biological data.

"....it is the very hardest book to read, to full profit, that I ever tried—it is so cram-full of matter and reasoning," wrote Hooker to Darwin in 1859. Asa Gray wrote him in 1860, "I do not think twenty years too much time to produce such a book in....I am free to say that I never learnt so much from one book as I have from yours."

His grasp of the facts of plant and animal life was encyclopedic, covering taxonomy, morphology, comparative anatomy and physiology, animal psychology, paleontology, anthropology, geology, and regional biology. Moreover, the greater part of this information was first-hand knowledge. Herbert Spencer's grasp of human thought is the admiration of every thinker. The author of the *Origin* wrote of him; "I could bear, and rather enjoy feeling, that he was twice as ingenious and clever as myself, but when I feel that he is about a dozen times my superior....I feel aggrieved"; but he adds, "If he had trained himself to observe more, even if at the expense...of some loss of thinking power, he would have been a wonderful man." Practically all of his knowledge was obtained at second hand. Darwin's facts came direct from nature, "fresh, buoyant, exact." This body of fact I consider not the least of the great philosopher's contributions to evolution.

To summarize: Evolution is indebted to Charles Darwin for demonstrating the fact of descent; for advancing an adequate working hypothesis in such a manner as to command the respect and attention of the scientific world and set them to work with it; for precipitating a decisive battle between dogma and the search for truth; for contributing a body of information unequaled in the whole range of biological science. It cannot be too greatly emphasized that he set men at work as never before, and with a definiteness of purpose hitherto unequaled. He unified knowledge by infusing vitality into a unifying principle, gave direction to the entire reach of human thought, and completely changed the character and content of post-Darwinian science.

What is Darwinism? The theory of natural selection. Yes, but to define it completely would necessitate a catalogue of practically everything that has been published, not only in biology, but in physics, in chemistry, in geology, in astronomy, in psychology, and in social and political science, since 1859.