Memorial to Georges Deflandre 1897-1973

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The death of Georges Deflandre on June 17, 1973, marked the passing from the current scene of one of the true giants of paleobiology. Probably no other single person except Ehrenberg has done so much to advance the field of micropaleontology, and comparison with that "father of micropaleontology" is really meaningless because of the vast difference in the body scientific with which each had to deal. Certainly those aspects of paleopalynology that deal with organisms other than the spore- and pollen-producing plants depend solidly on the foundations which Georges Deflandre laid, although he himself had little concern for stratigraphy and little interest in the strictly economic applications of scientific knowledge.

The monument to this man is many faceted. On one side he leaves a bibliography of 314 scientific monographs, books, and papers. On another side stand more than 1,000 new taxa described by him. Impressive as this number is in itself, it but tokens his extensive studies of the many groups of organisms represented: acritarchs, archaeomonads, chitinozoans, ciliates, coccolithophorids, desmids, diatoms, dinoflagellates, ebridians, foraminifers, phytoflagellates, radiolarians, scolecodonts, silicoflagellates, and thecamoebians. Of profound importance as an opportunity for the future as well as a record of the past, there is a research collection embodying about 12,000 reprints, 50,000 illustrated description cards, 15,000 microscope slides, and countless notes, drawings, photomicrographs, and correspondence. This was organized and indexed with meticulous care and donated by him to the services of future scientists at the Muséum National d'Histoire Naturelle in Paris, where it will be known as the "Centre Scientifique Georges Deflandre." But more valuable than all these is the intangible legacy he left through his influence on fellow scientists—on a fortunate few through personal contact, on others less directly through the media of correspondence and the printed word.

His success and the magnitude of his contributions reflect the happy combination of, on the one hand, a brilliant and creative yet highly orderly mind, a penetratingly critical judgment, and great energy and perseverance, and on the other hand, adherence to the highest standards in the recording and dissemination of scientific truth as he saw it. Perfect and omniscient he was not, but his errors, blind spots, and "hang-ups" were few compared to those which plague most of us.

Georges Victor Deflandre was born on March 18, 1897, in the town of Dizy-Magenta on the Marne some 110 kilometers east of Paris. His father's job as a railway man belied family abilities more closely akin to the field of his own future, for his father was also an artist. One grandfather was an organist and composer, the other an inventor of electrical and mechanical devices, and an aunt the holder of doctorates in both medicine and science. From this background it is not surprising that there sprang a man of science,

whose artistic abilities aided him directly by enabling him to record his observations in many highly accurate sketches (as well as to illustrate his own papers). These abilities also provided him diversion as a painter and as a musician skilled at the piano, organ, and cello.

His father's deteriorating health forced Georges to leave secondary schooling in 1913 for a job with the railway. Two years later he was appointed an elementary school teacher. World War I brought three years of military service, capture as a wounded infantry sublieutenant, and imprisonment in 1918. After the war, academic pursuits would have been his choice, but economics dictated otherwise. While continuing until 1932 to make his livelihood as a teacher, on the side he tenaciously indulged his curiosity about the natural world of living organisms and especially about his rapidly growing interest in microscopy.

This was no idle pursuit of science as a hobby, but a quest for knowledge and understanding, which soon became productive. In 1923 he published his first paper, on the use of an organic dye in the study of the lower algae, and his progress during the next several years showed that (at least for a few who are both gifted and fortunate) there are other ways to become a scientist than to follow the conventional track through preliminary academic degrees. Continuing his microscopical investigations, he reported them in a succession of papers on freshwater algology, and by 1926, when he requested (and received) permission to submit a doctoral thesis on the flagellate *Trachelemonas* to the University of Paris, he had already finished three-fourths of the work.

The following several years were difficult yet productive. An unpaid post as preparator at the Ecole Pratique des Hautes Etudes firmly established his contact with the Muséum that he had initiated earlier, but it was not until 1932, with appointment as a scholar under the Caisse Nationale des Sciences and his reception into the Laboratoire d'Evolution des Etres Organisés by Professor Maurice Caullery, that it was possible for him to devote full time to his chosen field. In the meantime, he had founded a new periodical, *Annales de Protistologie,* and a new society, Société Française de Microscopie, and along with some twenty-five other papers, he had produced two monographic studies of thecamoebian genera and a small manual on microscopy for the layman that had much popular appeal, *Microscopie pratique. Le microscope et ses applications. La faune et la flore microscopique des eaux.*

Now he began a more conventional progress through the levels of the academic hierarchy within the sphere of the Centre National de Recherche Scientifique (chargé de recherches, 1933; maître de recherches, 1936; directeur des recherches, 1953). Appointment in 1943 as first director of the Laboratoire de Micropaléontologie of the Ecole Pratique des Hautes Etudes, a position he held until his retirement in 1967, enabled him to devote his full energies to research.

His little manual on microscopy was the first of three popular works expressing Georges Deflandre's great enthusiasm for his field and communicating in terms that the nonscientist could appreciate. The two later efforts, also highly successful, were aimed at similar readers (*Les flagellés fossiles,* 1936, and *La vie, créatrice des roches,* 1941), but these reflected a new direction his interest took after 1932. His earlier focus on the microscopy of living freshwater organisms had shifted to the still more vast but less appreciated world of marine microfossils.

Led through his interest in modern diatoms to observe fossil diatomites, Georges Deflandre stepped progressively into a microworld of siliceous, calcareous, and organic-walled fossils. Viewed today in a retrospect spanning forty years, his footprints stand out as pioneering tracks into the wilderness. After 1932 his work reflects an intertwining of

interests in these groups, with occasional sorties into other subjects, such as the microstructure of flagella, modes of fossil preservation, techniques of sample preparation and staining, methods of locating and relocating individual specimens on permanent microslides, numerical taxonomy, and the concepts of genus, species, and coordinate parataxonomic categories.

Among siliceous fossils he dealt briefly with diatoms, but his major contributions were to our knowledge of the Radiolaria and several less familiar groups. The unique morphological specializations that he observed in Lower Carboniferous radiolarians from central France convinced Georges Deflandre of the basic falsity of the then-popular contention that the radiolarians were an evolutionally stagnant group that exhibited little change since the early Paleozoic. He vigorously cautioned against accepting what he believed to be hastily drawn and ill-founded concepts of radiolarian phylogeny that dominated the standard treatises. In his last years he again concentrated his research efforts on this group. Other groups of siliceous fossils illuminated by his studies are the archeomonads (minute siliceous cysts of marine chrysophytes), which he discovered, and the silicoflagellates and ebridians, on which he wrote definitive syntheses, as well as many shorter papers. Of special note is his demonstration of the extreme degree of morphologic variability that may be exhibited within a single species of silicoflagellate. Also notable is the scheme that he devised for analyzing the geometrically complex skeletal architecture of the ebridians.

Georges Deflandre's exploration of the calcareous nannofossils, which lately have played such a significant role in studies of deep-sea cores, date from first notes on discoasters in 1934 and on coccoliths in 1939. Thereafter, he returned repeatedly to problems of the stratigraphic range, taxonomy, species concept, polymorphism, and microscopy of the heterogeneous assemblage constituted by minute calcareous fossils. A series of papers in collaboration with Charles Fert culminated in a classic work in 1952, "Sur la structure fine de quelques coccolithes fossiles . . . ," on the application of the electron microscope, in conjunction with brightfield and plane-polarized microscopy, to the study of intricate calcareous fossils as small as a micron in maximum dimension. Larger (but only relatively!) were the 50 to 100 micron calcareous cysts of dinoflagellates, on which he wrote most of the existing literature.

Microfossils of organic composition, in contrast to the mineralized remains of the calcareous and siliceous fossils, first came to Georges Deflandre's attention in Cretaceous flints, common in the environs of Paris and extensively used as paving for paths in Parisian parks. A hundred years earlier, Ehrenberg had dealt with similar fossil material, but such fossils had aroused only spotty interest until Walter Wetzel and Otto Wetzel at Kiel began more systematic studies, which led to O. Wetzel's published dissertation in 1933. Georges Deflandre then began a careful study of microfossils in flint (mostly Upper Cretaceous from the vicinity of Paris), which he prepared mechanically into transparent flakes. Soon he extended his studies to include organic microfossils sieved from uncemented marls (Oxfordian of Normandy, 1938) and others recovered by hydrochloric acid etching of calcareous shales (Kimmeridgian of the French Jura, 1941) and limestones (Silurian of the Montagne Noire, 1943). Later, studies in collaboration with Isabel Cookson in 1955 were based on hydrofluoric acid residues from Australian Mesozoic and Tertiary sediments. Collectively, these and other materials yielded a vast quantity of varied fossils, many of them previously unknown, whose exploration is reported in about seventy papers from 1934 to 1970. Among these papers, the two parts of his first extensive study on the Cretaceous flints (*Microfossiles des silex crétacés,* 1936 and 1937) stand as landmarks in the study of organic-walled fossil microplankton.

Although most of Georges Deflandre's writings on the organic microfossils were primarily descriptive, some of them contributed vitally to the discussions of the nature of fossil dinoflagellates and of the "problème des hystrichosphères" (1947). These questions became of wide interest in the late 1950s as the application of palynology spread rapidly among petroleum companies. It was in this connection that I met Georges Deflandre in 1959. Coming as a neophyte to the master in Paris, it was with great trepidation that I laid before him the heretical, if not revolutionary, suggestion that most of the Mesozoic-Tertiary "hystrichospheres" were actually dinoflagellates, and that the fossil record of the latter needed a fundamentally different interpretation than it had received in the past. He listened carefully to the evidcence I presented, and far from resisting through inertia or with any judgment related to the discrepancy in the number of years of our respective experience in the field, he reacted with almost joyous endorsement, obviously sensing ideas whose time had come and quickly recasting his long-established thoughts in a new light.

Another major contribution to the dissemination of knowledge resulted from his role in the authorship of two great French treatises of the 1950s: *Traité de Paléontologie* and *Traité de Zoologie.* Among the many profusely illustrated chapters that he wrote for these comprehensive works, some were syntheses of previously published information drawn from the works of many authors, but others, notably those on the coccolithophores and the radiolarians, were much more on the order of original memoirs, replete with new observations and interpretations.

From 1941 onward, he shared his life and activities with Marthe Deflandre-Rigaud. Supporting each other as man and wife, they also worked together as teacher and student (he supervised her doctoral studies), and as collaborators on numerous papers, especially in the production of the mammoth *Fichier de Micropaléontologie.* This joint effort to make available to others the essence of the descriptive literature so essential to progress in their field consisted of more than 6,200 cards prepared by Mme. Deflandre and published over a span of 28 years.

Although he delivered a series of courses on micropaleontology at the Sorbonne (1946 to 1949), most of Georges Deflandre's teaching involved the quiet one-to-one relationships within his laboratory rather than lectures to classes. Through the years, a succession of students was exposed for longer or shorter periods to his guidance and example, some pursuing degrees under his tutelage, others only visitors taking advantage of a chance to associate with him for a brief while. In such circumstances, the vastness of his knowledge could seem overwhelming, and his own devotion to his field, his self-discipline and efficiency, and his insistence on high standards could give the impression of personal coolness. But those able to linger long enough and possessed of the basic ability and scientific honesty which he set as minimum requirements for his time, found a deeply responsive and warm human spirit, eager to throw open the facilities at his disposal and to share his total resources.

A linguistic purist, he loved the French language and guarded against its debasement by foreign imports. As an example, when "palynomorph" was proposed as a comprehensive term for any microscopic organic-walled body recovered by palynological methods, he objected and refused to use the term because the French rendition "palynomorphe" produced an adjectival form rather than a substantive.

Some of his characteristics, although consistent with his background and outlook, inevitably led to adverse criticism and to strained personal relationships. Since he would not tolerate mediocrity and always believed in speaking his mind, those whom he considered inept or perfunctory scientists drew his sharp castigation—at times in print. He

was a scientist for science's sake and was not, himself, deeply interested in economic applications of his results. He never truly understood nor highly valued the stratigraphic exactitude necessary to give his paleontological observations maximum—or sometimes even minimum—usefulness for solving geological problems. Truth as he saw it was for publication, and it could be shocking to find in one of his published notes a quotation from a personal letter written to him in presumed (though unspecified) confidence. While appreciating the great range of morphologic variability evident even within some single species among the organisms he studied, he was so impressed by unique features that many of his species and genera are based on single specimens, in some instances clearly bizarre or imcomplete. He generally adhered to the international codes of biological nomenclature, but he was unable to accept their legalistic application if the result seemed to him to be basically illogical.

Although world-renowned and visited by admirers from many countries, he seldom left his native land. His principal laboratory was in the Muséum National d'Histoire Naturelle in Paris, but he also loved the sunny solitude of a villa in the town of Forqualquier (Provence), where he installed an alternate laboratory and spent increasing amounts of time in later years.

His terminal illness extended over a year, and his final paper, printed posthumously, was dictated from his bed in the last weeks. He is survived by his wife Marthe and by a son, Jean, by an earlier marriage.

Honors he received and positions he held, beyond those already mentioned, include the following: Croix de Guerre (1914–1918); Société Botanique de France: Prix Gandoger de Cryptogamie (1927); founder and director, Annales de Protistologie (1928–1936); Académie des Sciences: Prix Thore (1931), Prix Neury (1936), Prix Millet-Ronssin (1942), Prix Bonnet (1947); founder and director, Société Française de Microscopie (1933); vice-president, Société Botanique de France (1938); Officier de l'Instruction Publique (1947); chevalier of the Légion d'Honneur (1951); honorary member, Société Royale d'Histoire Naturelle Dodonaea, Gand (1955); corresponding member, Austrian Academy of Science (1957); foreign member, Académie Royale Flamande de Belgique (1957); correspondent, Geological Society of America (1960), honorary member (1963); member, German Academy of Naturalists Leopoldina (1963); correspondent of the Académie des Sciences (1966).

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