Memorial to Marshall Kay
1904–1975

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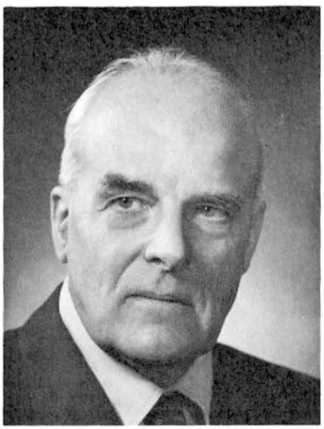

On September 3, 1975, Marshall Kay, one of the best known figures of American geology in the mid-twentieth century, died. The profession lost prematurely this remarkable man, who—as Columbia University's Newberry Professor Emeritus—was still vigorously pursuing important stratigraphic and tectonic research in Newfoundland. His last paper, which deals with that work, is Geological Society of America Special Paper 175.

Marshall Kay was born November 10, 1904, in Paisley, Ontario, the older of two sons of George F. and Bethea Kay. In 1907 the family moved from Kansas to Iowa City, Iowa, where Marshall's father began a distinguished career at the University of Iowa as professor of geology and later became Dean of Liberal Arts. Marshall grew up surrounded by geologists. Besides his father, there were on the faculty at that time J. J. Runner, A. O. Thomas, A. C. Trowbridge, and C. K. Wentworth. Wentworth was instructor when Marshall took field geology at Baraboo, Wisconsin, in 1923. His classmates at Iowa included such notables as Robert E. and Philip B. King, Harry S. Ladd, and Merrill Stainbrook. As youths, Marshall and friends amused themselves by, among other things, solving mathematical puzzles and memorizing railroad timetables. Besides providing amazing recitations about obscure rail lines to his students in later years, this memory training clearly paid off in Marshall's professional career. He later applied a similar intensity to stamp collecting.

Marshall received his B.S. from Iowa in 1924 (cum laude) and the M.S. in 1925. While a student there, he was awarded the Lowden Prize (shared with P. B. King) and a citation for his M.S. thesis. In 1924 he attended the University of Chicago field camp at Ste. Genevieve, Missouri, before going to Columbia University where he received the Ph.D. in 1929. His Columbia studies were partly supported by a Roberts Fellowship, which was endowed for Iowa scholars attending that institution. Kay was affiliated with Columbia for the rest of his career. While a graduate student, he was assistant curator of paleontology. Next he was lecturer (1929–1930), and then instructor (1930–1931) in Barnard College. From 1931 to 1937 Kay was instructor in Columbia College; he became assistant professor in 1937, associate professor in 1942, and full professor in 1944. In 1967 Marshall was honored with the title of Newberry Professor of Geology, and in 1973 he became Newberry Professor Emeritus. Besides graduate stratigraphy courses, he taught general sedimentology, undergraduate historical geology, stratigraphic paleontology, and field geology. He always thought of himself as a field geologist, and most alumni will remember vividly Kay's legendary Vermont plane-table mapping course. ("He didn't tell us until afterward that the entire sequence we had mapped was overturned.") Kay was chairman of the Department of Geology from 1953 to 1956 and again from

1971 to 1973. From 1944 to 1946 he was administrator in the university's Division of War Research, a branch of the Manhattan Project. From 1940 to 1942 he was also affiliated with the New York State Museum, and from 1943 to 1945 he held an adjunct position with the United States Geological Survey, which involved assessment of industrially useful carbonate rocks. Marshall Kay's bibliography totaled 110 titles (excluding abstracts and reviews) and included three major books.

Marshall frequently represented Columbia on the staff of the University of Wyoming Summer Science Field Camp. In 1934 Inez Clark, a botany student from the University of Michigan, took the Wyoming course, and in 1935 Inez and Marshall were married. The Kays had four children: Elizabeth, Katherine, Robert, and Richard. Everyone assisted Marshall in the field at different times, and three of the children ultimately studied geology. Inez, meanwhile pursued a distinguished career as high school biology teacher.

One of Marshall's earliest scientific field experiences was to assist with studies of fresh-water plankton. This must have provided some background for his own early contributions on fossil ostracods. A life-long interest in lower Paleozoic rocks began early. After the Baraboo field course in 1923, he assisted Walter Searight in stratigraphic studies of Upper Cambrian dolomite units in southern Wisconsin. This work introduced him to a then-current controversy precipitated by E. O. Ulrich's proposal of an Ozarkian System to include parts of Upper Cambrian and Lower Ordovician strata. Henceforth, controversy was no stranger to Kay.

Marshall Kay was the fourth in a distinguished lineage of professors of stratigraphy at Columbia, which began with J. S. Newberry (1866–1892), and continued with A. W. Grabau (1901–1919) and J. J. Galloway (1919–1931). When one considers Kay's roots in the upper Midwest and the fact that biostratigraphy reached full maturity in the 1930s, it is not surprising that his early scientific contributions emphasized paleontology. At Iowa he was schooled in the rigorous study of faunal assemblages. His competence with lower Paleozoic index fossils stood him in good stead throughout his entire career, but even during the 1930s he was becoming increasingly interested in physical stratigraphy. In a letter of tribute to J. J. Galloway on the occasion of that gentleman's retirement from Indiana University, Marshall wrote that it was Galloway who had inspired his own interest as a graduate student in stratigraphy. Kay credited Galloway with taking the dry bones of stratigraphy and giving them flesh and life. That poignant acknowledgment applies equally to Marshall himself, for as any of his own nearly 100 former graduate students can testify, he too gave life to a subject that in the hands of less skilled scholars could be the dullest of all geology courses. His secret was to use the stratigraphic record to illustrate general principles (see for example *Stratigraphy and Life History*, co-authored with E. C. Colbert, 1965). Moreover, he insisted that the student himself extract many of the regional relationships from stratigraphic data provided on dozens of columnar sections drawn as posters for teaching aids. Invariably, of course, it took Marshall the entire first semester to cover the lower Paleozoic.

Kay's own interests and his teaching mirrored the evolution of stratigraphy during the middle twentieth century. It was during the 1940s and 1950s that the preeminence of the biostratigraphic or index fossil approach was supplemented by a new, rapidly evolving physical stratigraphy. Kay, together with such figures as L. L. Sloss, W. C. Krumbein, E. C. Dapples, H. E. Wheeler, and A. I. Levorsen, emphasized the importance of lithofacies and biofacies, clarified the limitations of index fossils, and sharpened our concepts of chrono- (or time-) stratigraphy. After World War II, stratigraphy became increasingly concerned with the analysis of regional patterns of thickness, facies, and

unconformities, together with the relationships of these to major tectonic elements. Marshall himself pursued these matters in New York, Vermont, Ontario, Pennsylvania, Virginia, Nevada, Utah, and Newfoundland, as well as in Iowa and Wisconsin. Kay always emphasized that one of the ultimate goals of stratigraphy was refinement of paleogeographic restorations, and he pioneered in urging attention to such details as conglomerate clast composition in orogenic belts. Although Kay was always more stratigrapher than petrologist, he anticipated somewhat the next phase of sedimentary studies that was to mature in the 1960s and 1970s, namely, increasing attention to sedimentologic properties (for example, sandstone petrography and paleocurrents) as pioneered in America especially by P. D. Krymine and F. J. Pettijohn. In stressing the great variability of sediment types in orogenic belts, and by insisting that sedimentary environments must not be confused and equated to tectonic ones, Kay was in 1951 actually ahead of his times. His incisive 1945 paper on "Paleogeographic and Palinspastic Maps," his 1947 "Analysis of Stratigraphy," and the 1954 "Isolith, Isopach and Palinspastic Maps" were harbingers of the new physical stratigraphy, and they deserve rereading today.

After migrating east to Columbia University located in the classical Appalachian orogenic belt, Marshall became more and more involved with tectonics and stratigraphy. But the seeds of this interest, for which he was to become most famous, were sown back in the craton on the Iowa prairies. There is an interesting continuity in his complexly evolving scientific career. In his thesis work in Iowa, Kay had encountered an Ordovician volcanic ash layer and wondered about its origin. When he went east, he found more such layers, and began plotting the distribution of volcanic rocks together with sedimentary facies and isopachs of different ages for the entire continent. This effort was stimulated greatly by contacts with Hans Stille in the 1930s. Stille's subdivision of geosynclines into volcanic and nonvolcanic zones matched Kay's own compilations perfectly. Meanwhile, Marland P. Billings had proved in New Hampshire that the long-assumed Appalachia borderland of supposed pre-Paleozoic crystalline rocks could not have existed there after all because those very rocks had yielded Paleozoic marine fossils. A 1937 Geological Congress field trip to the eastern Ural Mountains confirmed Kay's growing realization of the fundamental tendency for stratigraphic contrasts between volcanic and nonvolcanic belts, and Hess's 1939 analogies between volcanic arcs and orogenic belts helped Kay understand the significance of the ancient volcanic zones (Kay, 1974). Kay's most important contributions to our understanding of the development of ancient orogenic belts developed during the 1940s and culminated in the publication in 1951 of his famous Geological Society of America Memoir 48, *North American Geosynclines.* The nature of strata of geosynclines depends upon the complex interrelationships of uplift, adjacent subsidence, and sedimentation. Most importantly, geosynclines, though generally subsiding, have at different times and places contained ancient volcanic arcs and tectonic lands raised *within* them. Kay argued that such lands were the major sources of clastic geosynclinal sediments rather than hypothetical pre-Paleozoic borderlands, which presumably lay *outside* the geosyncline. Others later wondered at the paucity of volcanic detritus in the central and southern Appalachian belt, but this fact merely reflects prevalence of tectonic lands as sources there.

It was characteristic of Kay to be everconscious of the great complexities and ambiguities of the stratigraphic record. To him the principle of simplicity blindly applied was a dangerous thing. Indeed, it was to emphasize and draw attention to empirical differences of stratigraphic and tectonic patterns that he proposed in the 1940s his well-known classification of geosynclines, for which he was to suffer much misunderstanding

and no little verbal abuse. One wonders why, in a period of general preoccupation with terminology and classification, Kay's scheme aroused so much emotion. In his teaching, Marshall made little of the names that he had coined, but rather emphasized those patterns. It is gratifying that with the arrival of the plate tectonics theory, the distinctions he was trying to elucidate finally became fully recognized by the profession at large, whose attention had been diverted by semantics for nearly two decades. In late years, Marshall was a trifle discomfited by admirers who tended to perpetuate his terms in the new plate tectonics context, for he felt most of them were now unnecessary. Conversely, he was understandably perturbed by the curious irony of yet new terms, which seemed superfluous (for example, *miogeocline* which is essentially synonymous with his own *paraliageosyncline*). It is fitting that Marshall himself should have the last word on that era: "The concern about terms has resulted in more penetrating analyses of the history of rocks; the very endeavor to classify has been rewarding" (Kay, 1967a, p. 315).

While full acclaim of his ideas in the 1960s understandably gave Marshall great satisfaction, it was typical that he was simultaneously dismayed by what, to him, seemed misguided over-enthusiasm and over-simplification. Generalization forms a crucial part of scientific hypothesis testing, and Marshall certainly contributed important generalizations himself. But his attitude was close to the philosophy that "if all the data fit one's theory, that's nice, but if some do not, then that's interesting." He was less concerned with smugly contemplating a seductively simple generalization "to which all the data seemed to fit" than in pursuing those interesting misfits. To him an anomaly or missing puzzle piece was like a new scent to a hound. He could become completely obsessed with the pursuit of a critical stratigraphic or structural relationship, such as the elusive proof of major low-angle overthrusting in the Taconic region of New York and in central Nevada. While others sometimes were impatient with Kay's emphasis of exceptions and details, it is uncanny how consistently his reservations proved well founded. Typical of his suspicion of dogmatic generalizations was this 1974 comment about the genetic significance of flysch and ophiolites: "Frequency of association need not imply genetic relationship . . . flysch does not uniquely characterize volcanic geosynclinal belts" (1974a, p. 378).

Kay was at the forefront of a number of investigations less visible than global tectonics. His long interest in overthrusting of different facies sequences in orogenic belts was highlighted by his having been the first to suggest that large allochthones existed in western Newfoundland, now a commonplace view. He also was early in recognizing the origin and significance of the Cambrian and Ordovician Levis and Cow Head boulder beds along the St. Lawrence estuary (". . . with blocks as big as Teachers' College," he used to say in class). And, with characteristic insight, he recognized in his last year that the Ottawa-Bonnechere graben, which he had mapped in the late 1930s (Kay, 1942), probably represents an aulacogen (Kay, 1975a). Of course not all pet ideas were winners. Kay for many years was a prominent advocate of permanency of ocean basins and gradual accretion by orogenesis of fixed continents (Kay, 1955a), the brain child originally of Dana and Suess in the late nineteenth century. But he was in excellent company, for this was the ruling hypothesis in North America (especially) until about 1965. What is remarkable is that Kay was able to accept continental drift so readily once the sea-floor spreading evidence began to flow in. Doubtless his first-hand knowledge of British as well as Appalachian geology helped in his conversion. But acceptance is one thing—his leadership role in amassing the evidence for drift in the North Atlantic region was truly exceptional for a man in his middle sixties.

While Marshall may have been ahead of the times with his Memoir 48, he was right on target when he conceived of the International Gander (Newfoundland) Conference on

Stratigraphy and Structure Bearing on the Origin of the North Atlantic held in 1967—the same year that the plate theory was fully announced. In an era marked by a plethora of meetings, the impact of most conferences is ephemeral and tends to be limited to the participants only. Few can have the profound influence of Gander, which brought together more than 100 of the leading authorities on western European and eastern North American structure and stratigraphy. The ripple effect of Kay's Gander Conference focused attention as no other event ever had upon the compelling evidence for continental separation across the North Atlantic. Even more significant was that "the associations encouraged interchange of experiences and travel to areas pertinent to the solution of the problems (of drift)" (Kay, 1969, p. 3).

While Marshall Kay's research accomplishments are well known, his other contributions may not be. Former Columbia students and Kay's close associates are privileged to have known and been influenced by a complex personality not fully revealed to the profession at large. Marshall's friendly volubility so familiar at meetings belied a basically shy reserve and contemplative nature. While proud of his own career, his family, his university, and his many students, there was not a trace of conceit in his makeup. In spite of his outstanding research contributions, I suspect that Marshall Kay would have preferred to be remembered first and foremost as the truly great teacher that he was. But how do we assess an outstanding teacher? Easy generalizations will not suffice. Kay was never theatrical, nor did he pontificate at or goad students into activity, neither did he lavish them with praise (that came only after graduation and even then usually not in one's presence). Marshall taught largely by example. First, by his own attitude, he instilled in the student a respect for his subject, and thus the importance of learning it. His intellectual honesty, objectivity, and crisp logic as revealed day by day in class was infused into student habits of thought and approaches to problems that gradually became second nature to most of them, too. At first, Doctor Kay often struck newcomers as a little aloof and even gruff, and it is true that he would not long tolerate sloth, sloppy thinking, or ill manners. But after a semester or two in Columbia's somewhat austere urban environment, most students came to realize that it was Kay perhaps more than anyone else who had a genuine concern for their well-being. As alumni, they later came to expect more than perfunctory inquiries about spouses and children. Similarly, Marshall was always supportive and helpful to other, especially younger colleagues. He was loathe to exploit others, and he strove to give credit to them. Habitually he wrote warm, personal notes of congratulations and encouragement, which were especially welcome to the struggling youngster. Probably most students only came to appreciate Marshall's teaching fully after leaving Columbia, when they realized from first-hand experience what an incredible grasp of complex regional geology he had, and what powerful tools he had given them for quickly coming to grips with local problems wherever they went. Not uncommonly, it appeared in retrospect that Marshall had seen the crux of stratigraphic problems in areas he never had visited more clearly than did local workers. More important, however, was the philosophy that he exemplified, especially "his basic honesty in all things," as one former student put it.

The list is beyond count of those indebted to Kay for help with such mundane tasks as locating an obscure reference (from that incredible memory!) to crucial matters like finding a job or obtaining support for research. For Marshall, as for most teachers, perhaps, the ultimate success of others he had helped in their pursuits was his chief reward.

Marshall Kay's honors were legion. He was elected to Phi Beta Kappa in 1924, received the Kunz Prize of the New York Academy of Sciences in 1941, was elected

Honorary Foreign Member of the Geological Society of London in 1964, and Honorary Correspondent of the Geological Society of Stockholm in 1968. He was designated Newberry Professor in 1967, and received the Penrose Medal, the highest honor of the Geological Society of America, in 1971. Kay also was given a Distinguished Service Award by his alma mater, the University of Iowa, in 1971, and Middlebury College presented him with an honorary degree in 1974. In 1972 an International Conference on Modern and Ancient Geosynclinal Sedimentation was held in his honor in Madison, Wisconsin; the proceedings were published and dedicated to him by the Society of Economic Paleontologists and Mineralogists in 1974 as Special Publication 19. In May 1975, Kay attended the Penrose Conference on "Paleozoic margins of paleo-American and paleo-Eurafrican plates: Drifting or rifting," which was held in Saint John, New Brunswick. The conference was dedicated to Kay and Sutton and was the last conference Kay was able to attend.

Kay was a member of many professional societies and commissions. Besides being a fellow of the Geological Society of America, he was also a fellow of the Paleontological Society (of which he was Vice President in 1945) and the Geological Association of Canada, a member of the American Association of Petroleum Geologists (on whose Business Committee he served from 1961 to 1962; he was also a candidate for President), the New York Academy of Sciences (of which he was Vice President 1943–1945), Sigma Xi (in which he was a member of the National Board, 1968–1972), the Society of Economic Paleontologists and Mineralogists, American Association for the Advancement of Science, American Geophysical Union, Paleontological Society of Japan, Paleontological Association, and Iowa Academy. He was a member of the Board of Managers of the New York Botanical Garden from 1961 until his death, a member of the American Commission on Stratigraphic Nomenclature (1944–1945), International Commission on Stratigraphy (1959–1975), and was a delegate to International Geological Congresses in Moscow (1937), London (1948), Copenhagen (1960), and Montreal (1972). He once remarked that between his father and himself, a Kay had attended all of the Congresses since 1904. Marshall was in demand as a lecturer, both at home and abroad. In 1966 he was invited to lecture in Russia and Sweden as well as in Canada, and in 1967 he lectured in Great Britain. He also led numerous field excursions, most recently in Newfoundland in conjunction with the 1972 Congress in Montreal.

Marshall Kay's remarkable intellect lives on in his writings, but that whole, complicated, wonderful personality is embodied in his family, countless friends, former students, and colleagues whom he touched during his long and tremendously productive life. What better thing can we say of such a fine man?

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