ing of the demonstratives, as I intend ultimately to develop certain doctrines of language most clearly brought out by them.

Since writing the above the managing editor of this journal has kindly forwarded the proof sheets of Prof. Fullerton's article, about which I beg to be indulged in a brief statement.

In my first paper it will be seen that I did not attempt to demonstrate anything; for I said: "In the following chapters an attempt will be made to show that we know much about matter, and although we do not know all, all we know is about matter in its categories of number, extension, motion, duration and judgment, or that we know of matter in its four categories and that we know of mind in the categories of judgment, but always this mind is associated with matter. In doing this we shall endeavor to discriminate between the certitudes and illusions current in human opinion."

I merely attempted to explain the nature of the problems which I designed to discuss and to show that these problems are fundamental to metaphysic and to science alike. To indicate that there are two views of these problems—the metaphysical view and the scientific view—I shall attempt to set forth a series of certitudes and another series of illusions which relate to these certitudes. If I prosper in my demonstration I shall show that the certitudes come from science and that the illusions come from metaphysic. Now it must be understood that metaphysic does not deal wholly with illusions but that fundamental illusions are developed by metaphysical reasoning, and I shall further show that science attempts to deal with certitudes, but often fails by adopting the method of metaphysic and still oftener adopts its illusions. The illusions which I shall attempt to explain will be chiefly illusions of metaphysic, but they will also be illusions of science, because science has not wholly divested itself of metaphysical reasoning. The certitudes which I shall attempt to demonstrate I shall hold myself ready to maintain until my errors are shown; if such errors are demonstrated I shall promptly confess and eschew. I do not know that the man who has published can fully assume this attitude, for in a long life of scientific reading I have discovered that publication is wax in the ears and thus a source of profound deafness to the voice of reason. If Prof. Fullerton will kindly attend to the propositions I shall attempt to demonstrate, he will be able to put me right where I am wrong, and I hope that he will be able to reinforce my certitudes by firmer rings of reasoning.

Professor Fullerton seems to be surprised and agrieved that an anthropologist should express opinions concerning metaphysic. The Professor may be interested to know that anthropology includes metaphysic as one of its themes of study for the purpose of discovering its certitudes and illusions and it sometimes finds in its ancient asphodel fields phantom flowers that turn to ashes when plucked by the hand of science.

J. W. POWELL.

SCIENTIFIC LITERATURE.

Geological Biology; an introduction to the geological history of organisms. By HENRY SHALER WILLIAMS. New York, Henry Holt, 1895. xx+395, pp. 8°. Illustrated.

Prof. Williams tells us that this book was originally written in the form of lectures delivered at Cornell University, which have been rewritten and elaborated so as to be available for use as a text-book as well as an exposition of principles. It has been prepared with a view to its use not only by students, but also the general reader "who is supposed to know something of the present popular theories regarding organic life, and has, perhaps, already become aware of the increasing sense of disappointment which those are meeting who have attempted seriously to apply them to the solutions of the problems of human life." It is not assumed that the reader has any special knowledge of biology or geology, and therefore many details are entered upon which would be superfluous for the specialist. "In defining our topic as geological biology we are not proposing to investigate the anatomical organs and tissues of which particular animals are made, but to review the facts and theories which have led to the belief that each living animal and plant is but the last of a long line of organisms whose remains can be recognized in more or less perfect fossils and whose varying characters can be traced back into the

immense antiquity of geological time" (p. 3). "The history of organisms which we particularly trace in the study of fossils is not the history of imperfect organisms struggling toward perfection, but it is the history for each age and epoch of the perfected adjustment of the organisms of the time to the particular conditions of environment in which they lived. They did not die before their time, overcome by the mythical fittest who are said to survive in the struggle. They were the fittest and died natural deaths, having provided, before they gave up the struggle for their progeny, to succeed them. The hard parts record the history of adults which had endured the struggle, and thus represent the royal line of succession for the geological ages" (p. 81).

The book opens with a discussion of the history of organisms and its geological aspect. The second chapter gives an excellent and interesting summary of the history of geology, which is followed by a discussion of the geological time-scale, and of the nature, nomenclature and fossil contents of stratified rocks, geographical distribution, the nature and origin of species, the acquirement of characters, intrinsic and extrinsic, their plasticity and permanency. The rate of morphological differentiation and progressive modification are considered at length and illustrated by the history of selected types. The final chapters treat of the laws of evolution as illustrated by the geologic history of organisms and the philosophical conclusions drawn therefrom.

The author concludes that "the Animal Kingdom is divisible into a number of definite groups marked by definite organization, all the grander features of which were outlined in the Cambrian age, and the large majority of all the differentiations of even ordinal rank had been accomplished in the first quarter of the recorded history of organisms," hence the laws of evolutional history must be read in terms of the minor groups. As emphasized by fossils these laws include an orderly succession of increasing differentiations in organic structure which we call evolution; certain parts of each organism exhibit the progress of evolution more rapidly than other parts, the characters of least structural importance showing the most constant and steady but slow differentiation, while the characteristics of higher rank are relatively more rapid in their initial development and subsequently very constant in each successive generation. These two tendencies are expressive of the two fundamental laws of heredity and variability, and the process of evolution is the combined result of their interaction. The mode of evolution consists in the acquirement of new characters by variation and in the acceleration or retardation of development of characters already required. The causes of evolution are extrinsic or intrinsic, the former being of the nature of an adjustment to the environment direct or selective; the latter "acts previous to the individual birth and seems to be at the foundation of variability. The mode and manner of expression of this kind of evolution are more difficult to define than in the case of extrinsic evolution, but the facts of paleontology clearly indicate that such a cause exists prior to the morphological appearance of each individual and species" (pp. 369–70).

"The great facts attested by geology," according to Prof. Williams, "are that the grander and more radical divergencies of structure were earliest attained; that, as time has advanced, in each line intrinsic evolution has been confined to the acquirement of less and less important characters; such facts emphasize with overwhelming force the conclusion that the march of the evolution has been the expression of a general law of organic nature in which events have occurred in regular order, with a beginning, a normal order of succession, a limit to each stage, and in which the whole organic kingdom has been mutually correlated. * * * So were we to lengthen out the gyration of organic plastidules or biophores, a million million years, continuously holding on to their original powers and potencies for all that time, we are not relieved in the least from the logical necessity of endowing them at the outset with the real directive energy which phenomenally expresses itself for the first time when the finally adjusted organism appears. And the increment to organic structure expressed by their final bursting into morphological reality after travelling unobserved but potential through the organic matter of countless generations is as

much a result of creative energy as if a new species were to arise out of the dust of the earth" (pp. 380–382).

It is of course almost impracticable by means of isolated paragraphs to give any adequate impression of a whole volume of observation and discussion with a wealth of varied illustration. But we shall not go far astray, perhaps, in summing up Prof. Williams' attractive book as in great part a restatement, in terms of evolution, of the argument for design in nature.

W. H. D.

WINGE ON BRAZILIAN CARNIVORA.

IN a recently published quarto of 103 pages* Mr. Herluf Winge gives the results of his studies of the extensive collections of Carnivora made near Lagoa Santa, province of Minas Geraes, southeastern Brazil, by Lund, Reinhardt and Warming, and now in the Zoölogical Museum at Copenhagen. The material thus brought together owes its peculiar interest to the fact that it consists partly of the remains of living animals and partly of bones and teeth from the earth deposits of the caves with which the region abounds. It is thus possible to compare the present fauna with the extinct fauna of which it is the immediate successor. As the author remarks (p. 79), the South American fauna is poorer in Carnivora than that of any other region except Australia. The latter was, however, probably isolated before the appearance of the order. While Lagoa Santa is, for a South American locality, remarkably well provided with Carnivora,† the group is represented by only four families, ten genera and twenty-five species. These the author arranges as follows:

FELIDÆ: *Felis tigrina*, *F. macroura*, *F. eira*, *F. concolor*, *F. onca*, *Machærodus neogæus*.

URSIDÆ: *Canis azaræ*, *C. vetulus*, *C. cancrivorus*, *C. jubatus*, *C. troglodytes*, *Icticyon pacivorus*, *I. venaticus*, *Ursus brasiliensis*, *U. bonariensis*.

PROCYONIDÆ: *Nasua narica*, *Procyon ursinus*, *P. cancrivorus*.

MUSTELIDÆ: *Galictis barbara*, *G. intermedia* (= *G. allamandi*), *G. vittata*, *Thiosmus suffocans* (= *Conepatus mapurito*), *Lutra platensis* (= *L. paranensis*), *L. brasiliensis*.

Twenty-three of these are found in the cave deposits ('jordfundne'), while eighteen are found living in the vicinity ('nulevende'). Two species, *Procyon cancrivorus* and *Lutra brasiliensis*, now occurring near Lagoa Santa, have not yet been detected among the cave remains. As the author remarks, however, this can scarcely be taken as evidence that the animals have recently appeared in the region. Among the Carnivora whose remains are found in the caves are six extinct species, and one, *Canis azaræ*, which though now widely distributed through South America, has not yet been taken at Lagoa Santa. The extinct species are *Machærodus neogæus*, *Canis troglodytes*, *Icticyon pacivorus*, *Ursus brasiliensis*, *U. bonariensis* and *Procyon ursinus*. *Machærodus neogæus* is one of the most highly developed as well as one of the largest members of its genus. It is also one of those which have most recently become extinct. The Copenhagen museum contains numerous remains of this animal from La Plata. These, however, do not differ from the Lagoa Santa bones in any essential way. The two closely related bears, *Ursus brasiliensis* and *U. bonariensis*, are in some respects more primitive in structure than other species of *Ursus*. They form, together with *Ursus simus*, a section or subgenus which is extinct, and as yet is known from South America and California only.*

Icticyon pacivorus is closely related to the recent *I. venaticus*. It is more primitive than the latter, of which it appears to be the direct ancestor. *Canis troglodytes*, also one of the extinct species, has much the same general form as the Old World *C. alpinus*. A detailed study of its

* Jordfundne og nulevende Rovdyr (Carnivora) fra Lagoa Santa, Minas Geraes, Brasilien. Med Udsigt over Rovdyrenes indbyrdes Slægtskab. Af Herluf Winge. Aftryk af 'E. Museo Lundii,' en Samling af Afhandlinger om de i Brasiliens Knoglehuler af Professor Dr. P. W. Lund udgravede Dyre og Menneskeknogler. Paa Carlsbergfondets Bekostning udgivet ved Professor Dr. C. F. Lütken, Kjöbenhavn, 1895.

† *Bassaricyon*, *Cercoleptes*, *Lyncodon* and *Mustela* are the only genera, except perhaps a few now extinct, known to occur in South America, that have not yet been detected there.

*See Cope, American Naturalist, XIII., p. 791, 1879, and ibid., XXV., p. 997-999, pl. XXI., 1891.