PALEONTOLOGY

Cuvier on the Value of Fossils

"A Classic of Science"

The Great Naturalist Who Died Just a Century Ago Was One of the First to Use Fossils to Date Rock Deposits

A DISCOURSE ON THE REVOLUTIONS OF THE SURFACE OF THE GLOBE, and the Changes Thereby Produced in the Animal Kingdom. By Baron G. Cuvier, Translated from the French. London: Whittaker, Treacher, and Arnot, 1829.

IN MY WORK on Fossil Remains, I proposed to determine to what animals those fragments of bones should be assigned which occupy the superficial strata of the globe. It was attempting to traverse the whole of a region of which as yet the first approaches were scarcely known. An antiquary of a new stamp, it was necessary at the same time to restore these monuments of past revolutions, and to detect their meaning: I had to collect and arrange in their original order the component relics; to re-model the creatures to whom the fragments belonged; to reproduce them in their just proportions and with their proper characteristics; and then to compare them with those beings now existing:—an art almost unknown, and which implies a science scarcely before even glanced at,—that of the laws which preside at the co-existence of the forms of the various parts of organized beings. For such an attempt it was necessary to prepare myself by long and indefatigable researches into the structure of living animals; by a survey of nearly the whole mass of created beings now existing, which alone could lead me to a certain and determinate result in my speculations on the ancient creation: this would at the same time afford me a great result of rules, and affinities not less useful, and the whole animal kingdom would thus, in some measure, beome subjected to new laws, resulting from this essay on a small portion of the theory of the earth.

I was supported in my twofold labours by the interest which it seemed to evince both for anatomy, the essential basis of all those sciences which treat of organized bodies; and for the physical history of the globe, the foundation of mineralogy, of geography, and, we may say, of the history of man, and of all which it most imports him to know in relation to himself.

If we are interested in tracing out the nearly effaced vestiges of the infancy of our species, in so many nations utterly extinct, why should we not seek to discover, in the obscurity which envelopes the infancy of the earth, relics of revolutions long anterior to the existence of all nations? We admire that power of the human mind, the exercise of which has enabled us to ascertain those motions of the planets, which Nature seemed for ever to have held from us; genius and science have soared beyond the limits of space; some observations, developed by reason, have detected the mechanism of the world. Would it not be some renown for a man, in like manner, to penetrate beyond the limits of time, and to discover, by research and reflexion, the history of this world, and of a succession of events which preceded the birth of the human race?

Astronomers have advanced in science more rapidly than naturalists; and the present state of the theory of the earth somewhat resembles that of the period when certain philosophers believed heaven to be formed of polished freestone, and the moon in size like the Peloponnesus; but, after Anaxagoras, have arisen Copernicus and Kepler, who paved the way for a Newton; and why should not natural history one day boast also of her Newton? . . .

Progress of Mineral Geology

In truth, the mineral portion of the great problem of the theory of the earth has been studied with admirable care by Saussure, and brought to a wonderful development by Werner, and by the numerous and talented disciples of his school.

The former of these celebrated men, scrutinising with indefatigable toil for twenty years the most inaccessible mountainous districts, in a manner attacking the Alps themselves in every direction,

Baron Georges Léopold Chrétien Fréderic Dagobert Cuvier, 1769-1832.

in every defile, has laid open to us all the confusion of the primitive formations, and has clearly traced the secondary formations. The latter, availing himself of the numerous excavations made in countries containing the oldest mines, has fixed the laws relating to the succession of layers; he has pointed out their relative antiquity, and traced each through its respective change. It is he, and he only, who has given a date to geology, as far as regards the mineral nature of the layers; but neither Saussure nor Werner have determined the fossilized organized species in each sort of layer, with that necessary exactness which is so requisite, from the prodigious number of known animals which they contain.

Other men of science indeed studied the fossil relics of organized bodies; they collected and published drawings of them by thousands; their works will be valuable collections of materials; but, more engrossed with animals of plants, considered as such, than with the theory of the earth, or, regarding these petrifactions or fossils as curiosities rather than historical documents, or, in truth, contenting themselves with partial explanations on the relative bearings of each relic, they have almost always neg-

lected to seek for the general laws of position, or the relation of fossils with the layers.

Importance of Fossils in Geology

And yet the idea of such a research was very natural. How was it overlooked that it is to fossils alone that must be attributed the birth of the theory of the earth; that, without them we could never have surmised that these were successive epochs in the formation of the globe, and a series of different operations? Indeed they alone prove that the globe has not always had the same crust, by the certainty of the fact that they must have existed at the surface before they were buried in the depths where they are now found. It is only by analogy that we extend to primitive formations that conclusion which fossils enable us definitively to ascribe to secondary formations; and if there were only formations without fossils, no one could prove that these formations were not simultaneously produced.

Again, it is to fossils, small as has been our acquaintance with them, that we owe the little knowledge we have attained respecting the nature of the revolutions of the globe. They have taught us, that the layers which comprise them have been undisturbedly deposited in a liquid; that their alterations have corresponded with those of the liquid; that their exposure was occasioned by the removal of this liquid; that these exposures have taken place more than once. None of these facts could have been decided on without these fossils.

The study of the mineral portion of geology, which is not less necessary, which is even of still greater utility with regard to the mechanical arts, is yet much less instructive with relation to the object of which we are treating.

We are in positive ignorance regarding the causes which can have produced the changes of the substances composing the layers; we do not even know the agents which could have held certain of them in solution; and it is yet a matter of controversy, whether certain of them owe their origin to water or fire.

To come at once to the point, we observe that there is a general agreement on one point only; namely, that the sea has changed its situation. And how should we know that if we had no fossils?

Fossils, which have given birth to the theory of the earth, have also furnished it with its principal lights, the only ones which have been generally recognized down to the present period.

It is this idea which has encouraged us to take up the subject; but the field is immense; a single person could only glance over but a very trifling part. A choice was to be made therefore, and we did not hesitate. The class of fossils which forms the object of this work at once determined us, because we saw that it is at the same time more pregnant with precise results, and yet less known and more rich in novel matters of research.

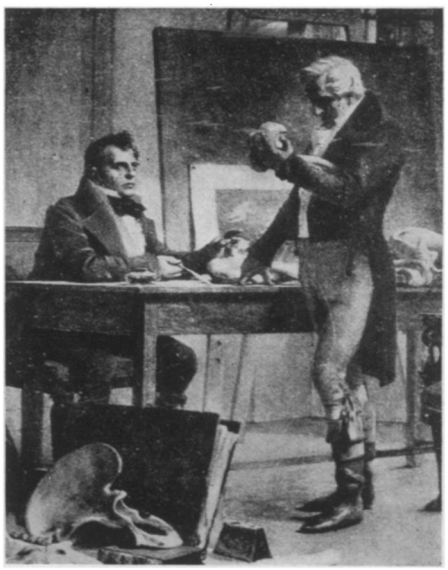
Paramount Importance of the Fossil Bones of Quadrupeds

It is apparent, that the bones of quadrupeds conduct us, by various reasonings, to more precise results than any other relics of organized bodies.

In the first place, they characterize more clearly the revolutions which have effected them. Shells prove that the sea was once where they are now found; but their change of species could only at the utmost proceed from slight variations in the nature of the liquid or merely its temperature.

They might have had relation to causes still more accidental. There is nothing to assure us that at the bottom of the sea, certain species, even certain genera, after having occupied for a larger or shorter period determinate situations, have not been forced away by others. Here, on the contrary, all is precise; the appearance of the bones of quadrupeds, particularly the whole carcases in the layers, betokens either that the layer itself which contains them was formerly dry land, or that there was terra firma in its immediate vicinity. Their disappearance renders it certain that this layer was inundated, or that this dry land ceased to exist. It is then by these that we learn in a positive manner the important fact of the repeated irruptions of the sea, with which shells and other marine productions could not have made us acquainted; it is by studying them profoundly that we may hope to ascertain the numbers and periods of these irruptions.

Secondly, the nature of the revolutions which have altered the surface of the globe must have exercised a more entire action over terrestrial quadrupeds than marine animals. As these revolutions have in a great measure consisted in changes of the bed of the sea, and the waters must have destroyed all the quadrupeds which they reached, if the irruption were general, the whole class must have perished; or, if only operating on certain continents, it must have destroyed at least the species peculiar to these continents, without exercising the same influence upon marine animals. On the contrary, millions of aquatic individuals might have been left on dry land, or buried under new layers, or thrown with violence on the shore, and their race be still preserved in some places more tranquil, where it might again be propagated after the disturbance of the waters had ceased.



CUVIER COMPARING FOSSILS
—from a painting by Chartran in the Sorbonne in Paris

Thirdly, this action, as more complete, is more easily seized on; it is more easy to demonstrate its effects, because, the number of quadrupeds being limited, the greater part of their species, at least of the larger kind, being known, we have still further means afforded us of ascertaining whether the fossil bones belong to one of them, or if they formed a part of a species now extinct. As we are, on the contrary, very far from knowing all the marine testacea and sea fish; as we are probably ignorant yet of the greater part which are in the depths of the ocean, it is impossible to know with certainty if a species found fossilized be or be not extinct. Thus we observe learned men obstinately bent on giving the name of pelagian shells, that is, shells of the deep sea, to belemnites, to cornua-ammonis, and other shelly relics, which have as yet only been ob-

served in ancient layers; meaning by that, that if they have not been yet found in a living state, it is because they inhabit depths beyond the reach of our nets.

Certainly naturalists have not yet traversed every continent, and do not even know all the quadrupeds which inhabit the countries over which they have traveled. New species of this class are from time to time discovered; and those who have not attentively examined all the circumstances of these discoveries, might believe also that the unknown quadrupeds whose bones are found in our layers have remained concealed to the present time in some islands not yet discovered, or in some of the vast deserts which occupy the middle of Asia, Africa, the two Americas, and New Holland.

However, if we examine what species of quadrupeds have been recently found, and in what circumstances they have been discovered, we shall see that there is but little hope of ever finding those that we have only seen as fossils.

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(From Page 177)

The mounting of the McDonald telescope will be similar to that of the 72-inch reflector at Victoria, B. C., and the 69-inch at the Perkins Observatory, Delaware, Ohio, with a long axis in the north and south line, supported between two concrete piers, and inclined at an angle equal to the latitude of the observatory. This turns from east to west once a day to compensate for the motion of the earth. Another axis at right angles to this, and supported in its middle, permits the instrument to move in a north and south direction. The new instrument will differ from those at Victoria and Delaware, however, in that it will be possible to bring the starlight, concentrated by the telescope, into a closed room of constant temperature where it can be analyzed by spectroscopes and other instruments capable of use only in a physical laboratory. Such instruments cannot ordinarily be attached to the moving end of a telescope. A similar arrangement is possible with the two great telescopes at Mt. Wilson.

Dr. Struve has listed the following problems which the new telescope is expected to attack:

The study of the chemical composition of the atmosphere of the stars.

The study of the properties of matter exposed to temperatures ranging from 3,000 to 50,000 degrees or more.

The study of distant universes, which involves a test of the Einstein theory.

The study of the composition of gaseous nebulae, of comets, planets. etc.

The new observatory is made possible by the bequest of the late William J. McDonald of Paris, Texas, who died in 1926 and left to the University of Texas a fund now slightly in excess of $840,000 for an astronomical observatory. The University of Texas will own the McDonald Observatory but the University of Chicago will provide the staff. Its program will be coordinated with that of the present Yerkes Observatory.

Science News Letter, September 17, 1932

SEISMOLOGY

Colima Earthquake Located Off Mexican West Coast

THE EARTHQUAKE that shook the city of Colima, Mexico, on Wednesday evening, Sept. 7, originated at sea a short distance off the coast, the U. S. Coast and Geodetic Survey stated after examining reports from seismological observatories transmitted through Science Service. The epicenter was in latitude 18 degrees north, longitude 105 degrees west. Time of origin was 8:41 p. m. eastern standard time.

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Two complete test laboratories, applying the most up-to-date methods of grocery store management, are being set up in Philadelphia by the grocery trade interests of the city in cooperation with the U. S. Commerce Department.