Great Names in Micropalaeontology

2. Joseph Augustine Cushman, 1881–1949

by

RUTH TODD

Vineyard Haven, Massachusetts, U.S.A.

In a retrospective view of Cushman's life, Professor Percy Raymond of Harvard University wrote (1950, p. 38):

When I arrived in Cambridge in 1912, the name Cushman was new to me. I found him over in the dusty rooms of the Boston Society of Natural History, where he was a curator. He was a quiet, unassuming young man, curiously enthusiastic about Foraminifera. All that I knew about these creatures was that some of the pyramids were built of nummulitic limestone, and that myriads of small specimens occurred in Mesozoic and Tertiary strata. But I had been warned against wasting my time on them.

Joseph Augustine Cushman was born Jan. 31, 1881 in Bridgewater, Massachusetts. His parents were of modest means; his father, Darius Cushman, sold and repaired shoes in the small college town where they lived, and his mother took college students to board. He attributed to both his father and his grandfather Thomas Cushman, on whose riverside farm the family lived when Joseph was a child, much of his lifelong interest in natural history.

His father's death when Cushman was 16 required him to abandon his plans for a medical career and to earn his own education. He attended Bridgewater Normal School for four years and then obtained a scholarship to Harvard University, from which he graduated with honours in 1903.

In normal school his interest in a scientific career had been aroused, and he planned to follow a career in cryptogamic botany. While at Harvard, Cushman studied with Robert Tracy Jackson, who influenced him to change his field to palaeontology. His thesis concerned developmental stages in the Lagenidae (Cushman, 1905), and was praised by Professor Jackson as "a contribution to science of high value in its originality of treatment and in a group of animals in which such work has never been tried so that it has the added value of path making work" (in Todd, 1950). Read in the light of subsequent developments, this
college thesis clearly foretells the direction of his thought toward the application of Haeckel’s principle of recapitulation—namely that the phylogeny of a species can be detected through study of the ontogeny of an individual of that species.

During the 19th century, microscopic shells of foraminifera had been collected from rocks, from beaches and from the sea bottom and studied by a few early scientists and hobbyists mostly in western Europe. At that time, and even into the early 20th century, foraminifera were regarded as long-ranging forms that existed unchanged throughout geologic history, and hence could have no value other than as curiosities. In his initial studies of foraminifera, Cushman looked upon them in this same light.

The rich collections of foraminifera obtained by the British sailing ship Challenger in 1873–76 had been studied intensively by H. B. Brady who classified them chiefly by nature of the wall and plan of growth. Brady regarded many of these modern specimens as present-day representatives of geologically ancient species. The equally-rich collections of foraminifera that had been obtained by the U.S. Fish Commission Steamer Albatross in 1883–1900 still lay unstudied in the National Museum, except for a small part of the collection that had been taken up as a hobby by Dr. James M. Flint (naval surgeon) (1899).

During the summers of 1904 and 1905, spent in study at Woods Hole, Cushman met Miss Mary Jane Rathbun at the U.S. Fish Commission. She urged him to take up the much-neglected field of foraminifera and arranged for her brother, then head of the U.S. National Museum, to have the rich collections obtained by the Albatross turned over to him for study and classification. Thus was opened up to him a vast and virtually untouched field.

This contact with the U.S. National Museum continued throughout the following 45 years, to the mutual benefit of both parties, and only ended with his death in 1949. His extensive collections of foraminifera from all parts of the world, amassed during nearly 50 years of research, were bequeathed to the U.S. National Museum in Washington, D.C., where they now constitute the world’s largest collection of foraminifera.

Cushman began his classifying work on the Foraminifera within the framework of the already existing Brady classification of 10 families that had been founded on the Challenger collections. Having acquired familiarity with modern species of foraminifera and their geographic and ecologic distribution, Cushman began to recognize differences between species in the geologic section and thereby began to use foraminifera to identify ages of rocks penetrated by well cores or found in the cuttings brought up during well drillings and to interpret their palaeoecology.

Continuing Professor Raymond’s recollections (1950, p. 38):
An eminent authority had published a paper on Palaeozoic forms and had shown that among them were genera, and perhaps species, indistinguishable from Tertiary and even Recent ones.

At that time Cushman had been studying the Foraminifera intensively for more than a decade, and had worked on material collected over a considerable vertical range. He justified his enthusiasm by pointing out that, although there were many Foraminifera which resembled each other greatly in general habit, yet there were great differences in the forms of the apertures, and that it was possible not only to distinguish species if good material were properly studied, but that many of the genera and species had relatively short ranges. He was convinced that they could be used in the identification of stratigraphic zones. In 1914, he had an opportunity to demonstrate the truth of this prediction.

In 1912, Cushman was employed by the U.S. Geological Survey as a specialist on foraminifera and worked on assemblages from the Atlantic and Gulf Coastal regions. He made his first age determinations by foraminifera in some well samples from South Carolina in 1914. Shortly after (Cushman 1921, p. 145), he stated confidently that foraminifera “faunas of the various members of these formations in [the American Gulf Coastal plain] are easily recognizable.” Concurrently some oil company palaeontologists had independently realized the truth of and were taking advantage of this statement in their economic work.

Professor Raymond’s recollections continue (1950, p. 38):

Companies drilling for oil in Tertiary deposits were constantly bringing to the surface immense quantities of Foraminifera but only few macroscopic fossils in condition to be identified. At last one company, prospecting a large property, got the idea that the micro-fossils would prove useful. Strange as it seems now, they had to hunt for a man who knew Foraminifera. They asked Schuchert, Schuchert asked me, and naturally, Cushman was selected. Fortunately, the company was willing to spend money and take advice. The story of that exploration has often been told. Cushman and his “forams” jumped suddenly from obscurity into the limelight. Once again pure research of no commercial value had produced a tool of great economic importance.

In January 1923, Cushman accepted a brief consulting assignment to apply his knowledge of foraminifera in correlating surface rock outcrops and drill holes for the Marland Oil Company in Mexico. Upon his return to his home in Sharon, Massachusetts, he built a private laboratory for consulting work. After a year he retired from commercial work to rejoin the U.S. Geological Survey and devote his remaining 25 years to research. In 1925 he began his privately financed quarterly journal Contributions from the Cushman Laboratory for Foraminiferal Research, and, together with his many students and colleagues, filled it with the results of his studies—systematic descriptions of modern and fossil faunas and monographic studies of families and genera. His classification, first published in outline form in 1927, became the text book
"Foraminifera, Their Classification and Economic Use" (Cushman, 1928).

In the original presentation of the new classification, Cushman (1927) resurrected a number of long-unused genera of Montfort, Defrance and Lamarck. The 10 families of Brady were expanded to 45 families, and phylogenetic relationships between genera were shown diagrammatically. In justifying the greatly increased complexity of his classification, he wrote, "An ideal classification should be based upon the known phylogeny of a group as shown by the fossil record, and coupled with the ontogeny of the individual as shown in its complete development, together with what may be learned of the morphology and physiology of the group." (1928, p. 47). Following his own formula for an ideal classification, it was inevitable that a copious proliferation of families, genera and species would ensue. Regarding his new classification he commented (1927, p. 5), "The increased number will be found not to represent a complexity but rather a simplicity over the older families which contained many remotely related forms."

Cushman (1927, p. 4) earlier had pointed out "the essential value of the study of early stages from thin sections." Studying the geologic ranges of species he saw (Cushman, 1940, p. 56) that "similar groups have arisen . . . several times, from the same or different sources." Major advances were being made in understanding the life history of living specimens of foraminifera. It was discovered that in certain species there was an "alternation of generations", a condition in which a species existed in two or more morphologically different forms: microspheric, resulting from sexual reproduction, and megalospheric, from asexual reproduction. Ecologic studies showed that environmental conditions under which a species existed strongly influenced its variability and even its morphology. These new developments added force to the statement included in the final edition of his textbook (Cushman, 1948, p. 56) that "very much has yet to be learned before any really final classification of the group can be made." Moreover, this new classification system provided ample blank spaces for unlimited additional new taxa to be erected with each new discovery of morphologic shell features or combinations of features, or new biologic observations, or expanded evolutionary history as revealed in the geologic record. Thus the pattern was set, and the new Cushman classification found wide acceptance, particularly in North America.

At about this same time, the so-called Cushman–Galloway feud had its origin following a personal visit made by Galloway to the Cushman home in May, 1926. Upon the appearance of the outline of the Cushman classification only 10 months later (Cushman, 1927), the guest accused the host of having been unethical in presenting, as his own, ideas he had acquired by discussion with his guest (Galloway, 1933, preface) and in
rushing into print with them so that the Cushman classification would supersede the Galloway classification, resulting in a loss of prestige as well as financial loss to the author of the junior classification. During the subsequent years the two cut off their correspondence, retaining only a polite and perfunctory contact.


Cushman’s lifetime spanned a period of unprecedented flowering of the science of micropaleontology, and his career had far-reaching influences on the direction and development of the field of smaller foraminifera. He predicted, but did not live to see, the potential of planktonic species as a means of worldwide stratigraphic zonation. His descriptive records of modern assemblages from the deep seas and littoral and shelf areas still provide data basic to the palaeoecologic interpretations of fossil foraminifera.

His new concept of classification seems somewhat of a rigid structure into which all the myriad of the highly plastic forms assumed by foraminifera could be fitted, once they were discovered. His use of such a rigid structure opened the door to the excessive proliferation of genera and higher categories that have followed in the 25 years since his death. His researches were a major factor in the use of foraminifera in stratigraphy and consequently in the search for oil.

Cushman’s address in December, 1937 as retiring president of the Paleontological Society (Cushman, 1938) is a remarkably foresighted document in setting forth recommendations for, and predicting the course of, development of the study of microfossils.

To the paleontologist is given a rare privilege, for his is the stewardship of the oldest book of records that we possess . . . the only record of the past life of the world and as such is beyond price. Given into his hands, it is the sacred duty of the paleontologist to study the pages with the utmost care, to translate the hidden meanings, to fill in to the best of his ability the blurred lines, and wherever possible to replace the missing pages. (Cushman, 1938, p. 359.)

Finally, here are some personal reflections. He was tall, spare and sparing of words, more inclined to listen than to talk. He lived with characteristic Yankee frugality and quiet enjoyment of a simple country
life. To the end of his life, Cushman remained a quiet, unassuming man, still enthusiastic about foraminifera. The Laboratory, a small, five-room building at the lower end of the garden, was the nucleus around which the activities of the entire Cushman household centred. It was a unique household.

His wife, Frieda Billings Cushman, devoted her life to maintaining the traditionally gracious hospitality of the home, where, over a period of 27 years, countless colleagues and students, together with their families, were welcome guests. His daughter Alice likewise devoted herself to the Laboratory, serving as secretary and taking care of the proof-reading and financial and record-keeping details connected with the quarterly publication.

The household included a governess for the children (a son and two daughters) when they were small, a housekeeper, a gardener, various laboratory assistants and artists and a collie. The 60-acre estate at the edge of Sharon, a quiet residential town, consisted mostly of woodlands with a brook flowing through it, an orchard, a wildflower garden, a vegetable garden and poultry. Summer usually saw the entire household, including some laboratory equipment and samples to be worked on, move to the nearby seashore in the earlier years, and to the Presidential Mountains in New Hampshire in the later years. Even at those vacation spots the work on foraminifera continued. Whether on vacation or in residence at the Laboratory, the daily routine of microscope work was broken by outdoor activities—gardening, wood-cutting, snowshoeing, sailing, mountain-hiking, fishing, picknicking—in which household members and guests alike took part.

Lasting a quarter of a century, it was a self-contained unit, a world apart.

Though it is impertinent to infer what might have been the mental concepts and evolution of thought of some other person, we may surmise somewhat by reflecting upon the history of that person's work. Early in his career, Cushman established a formula which he followed in describing a species. It consisted of filling in the blanks of the following outline: Test ------; chambers ------; sutures ------; wall ------; aperture ------; dimensions ------. Because forams were regarded as relatively simple creatures, there were relatively few characters that made up a specimen. It was my impression that he felt that after one had filled in the blanks accurately and carefully, it could be determined whether any species would stand as separate from any other by comparing the respective points of difference (or characters) in the outline. How many different characters were necessary before any one described species was regarded as distinct from any other described species was wholly a subjective matter; a matter of experience rather than of measurable precision.
He had little first-hand experience with living specimens other than those he wrote about so interestingly following his trip to the Dry Tortugas in 1919 (Cushman, 1922, p. 7–10). In the early part of his career, he discussed the factors that cause variability in foraminifera and concluded that “the actual amount of true variation in the group is relatively small” (Cushman, 1922, p. 11). Toward the end of his career, his feeling about the amount of variation in foraminifera was considerably changed. Nevertheless, his concepts of the species he described as new were rather narrow as compared with modern concepts of the same species.

The natural pendulum-swing, from “lumper” to “splitter” to “lumper” again, that is to be expected during the course of increasing acquaintance with any biologic group was incomplete in Cushman’s career. He was still, at the time of his death, assembling the essential components (species and their geographic and geologic ranges) necessary for eventual construction of a system of biostratigraphic zonation and of palaeoecologic interpretation. His final illness robbed him of the time to complete it and, in the final several years, of even the strength to do the more arduous and thought-challenging work required of it. So he ended his days still filling in the blank spaces.

Pioneer work, by its nature, is open to criticism by those who with hindsight would have done things differently. Perhaps Cushman’s greatest contribution was the popularization of foraminifera through his teaching and his prolific writing. Their use, initially in the search for oil and later as biostratigraphic and palaeoecologic tools currently of value in the various fields related to stratigraphy and oceanography, followed as a natural consequence.

References


