JOHN CAMPBELL MERRIAM AS SCIENTIST AND PHILOSOPHER

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THE development of a man's philosophy when seen in the light of his past labor and experience frequently irradiates the process of thought itself and defines more clearly the contribution that is made in a search for the ultimate values of life. When one examines the writings of John Campbell Merriam the conclusion is inevitable that the richness and æsthetic qualities of his later contributions are the products of research and teaching in which human values have ever maintained an important place. To those who believe that a devotion to science and to its rigorous demands in the realm of thought presages a satisfactory approach to philosophy, it is stimulating and enlightening to trace the intellectual development of a great contributor to science.

Merriam's interest in the historical aspects of the geological sciences was evidently aroused at an early age, but the decision to make geology his chosen field for study, contemplation, and teaching formulated itself more definitely on completion of his undergraduate work at Lenox College, Iowa. His decision to come to the University of California in the late 'eighties and early 'nineties to study under Joseph LeConte emphasizes his growing desire and purpose, for Professor LeConte had become well known through his teachings and books as a scholar steeped in the lore of earth history. During his first period of residence at the University Merriam not only devoted himself to geological studies and served as assistant in mineralogy, but his range of interests included also the field of natural history. Under Professor E. L. Greene he was to acquire a foundation and sustaining interest in botany, which, as we shall see, became of considerable value and assistance to him in his later career as scientist and philosopher. Like many students of that day, Merriam took his doctorate abroad. At the Uni-

versity of Munich, under Professor Karl A. von Zittel, he selected palæontology as his major field of inquiry and wrote his dissertation "Ueber die Pythonomorphen der Kansas-Kreide," receiving his degree in 1893. Thus, a study of Cretaceous mosasaurs became a fortunate choice, for it permitted Merriam to obtain an acquaintance with the morphologic details of living and fossil reptiles, acquiring thereby a fund of information upon which he was to draw later in his study of the Triassic Ichthyosauria and Thalattosauria.

Although his doctorate was in vertebrate palæontology, Merriam had by this time acquired a very broad training in the geological sciences. On his return to the University of California in 1894 he was for some years occupied with both the invertebrate and vertebrate branches of palæontology. Between 1896 and 1899 he published six papers describing Tertiary molluscan faunas from Vancouver Island and discussing the geologic relations of the Martinez Group of California. His papers on the Tertiary echinoids of California remain perhaps his most significant contribution to invertebrate palæontology, for they laid the foundation on which important phylogenetic and stratigraphic studies were based by later investigators. Merriam was among the first to appreciate the significance of evolutionary changes in Tertiary echinoids, and especially their utilization in the recognition of horizon markers of value in an age determination and correlation of deposits in which these fossils are found.

In the course of his researches Merriam was frequently called upon to make identifications of fossil organisms encountered in Tertiary deposits exposed in the vicinity of San Francisco Bay. This led to an active cooperation with Professor A. C. Lawson in the study of the fossiliferous formations of the Concord quadrangle and in the unraveling of the geological history of that area. His first description of a fossil mammal from the California Tertiary was a result of this geological study. Prior to this description, he had already noted in print the occurrence of ichthyosaur remains in northern California, brought to his attention by the late James Perrin Smith. It was not until six years later, however, that he began to make available the results of his studies on this group of marine reptiles, and thence followed a series of papers which culminated in his great memoir on the Triassic Ichthyosauria, published in 1908.

This monograph treats not only of the geologic and geographic occurrences as well as of the morphological characters and taxonomy of the several types of Triassic ichthyosaurs known from America, but it also discusses succinctly the relationships of the Triassic types of western North America and the significance of these forms with regard to fundamental problems presented by higher vertebrates evolving under a marine environment. The development of the Ichthyosauria from antecedent land reptiles is generally accepted, but in the discussion of some factors involved in the evolution of the ichthyosaurs Merriam expresses clearly his palæontological point of view with regard to variation and environment. Thus, to quote from Merriam:

> The plasticity, or the greatest variation, in ichthyosaurs has appeared in those portions of the skeletal structure which stood in the most immediate relation to their environment, and could be most easily modified by changes in habits, food, or any variation in the elements of their surroundings. The most variable portions of the skeleton are probably the paddles and the caudal fin. In many of the principal characters of the cranial region of the skull a most remarkable conservatism is shown; only in the form of the rostrum and in the nature of the orbit do we find variation comparable to that of the limbs. The significance of the location of the centers of greatest variation seems to be that the variation is to a great extent determined by the peculiar relation of the animal to its environment, and in those centers where no distinctly important relation of this nature exists variation has been insignificant.

And again:

> The extent of the changes required in the accommodation of all ichthyosaurians, whenever and wherever they have existed, to those simpler features of aquatic life which are the same in all periods and in all places, may be responsible in a large measure for the generally similar trend of evolution.
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> In this connection we naturally enquire why it was necessary for the Ichthyosauria to leave their original environment, for surroundings in which an entirely different equipment was necessary. The only explanation which offers itself suggests a possible change of food habits, through the discovery that certain of the thriving cephalopod groups of the early Mesozoic furnished an abundant and easily obtained food supply. Even in the most favorable light, however, the problem of definite variation in the Ichthyosauria in some of its aspects seems to invite a resort to orthogenesis; or to the view that there are factors influencing variation which are not as yet understood, and that these tendencies to similar variation may express themselves in related groups for long periods, and in regions widely separated geographically.

In passing it would be well to emphasize the difficulties inherent in this research on the ichthyosaurs. Only those who have had experience with the type of preservation of fossil remains encountered in the Triassic limestones of northern California can fully appreciate the tedious and painstaking application required in the identification of skeletal parts whose outlines are often well-nigh obliterated by long entombment of the fossil in the rock. Probably no other single palæontological contribution by Merriam is as formidable and as valuable in its documented record of an extinct group of organisms as this work on Triassic ichthyosaurs. The scope of the memoir makes it indispensable to future students of this great group of marine reptiles.

Contact with the intriguing problem of aquatic adaptation among marine reptiles and knowledge of the presence of fossil whales in the marine Tertiary of the Pacific Coast led Merriam to recognize the great importance of extended research on the extinct Cetacea. A program of investigation in this fertile field was at one time projected by Merriam, but pressure of other matters never permitted him actually to engage in this study. In the capable hands of one of his students, Remington Kellogg, this research is yielding results of outstanding scientific value.

With the closing years of the nineteenth century we see the initiation of a field of inquiry by Merriam destined to become one of his major contributions to science. The John Day Basin, lying east of the Cascades in north central Oregon, had yielded one of the more important faunal horizons in the American Tertiary sequence when Merriam and his expeditions explored this region in 1899 and 1900. The rich vertebrate life recorded particularly in the John Day beds had been described by the eminent palæontologists Cope, Marsh, and Wortman, but in no previous work had the geologic relationships of the several fossiliferous horizons been adequately established. This was accomplished by Merriam in his paper on the geology of the John Day Basin, a contribution that has furnished the basis for all further geologic and palæontologic inquiry in this section of the northwest. Not only was the geologic history and the sequence of faunas established by Merriam in this paper, but his observations on the origin and deposition of the John Day sediments were among the earliest to cast serious doubt on the prevailing views then held as to the lacustrine origin

of many of the Tertiary deposits of the West. This enterprise was the first of many similar research projects that involved both field and laboratory investigations carried on by Merriam and in later years by his students under his guidance. Large portions of the Great Basin province of western North America were subjected to palæontological and geological inquiry with the result that many new Tertiary and Pleistocene vertebrate faunas were discovered.

In these studies Merriam frequently stressed the necessity of reading the geological story and the importance of determining the relation of a particular fragment of earth history to the account which might be rendered for a larger area. Thus, the investigations which were conducted by him in specific regions, as, for example, in the John Day Basin of Oregon, in the Thousand Creek and Virgin Valley basins of northwestern Nevada, or in the Mojave Desert area of southeastern California, to cite only a few, contributed important results to geology and palæontology. But as time and opportunity permitted these individual records of earth history were to be placed by Merriam and his associates in their proper time relations so that the broader correlations and generalizations might be realized in a recounting of the geological history for this great western region of the North American continent. We see here an early development of Merriam's views, expressed in later writings, wherein are unfolded the historical approach to problems, his constant desire to view the parts with regard to the whole, and his deep appreciation of time and movement in all change.

Merriam's studies in vertebrate palæontology were never dominated by a systematist's point of view. While he thoroughly appreciated and frequently availed himself of facts drawn from vertebrate zoology in an attempt to understand the biotic and physical environments under which fossil faunas lived, he was by no means content to describe fossil animals for the sake of recording only new species and genera. As a matter of fact a survey of his contributions to mammalian palæontology leaves the impression that he often conceded this privilege to others. His description of such forms was always undertaken with a view to making available data of value in geologic correlation, geographic distribution, or discussions of phylogeny. In his work on Tertiary mammals he seems seldom to have concerned himself with the central problems of evolution that have been of interest to palæozoologists. However, the

problems with which he was concerned were in large measure geologic and the fragmentary character of the palæontological material afforded little basis for a discussion of such questions.

Yet his contributions to what might be designated the broader biological aspects of palæontology possess considerable scope and significance. Merriam's discussion of the relationship of fossil forms often displays the operation of a keenly analytical mind intent upon weighing facts derived from fragmentary evidence. Alternate possibilities are frequently in the balance and final judgment is often deferred until more and better materials become available. On occasion the presentation of evidence in the consideration of a problem reminds one of a legal brief. Relatively few of Merriam's papers contain restorations of the extinct animals he describes, illustrating his caution in pushing fact to the point of conjecture. Seldom, if ever, do we encounter a tendency to extend the palæontological generalizations beyond the realm of observational fact into that of speculation. When, for example, the curious antelopine genera *Ilingoceros* and *Sphenophalos* were discovered in the Thousand Creek Pliocene of northwestern Nevada, with their presumed important zoo-geographic implications, Merriam's description of these forms included a statement of their possible relationship to the Old World strepsicerine or twisted-horned antelopes. Previous work had suggested the occurrence of a form with these Eurasiatic affinities elsewhere in the Pliocene in America, but Merriam carefully refrained from subscribing to a view other than that both in the Old World and in North America there were present during the later Tertiary antelopine forms with twisted horns. Subsequently, when he explored the problem further, he was able to demonstrate the relationship of one of these genera (*Sphenophalos*) to the antilocaprid stock. Merriam's views concerning the twisted-horned antelopes involved a consideration of possibilities. To quote from him:

> In the present state of our knowledge there seem three hypotheses open to account for the presence of the twisted-horned antelopes in the Thousand Creek fauna: (1) They are typical Old World tragelaphines which came into America in late Miocene or early Pliocene time and developed long-crowned molar teeth. (2) They are tragelaphine forms which originated in America from Merycodus-like ancestors at some time during the Miocene, and soon migrated to the Old World, leaving only few descendants here as late as the Thousand Creek epoch.

> (3) They are a peculiar twisted-horned division of the Antilocapridae originating in America and possibly limited to this continent.

He concludes:

> It would seem to the writer that with the evidence available we are not in a position to determine the affinities of the American twisted-horned antelopes with certainty. So far as can be determined they appear to be near the Antilocapridae, but they are evidently generically distinct from *Sphenophalos*. If, as seems probable, the only type of dentition known from the Thousand Creek Beds really represents this group along with *Sphenophalos*, these forms are probably derived with the Antilocapridae from some type like *Merycodus*, and are not closely related to the Old World strepsicerine forms. If teeth like those obtained by Matthew and Cook at Snake Creek belong to this group it may represent an immigration of typical Old World forms or might be derived from a Palaeomeryx-like American form.
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> With the available information it is probably desirable to refer *Ilingoceros* tentatively to a distinct family, the Ilingoceridae, and to include *Sphenophalos* in the Antilocapridae.

The occurrence of fossil mammalian assemblages in deposits intercalated in the sequence of marine sedimentary formations of the Coast Ranges of California furnished again a marvelous opportunity for the type of palæontological and geological investigation Merriam was particularly interested in. Furthermore, the problems of correlation presented here were of the utmost geologic interest since the position of these deposits offered for the first time an adequate basis for comparing the time relationships of the North American continental record of the later Tertiary with the marginal marine record of the Pacific Coast. Merriam's early broad training made him especially well fitted to consider this problem, which involved questions of vertebrate and invertebrate palæontology as well as of stratigraphy. His memoir on the "Tertiary Vertebrate Faunas of the North Coalinga Region of California," published in the *Transactions of the American Philosophical Society* in 1915, is a pivotal contribution wherein we note again his careful deductions from observed facts and his attempt to place this local history in its broader relationships.

With his knowledge of botany and as a result of his correlation studies in later years, Merriam was the first to recognize the significance of work in western palæobotany. Largely through his

own efforts a research program in Cenozoic palæobotany was undertaken by Dr. Ralph W. Chaney, and the contributions which have come from Dr. Chaney and his associates have clearly shown the wisdom of developing palæontological inquiry in this direction.

The early search for ichthyosaurs in the Triassic limestones of northern California contributed indirectly to a wholly different type of palæontological inquiry. Recalling that Cope had obtained some Pleistocene bear material from a limestone cave in this region during the 'seventies, Merriam asked his assistant E. L. Furlong to explore the area for cavern occurrences. With the aid of an Indian guide, Furlong rediscovered Potter Creek Cave, and thus was initiated the program of cave explorations conducted under Merriam's direction for a number of years. Before completion of the excavations at Potter Creek Cave, Furlong had uncovered another occurrence, Samwel Cave, and an account of the exploration of this site was given some years later by Merriam in his charming story, "The Cave of the Magic Pool." In the progress of this work the question of man's antiquity arose, since in these cave deposits human remains and cultural materials were encountered, sometimes in close proximity to skulls and skeletal parts of animals that are generally looked upon as characteristic of the Ice Age.

Soon the program was expanded to include additional sites in other parts of the state. W. J. Sinclair, who took his doctorate under Merriam, completed the exploration of Potter Creek Cave and described the Pleistocene fauna from this and from other cavern deposits. Sinclair likewise concerned himself with the occurrences of early man in cave deposits and in the auriferous gravels of the Sierra Nevada. He later became professor of geology at Princeton University. In the region of San Francisco Bay the ancient shell mounds bordering the bay, in some instances giving evidence of accumulation prior to the last period of subsidence of that area, were investigated by Max Uhle and N. C. Nelson under the direction of Merriam.

The study of early man became for Merriam an ever enlarging sphere of interest. He recognized at an early stage the appeal which the subject has to those not intimately acquainted with the facts of palæontology and geology. In a popular article published in 1910 and entitled "The True Story of the Calaveras Skull" he discussed one of the early finds of supposedly ancient man recorded

by J. D. Whitney from the Bret Harte country of the Sierra Nevada. This skull had attracted considerable attention because of assertions of its great antiquity by Whitney and others. The specimen itself gave definite evidence, however, of having come from some other deposit than that in which it was supposedly found. The probability that the Calaveras skull was a hoax, to confound the erudite if not wise professor who served as the second state geologist of California, may have been responsible, as Merriam notes in a later paper, for lack of credence in other occurrences of early man in America.

As a continuation of his interest in the problem of early man we note his statement published in 1910 on the relation of palæontology to the history of man, with particular reference to the American problem, presented in a symposium before the Society of Vertebrate Paleontologists. Here he called attention to the important part which palæontologists can take in the search for man's early records. His statement that "the results which must come are of great importance in the large problem of man's relation to nature" has been abundantly demonstrated by later research. It is not surprising to find, therefore, that when Merriam was asked to give the lectures in the William Ellery Hale Foundation before the National Academy of Sciences in 1918, he chose for the subject of his addresses: "The Beginnings of Human History Read from the Geological Record: The Emergence of Man." Here he reviews the palæontological evidence of man's origin and development in the changing environments of the geologic past and points to the need of appreciation of this background for proper understanding of the relationships of peoples in a modern world. He concludes with the statement:

> Man of the present day may read his story back to that early stage in which he first sees himself distinguished from the beast. He sees the beast made to a man-like beast and then a man. Perhaps to you the student of this ancient life has seemed to look upon a passing scene which might well have been left unknown —and yet to those who read what he who runs may see, the present world is brighter for the view—the future built upon the upward striving of the past must see the best there is in life at length prevail.

In more recent years Merriam reviewed the status of our knowledge concerning man's antiquity in America for the Sixteenth International Geological Congress and fostered a widespread attack

on the problem through facilities offered by the Carnegie Institution in cooperation with other educational agencies. In this, as in other inquiries, Merriam conceives greatest effectiveness in reaching conclusions to be derived by interplay of several minds whose approach to the problem is through individual experience.

A large share of Merriam's time in the study of the Quaternary and its life was devoted to an exploration of the famous asphalt deposits of Rancho La Brea and to a description of the unusual treasures of prehistoric life recorded in these beds. Although this occurrence was known and had been mentioned in the literature as far back as the 'seventies, interest in the accumulation lay dormant until Merriam aroused widespread attention by describing the many unusual features which characterize these deposits and their entombed life record. The program of study and investigation which he instituted continues with unabated vigor. Its value when measured in terms of research and of scholarly productiveness by himself and by others is manifestly of a high order. In addition, Rancho La Brea is provocative to the imagination and has great public appeal.

A desire to share the facts derived from his special studies with a larger group than that comprised by the votaries of his own science is revealed by his essays for the lay reader. In addition to those already mentioned are others that also concern projects with which he has had intimate acquaintance, as for example, the article on "The John Day Fossil Beds" in *Harper's Magazine*, a description of the Rancho La Brea occurrence published in *Sunset* magazine and *Harper's Weekly*, and the several papers published in *Popular Science Monthly*. In his "Significant Features in the History of Life on the Pacific Coast," Merriam briefly outlines the more important stages in the history of plants and animals found in the fossil record of the Pacific Coast. Showing maturity of thought and deeper reflection are the later articles that have appeared in *Scribner's Magazine* and been reprinted in "The Living Past."

The urge to write a text which comes to every energetic teacher in a rapidly advancing field of inquiry was early thrust aside by Merriam. In its place came a synopsis of his lectures in palæontology which presents the subject matter in concise form and treats this with full cognizance of the fact that palæontology is closely affiliated with both the geological and the biological sciences. The

synoptic treatment emphasizes Merriam's desire to have the student acquire knowledge not wholly by reading but by actual experience with the things as they are found in nature. And to Merriam experience implies contact with the outer world through as many sensory channels as one can marshal—certainly not that of sight alone.

It is not surprising, therefore, to find Merriam strongly advocating field as well as laboratory study and more particularly research. His energetic prosecution of the latter attracted a number of graduate students, especially from 1910 to the period of the World War, when he was in the full stride of his major scientific interest. His views concerning teaching and research are perhaps best expressed in his article on "The Function of Educational Institutions in Development of Research." Here he states:

> . . . the function of teaching in an educational institution does not concern alone the retailing of facts already assembled: it must include that kind of understanding of the subject which will prepare the student for his task as a leader in the future. To become such a leader that student must look beyond our present knowledge and experience with the expectation of accomplishing things which have never before been done. No good instructor can avoid recognizing this need of his students. No teacher who sees this requirement can fail to make a serious effort to determine the direction of advance in constructive use of his subject, if for nothing more than to point out to students the trend of the path and the preparation necessary for those by whom it will be extended to new fields of usefulness. It is hardly possible for the instructor to obtain a clear view of future development in his subject without intimate personal relation to the most advanced work in progress.

While he recognizes the value of the specialist in the acquisition of new knowledge, too much specialization often defeats its own end. The frontier posts in the advance of science are like salients developed along a battle front. From time to time these need to be consolidated, and only by an assimilation of the great and far-reaching discoveries by the masses, out of whom the great discoverers come, can we hope for an emancipation from wrong thinking and ignorance.

Merriam stresses on numerous occasions the need for a historical approach to our problems. As he remarks: "I am suggesting that the deepest view of history is desirable for purposes of most fundamental decisions; that, no matter how far back this vision leads us, if it continues to add to knowledge of what we are by showing us

how we came to be, it is desirable and should be secured." He feels that the student of the earth sciences is in better position than anyone else to see the true course of history through the ages. Not only that, but the student comes to recognize the two great mobile elements in it, namely the earth itself and the stream of life which flows over it in time. Thus the earth sciences form, indeed, the background of history.

It is quite clear that Merriam's contributions to philosophic thought are the direct outgrowth of his work in science. They are the outcome of research and teaching in which human values have helped in the selection of those materials vital to teaching. He brings also a fundamental training in religion acquired in his youth, which with the passing of the years knows neither creed nor dogma. There is for him no conflict between religion and science, but both are essential to his philosophy of life. A long contact with the historical record, both physical and organic, convinces him that growth or evolution in the world is a continuing process. In this light, man and the world about him are the result of a long series of changes through the geological ages in which the present is merely one stage superimposed upon innumerable antecedent stages of the past. To him, the immeasurably long road over which this growth has come is in itself a certain assurance that evolution will not cease now but will continue into the future. The opposite view is as inconceivable as would be a concept that the earth, which has shown great change in the past, should forego all change in the future. And Merriam holds no brief for a world that is running down at the present time.

Unless some extraordinary forces appear, such as we have never been cognizant of before in the history of the world, it is inconceivable that the laws which lie behind the changes in the past will not also be operative in the future.

As Merriam passes in kaleidoscopic review this picture of the past he is particularly impressed by the reality of the story. It matters not that the evidence at times is fragmentary. The impress of feet in stone left ages ago, a leaf or a bone from strata formed in the geologic past mean to him the presence of once living organisms. More than that, they reveal an omnipotent creative force that has carried what we call life to higher and higher stages with the passing of geologic time. When, as sometimes happens, this story can be

read at a great natural spectacle or shrine—at the brink of the Grand Canyon of the Colorado, in a redwood grove, or along the John Day River in eastern Oregon—it comes as revelation and with it is borne unto the mind the true meaning of time. And since in the main all growth or evolution has been forward and upward, are we to doubt that with the coming of the future there can be further advance? Long ago, the poet Bryant asked: "Has nature, in her calm, majestic march, faltered with age at last?" In his penetrating essay, "Are the Days of Creation Ended?" Merriam says:

> So, as we read the history of life and of man, and appreciate the dangers of our advance in learning and in civilization, we may realize that we are taking for our use that dangerous fruit from the tree of knowledge, and may question whether we can bear the consequence of coming to view the world as gods. At such a time it is proper that we turn in reverential inquiry to view the record of the past through which creation has revealed itself. There we find a history open for our information. It tells us of forward movement of the world from which we have grown, and in which we are a part. What greater gift could we receive than to learn through the evidence there presented that the conditions which have governed the creative process are essentially those which operate to-day and should be expected to continue; that whatever power has existed behind nature in the past expresses itself to-day, keeping the world a place that may be ever new, and justifying faith that progress will extend itself into the future?

This story of the past holds for man of today a special significance, since it is he who completes the link between past and future. Man faces thereby a sacred trust because of his dominant position. He must needs be called upon to judge those values of peculiar import to his place in the continuity of life, for he cannot live by self alone. Science may help, but in the end one of its greatest contributions should be in the determination or selection of proper human values. In conservation, in the maintenance of life, in the appreciation of nature, in keeping men free, we may look with confidence to science for help. As Merriam says:

> . . . even more important than those values which aid to bring riches and abolish poverty is the fact that science contributes toward betterment of life by placing before us the desirability of facing the realities, or the facts, and of taking the broader and longer view with reference to everything in life. Giving increased significance to truth, and depending more fully upon it, means not only a bettered and more nearly stable and safer world, but one in which the possibility of forward building or of accomplishment is enormously enhanced.

Our spiritual values should likewise never diminish, for as Merriam states:

No one can escape the feeling that, as knowledge advances, the greater world we come to know in terms of space, and time, and power, becomes the object of increasing reverence. Our place of habitation and the period of our existence shrink to relatively small dimensions, but the glory of our part in the plan of the universe increases when we see creation renewed in each successive age, and the way open to us for that continuing growth or progress to which the life of each stage has made its contribution.

So I repeat what a poet and philosopher has written for us:

> Let knowledge grow from more to more,
> But more of reverence in us dwell;
> That mind and soul, according well,
> May make one music, as before.

And again:

One of the greatest advances of all time was that expressed, ages ago, in the view that there is in the universe one power in many forms, or, in terms of religion, one God instead of many warring deities. It may be in order for mankind to make this discovery anew, or from time to time, when unity in views of the world and in belief seems threatened by erection of too many temples to deities of varying and perhaps inconsistent missions, in a world that, so far as nature is concerned, has operated as one system since time's beginning.

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