

A Century and a Half of Geology in Indiana

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Fifty years ago, on December 8, 1916, in an address to the General Session of the Indiana Academy of Science, a former State Geologist of Indiana, Willis S. Blatchley, related the apocryphal story that the Lord made the geology of Indiana simple so that it could be easily understood by the State Geologists elected by the people.

Origin of this story commonly has been ascribed to Dr. David Starr Jordan, once Professor of Zoology and President of Indiana University, but probably the true origin will never be known. Perhaps as commentary on Hoosier politics and thought, the story contains elements of truth that persisted through subsequent decades. Certainly Indiana was unusual, if not unique, in requiring for nearly thirty years that the State Geologist and heads of other state scientific agencies stand for election at the polls on the same partisan basis as congressmen, coroners, and dog wardens. In a geological sense, however, the story is untrue. Indiana geology is not quite as simple nor Indiana geologists quite as incompetent or ignorant as the story suggests.

The 1916 address by Blatchley (1) that contains the preceding story was subsequently printed in the *Proceedings* volume for 1916 under the title "A Century of Geology in Indiana." It follows logically that in titling this paper the precedent set by Blatchley is followed. Such a title does not connote need for an exhaustive review of every person, place, and thing remotely connected with the progress of geologic investigation in this state. Indeed, after thoroughly reviewing Blatchley's paper, and allowing for predictable personal prejudices developed from his experiences, vicissitudes, and frustrations of sixteen years in an elective state office, I find little of his story or analysis subject to correction or criticism. His eighty-eight page narrative of early geologic inquiry is relatively subjective, thorough, and factually unchallengeable a half-century later. I unreservedly recommend his paper for a few hours of interesting, stimulating, and even amusing reading.

Lacking any requirement for redigestion of a narrative already related so capably, the outline for this paper became relatively clear. First, a brief review of the "Naturalist" period, commencing with the "Owen survey" of 1839 and continuing until establishment of the Blatchley survey in 1895 when well-trained geologists in the modern sense of the word first appear in any real numbers on the Indiana scene. Second, an analysis of the Blatchley survey and its leader, who occupied the position of State Geologist from 1895 to 1910, a span longer than any other occupant of the post. Third, a review of succeeding survey-type organizations commencing with that of Edward Barrett, the last of the geologist-politicians, and continued without interruption, though under different administrative titles and with varying degrees of success, until the present time. Fourth, an area not considered by our earlier historian, a review of contributions of geologists operating outside the framework of the state geological surveys,

that is within the academic environment of our colleges and universities, as private individuals, or the Federal Government. It is necessary to interweave into this account such aspects of the early history as bear on the progress of geology and geologists in Indiana during the past five decades. History tends to be repetitive, is certainly cumulative, and there is much to learn from a recital of past events. The emphasis herein is on people, rather than published contributions; general agreement is possible on the total importance of individuals, but disputation is common about the lasting scientific merits of specific studies, interpretations, or publications.

Geological surveys had been established in fifteen states by 1839, and although some were short-lived, some of those discontinued were revived when full realization of their practical as well as scientific value became apparent. Thus, it is easy to understand why the Indiana legislature and private citizens, perhaps as early as 1830 and certainly by 1835 began to appreciate the necessity for a geological and topographical reconnaissance and mapping of the state. In an era of railroad and canal building and general appreciation of the need of an arterial highway system, mineral exploration seems to have assumed a relatively minor role, as can be observed from careful reading of the first enabling act of the legislature on February 6, 1837, providing for such a survey. It is interesting that although the title of this act is "An Act to provide for a Geological Survey of Indiana" no geological organization of the state ever had the exact words "Geological Survey" in its administrative title until 114 years later when the present Indiana Geological Survey came into existence in 1951.

In casting about for "a person of talents, integrity, and suitable scientific acquirements as Geologist for the State of Indiana" as required by the authorization act, it was necessary only to go as far as the former Rappite colony at New Harmony, Indiana, in the person of Dr. David Dale Owen, commonly acclaimed as the most learned and most eminent of all Indiana geologists. Association of Owen, trained in medicine (as were most learned men of his day) at the Ohio Medical College in Cincinnati, with the New Harmony colony has been amply described in popular accounts of early Indiana history, in a more formal way by Fenton and Fenton (3), and again only recently in an excellent article by Lane (4). It suffices that Owen, in conducting the pioneer geological survey with the munificent sum of \$3,500 for the biennium to cover salary and all field expenses, operating on horseback in malaria-infested, bridgeless terrain, and lacking adequate maps on which to base his work, did a monumental job of reconnaissance in a nearly virgin land.

Based on discoveries during his two-year term of office, Owen published two brief reports in 1838 and 1839, of 38 and 54 pages respectively. Reprinted in 1853 and again in 1859, perhaps as a result of an abortive attempt by the newly-formed State Board of Agriculture to reestablish a survey under Dr. Ryland T. Brown, these reports constituted the total body of Indiana geological literature for a period of twenty years.

The legislature had in 1839 passed a new Act whose purpose appears to have been to continue the work commenced by Owen. However, the

act was never implemented and neither Owen nor anyone else was appointed. It appears that a series of recurring financial crises in state government during the 1840's explains the lack of implementation rather than dissatisfaction with Owen's achievements.

After a twenty-year lapse, and under constant prodding by the State Board of Agriculture, the legislature approved on March 5, 1859 a new Act authorizing a geological study and appropriated \$5,000 from the State Treasury for the purpose of "Geological Reconnaissance, collecting and analysis of specimens of minerals, ores, earths and stones." Accordingly, the State Board of Agriculture reappointed David Dale Owen as State Geologist, with directions to pursue a survey of the coal fields of the state as his first duty. After partly completing this survey and writing a brief summary report, he died of malaria in November, 1860. Completion of the survey and final assembly and publication of the report was left to his brother Richard Owen, who had served as David Dale's chief field assistant.

The report of 1859-1860, as compiled by Richard Owen, is more notable for its prose than geological content. Richard Owen appears to have been more poet and naturalist than geologist, and this 368 page report has geology interspersed with glowing commentary on worms, clams, water weeds, and piscatorial delights, all evidently flowing from Richard's pen rather than the field notes of his noted brother.

Merrill (5) rather summarily dismissed Richard Owen as an incompetent. He commented on the 1859-1860 report as follows: "Like other of this author's writings it is prolix and uninteresting, differing in this respect in a marked degree from those of David Dale." Yet this treatment seems unduly harsh. Richard Owen's training was probably neither better nor worse than most of his contemporaries, and for a number of years he appears to have enjoyed successful tenure as Professor of Geology at the University of Nashville (Tennessee) and Indiana University. In 1872, he was appointed first president of Purdue University, but because of difficulties with the trustees resigned his post prior to actual opening of the school in 1874. Judging from his portrait, Richard Owen was a lean, saturnine man and one subjectively feels that he may not have been the "man of amiability, simplicity, and integrity of purpose" that Merrill ascribes to his brother. His influence on the curriculum of the newly budded university may, however, be reflected in the courses required by the Natural History option during 1874-1875; first year (general) geology; third year, economic geology and paleontology; fourth year, mineralogy and fossil botany (paleobotany). Perhaps if this program, ambitious for its time, had been allowed to evolve, Purdue today could look backward on a long history of fruitful research and successful graduates in geology rather than the low status it has held in this area for many decades.

Because of the Civil War and questions of social action and financial crises that followed, there is little record of geological activity in Indiana between 1862 and 1869.

On March 5, 1869, again at the urging of the State Board of Agriculture, the legislature reestablished the post of State Geologist. Edward T. Cox of New Harmony, who had been chief chemical assistant or "chemical geologist" to David Dale Owen in Kentucky, Arkansas,

and on the 1859-1860 Indiana survey was appointed to the post by Governor Baker. His tenure of ten years (1869-1879) was the longest in a series of relatively short-lived surveys conducted by state geologists, some appointed and some elected, lasting until 1895. These surveys were always underfinanced (always \$5,000 or less per annum to cover salaries of the State Geologist and all field assistants, field expenses, equipment, geological and chemical assaying, museum acquisitions and maintenance) and more often than not were headed by non-geologists, although occupants of the post usually did have qualifications in engineering or a biological science. The requirement that the State Geologist issue an annual report of progress led to production of a lengthy series of nineteen published volumes of reports, the first appearing under Cox in 1870 and continued by his successors—John Collett, Maurice Thompson, and S. S. Gorby.

As might be expected, field investigations tended to be hit-and-miss affairs, dictated more by political expediency, finances, and local interests of field assistants and legislators rather than by any carefully planned program of intensive geological investigation. Geological contents of these volumes are a series of county reports, paleontological studies of varying degrees of excellence, mineral resource surveys (particularly coal) and miscellaneous reports whose scientific value, even at the time of publication, is quite dubious. The county reports tend to be typified by inadequate geographic and geologic description (though not atypical of the time), inadequate maps, and interminable discussions of non-geologic considerations such as the incidence of "milk sickness," malaria, and so on. Such examples are understandable, because many field assistants of the period were naturalists more versed and qualified in other areas of natural history, or even men of medicine (perhaps in part explaining their preoccupation with malaria rather than geology). Although the lack of geological expertise by physicians such as Rufus Haymond, Ryland T. Brown, Moses N. Elrod, and Arthur John Phinney was acute, consider that they acted in most instances without salary or at best were provided only field expenses; therefore, we cannot be too critical of their product and should give them credit as public-spirited, forward-looking citizens. In many respects, the annual report papers on botany, ornithology, cave fauna and fishes appear to have more perpetual value than the geological reports.

Nevertheless, some geologic reports in these early works stand up reasonably well under modern scrutiny. For example, John Collett's report on Warren County (2) contains valuable information despite a poor map; the geologic sections are reasonably accurate and some attempts were made at correlation. In fact, even today it is the only suitable general background reference on this county. In contrast, the 1882 report on adjacent Fountain County by Ryland T. Brown is little more than a travelogue and was, in my opinion, almost worthless even at time of publication. In fairness to Dr. Brown, it must be recognized that he lacked Collett's background and the work was done in his declining years—he was 74 years old, and the total field work cost was \$125! Such parsimony and inadequate treatment is indeed unfortunate; eighty-five years later we still lack adequate geological publication on Fountain County as a political entity.

Additionally, a rare bit of humor or tartness glows from the pages of these ancient volumes, as witness the following quotation from page 92 of Maurice Thompson's Sixteenth Annual Report of 1888 (6) concerning the occurrence of gold and precious stones in Indiana.

" . . . there is no true gem stone to be found, high or low, anywhere within the limits of Indiana, and the only way by which an Indianan can remain in this State and obtain these beautiful and precious crystals is to work hard, earn the money and then buy them. A like statement is true touching the acquisition of gold and silver; the only method of obtaining these from the earth in this State is that of steadily and persistently following the plow. Every person who claims to have discovered in Indiana mines of precious metal or deposits of valuable gem-stones should be treated with the utmost caution. He is dangerous, if he is not ignorant, and if he is not crazy he soon may be, for that way madness lies."

Further reading indicates that Maurice Thompson, engineer and successful novelist, was thoroughly disgruntled with what he called crafty, avaricious Indianans. Unfortunately, the human traits displayed in print by our early geologists no longer grace the white, sterile pages of modern geological literature here or elsewhere; and I, at least, think we are poorer for it.

Blatchley Survey 1895-1910

Willis S. Blatchley, often called the greatest all-purpose naturalist produced in Indiana, headed the first geological survey to produce any quantity of geological study of lasting value since the days of David Dale Owen. Though still an elected official—this hideous practice started in 1882 largely as the result of a Supreme Court decision grown out of political infighting between the Governor and a legislature dominated by the opposition party—having to quadrennially fight the battle of the ballot, and hampered by a niggardly budget that in 15 years of office never exceeded \$7,000 per annum for all salaries and expenses, both field and museum, he was successful in surrounding himself with a host of qualified and productive assistants, all of whom eventually moved outward geographically and upward professionally to achieve distinction or success in our science. Names such as G. H. Ashley, T. C. Hopkins, E. M. Kindle, C. W. Shannon, C. E. Siebenthal, E. R. Cumings, and J. W. Beede are as well known to geologic practitioners as to geological historians. Thus sixteen annual reports and one bulletin issued by the Blatchley survey abound with source information that today is the starting point for advanced studies in stratigraphy, paleontology, and economic geology in Indiana. Only a few are mentioned here: Ashley, coal deposits (23rd Annual Report, 1899); Kindle, Devonian fossils and stratigraphy (25th Annual Report, 1901); Ashley and Kindle, the Lower Carboniferous of southern Indiana (27th Annual Report, 1902); Hopkins, Carboniferous sandstones of western Indiana (20th Annual Report, 1896); Hopkins and Siebenthal, the Bedford Oolitic Limestone (21st Annual Report, 1896); Kindle, stratigraphy and paleontology of the Niagara of northern Indiana (28th Annual Report, 1903); and Beede and Cumings, Fauna of the Salem limestone (30th Annual Report, 1906). There are many others.

Blatchley, a lean, sparse man, was noted for his forthrightness. The annual reports, his presidential address to the Indiana Academy in 1904, and his subsequent writings reveal these things: first, that even though of necessity he was a political animal, he considered politicians niggardly and treated politics itself with contempt; second, a realization that growth of the mineral economy of the state could only be commensurate with an adequate investment of money in a well-staffed geological survey; and finally, his justifiable pride in the success that he, more ornithologist and zoologist than geologist, had in surrounding himself with a corps of capable and productive geologists, though unfortunately in later years they left Indiana to seek success and fame elsewhere.

Much of Blatchley's success in hiring well-trained assistants must be attributed to the arrival of John Casper Branner as Professor of Geology at Indiana University in 1885 following the retirement of Richard Owen. Branner, a graduate of Cornell University, came to Indiana after lengthy experience abroad in Brazil and later with the Pennsylvania Geological Survey. Whether ascendancy of Dr. David Starr Jordan to the presidency of Indiana University in the same year as Branner's arrival is relative or coincident has not been ascertained, but a later fact is not controvertible: that when Jordan departed to assume the presidency of the newly-founded Stanford University in 1891, he took Branner along to head the geological department at the new institution. (It might be noted that Jordan likewise absconded with Joseph Swain, Professor of Mathematics at Indiana University, as well as several lesser luminaries of the Bloomington school, indicating that "faculty raiding" is not a twentieth century innovation.) Later Branner was Vice-President of Stanford and was President from 1913 to 1915 after Jordan's retirement. Branner produced Stanford's first geology graduate (*not* mining engineer, as commonly stated)—Herbert Hoover, perhaps the most universally known, respected, and financially successful geologist of all time.

Although Branner contributed little to research in Indiana geology, he was as successful in attracting graduates of other Indiana colleges to do graduate work under him as he was in teaching Hoover and others in later years. Only 45 years old when reaching Indiana University, he appears to have possessed great vigor as well as talent. His lack of Indiana research is readily explained by the fact that he was an early practitioner of "moonlighting," the art of holding two jobs at the same time; for from 1887 until 1892, while teaching at Indiana University, he was also State Geologist of Arkansas. His common practice was to have his graduate students "cut their teeth" in the Paleozoic backwoods of rural Arkansas where Branner, as E. R. Cumings relates, almost literally kicked them off the train, forcing them to do geologic mapping on their own with little or no assistance from their mentor. It is not surprising that in view of this Spartan introduction to field geology their studies for Blatchley in later years were so thorough and accurate.

From the time of Blatchley and Branner, the history of geologic research in Indiana is principally an almost inextricable mixture of

the State Geologist's office and the geology faculty of Indiana University, for reasons that will be related.

Barrett Survey 1911-1918

Edward Barrett, last of the elected State Geologists, triumphed over Blatchley at the polls and assumed office on January 1, 1911. By this time most of Blatchley's professional staff had left the state, and most publications of the Barrett survey consist of soils reports of various counties. The few major exceptions appear for the most part to be work contracted by Blatchley but not completed during his administration. The last voluminous annual report, the 41st in the series dating back to 1870, was published in 1917. Barrett's two final annual reports, published in 1918 and 1919, are totally administrative in character as are most of the annual reports issued since that time. Research reports shifted to other publication series with reorganization of survey administration.

The Indiana Geological Survey 1919-1966

By World War I, it must have become apparent that continuation of state scientific agencies as electoral offices was quite absurd. Cumings has recalled that as early as 1915 he reached agreement with Governor Ralston to discontinue this practice, instead reinstating the system whereby the State Geologist was an appointive officer with the incumbent picked by a commission appointed by and responsible to the governor. For some unknown reasons, perhaps exigencies of war, the plan was not carried out until 1919 when Dr. William N. Logan was appointed to the office, a position he capably occupied until his retirement in 1935.

At this point, we move into relatively modern times, and some digression from my theme is necessary. With reorganization of the State Geologist's office into a less politically dominated setting, the incumbent State Geologist also was, by statute, a member of the faculty of the State University (i.e., Indiana University); furthermore, many other geology faculty of the university held non-paid appointments with the survey in addition to their faculty duties. As a result, many of their results of geological research were published as numbered publications of the Division of Geology of the Department of Conservation, the administrative successor to the previous Geological and Natural History Survey. This explains the previous statement about the inextricable blending of the State Geologist's office and the University faculty.

In the last four decades, an increasing number of people have contributed to the advancement of knowledge of Indiana geology. No longer could the names of all active contributors be counted on the fingers of two hands, nor do the same names appear over and over in publications scattered across a score of years. In some instances, the principal contributions of new faces pertain to Indiana geology; in other instances by promotion of geology within and without the state by administrative leadership; and finally, by acquiring national or world-wide reknown as Indiana-based scientists without regard to their individual specialities or major preoccupation with the geology of

Indiana itself. For obvious reasons, any critical analysis of the contributions of many workers is inappropriate; they still live, and though the importance of their published research and durability of the product is assured, analysis is best left to the geologist-historian of the year 2016 when all, including the present writer, are only a part of the passing parade.

By any standard, however, five individuals of the post-1920 era have attained personal recognition. Discussion of these men and their achievements is in order. They are William Newton Logan (1889-1941), Charles Frederick Deiss (1903-1959), Clyde Arnett Malott (1887-1950), Paris Buell Stockdale (1896-1962), and Jesse James Galloway (1882-1962).

Our recital continues with William N. Logan, appointed professor of economic geology at Indiana University in 1916 and named State Geologist in 1919 in the reinstated appointive system. A native of Kentucky, educated at Kansas University and the University of Chicago, he had acquired broad experience in Mesozoic stratigraphy and vertebrate paleontology in the West. Subsequently, he spent 12 years as chairman of the geology department at Mississippi State College and as head of the Mississippi Geological Survey, where his principal interest was in studying the economic potential of clay minerals, marls, and groundwater of the Gulf Coastal Plain.

As expected, most of Logan's own work in Indiana was published by the new Division of Geology. Additionally, although he apparently suffered under the same budgetary handicaps as his predecessors (in 1935, the last year of his tenure, geological expenditures were only \$9,600), he was singularly successful in promoting research and resultant publication of some of the greatest documentaries of Hoosier geology. Commencing with Kaolin in Indiana (1919), a paper reflecting continuation of an interest in clays acquired while in Mississippi, he thereafter devoted himself to a study of the subsurface strata, particularly in regard to development of and exploration for oil and gas in the state. Under his aegis a number of important research studies were implemented and published: Cumings and Schrock, geology of the Silurian rocks of Northern Indiana (1928), Stockdale, the Borden (Knobstone) rocks of southern Indiana (1931), and Whitlatch, the Clay Resources of Indiana (1933). Any of these works stand on their own merit, but perhaps Logan's greatest achievement was successful compilation of the monumental 1120 page "Bible" of Indiana geology, Handbook of Indiana Geology (1922). For this volume, Logan wrote a 500 page section on Economic Geology, but it is accompanied by excellent sections on Geography, by S. S. Visher; Physiography, by C. A. Malott; and nomenclature and description of geological formations (stratigraphy) by E. R. Cumings. Certainly, no single other contribution to Indiana geology is its equal.

Logan is characterized by Cumings as a kindly, well-bred, patient and good-humored man who reportedly always typed his own manuscripts. After retiring from office because of ill health in 1935, the Division of Geology languished for a number of years, although research

and publication on a limited scale was continued, principally in mineral resource studies, ground water, and petroleum. Probably the economic depression of the late 1930's and the advent of World War II are largely responsible for this relative hiatus.

In 1945, Dr. Charles F. Deiss was appointed Professor of Geology at Indiana University and State Geologist and reorganization of the Division of Geology commenced in September of that year. In March, 1946, Deiss recommended removal of responsibility for the administrative and essentially non-technical services of supervision of oil and gas activity in the state, a chore which apparently had eaten away much of the limited appropriations of earlier years; with this accomplished, it would be possible for the Geology Division to concentrate on work more closely related to geological problems. As a result, the Division of Oil and Gas was created on May 1, 1947 by H. B. 207, Chapter 277 of the Acts of 1947, and by late 1947 the reorganization of the Division of Geology was nearly complete. In conclusion of severance from service functions, the Division of Geology moved from Indianapolis to Bloomington and reorganized into a number of separate branches, a structure it still essentially retains, although in 1951 the administrative title was changed to Indiana Geological Survey . . . the first time in history the survey became one in name as well as mission.

Although he held a substantial reputation as paleontologist and Cambrian stratigrapher before coming to Indiana, reorganization and revitalization of the survey to a progressive and viable establishment was perhaps Deiss' greatest achievement. The work of the survey has been enhanced greatly by significant increases in appropriated funds, largely coming from a 1% severance tax on oil and gas production imposed by the state in 1948. For example, survey appropriations increased from \$20,000 in 1946 to \$114,000 in 1948. Blatchley would be extremely pleased and think his arguments vindicated.

Clyde A. Malott, a native Hoosier and graduate of Indiana University, was an outstanding geomorphologist, an expert on caverns and underground drainage, and a remarkably perceptive Mississippian and Pennsylvanian stratigrapher. He perhaps was more devoted to study of the geology of his native state than any other man of recent times. Most of his free time was spent in research at his own expense, apparently investigating problems that were of personal interest to him without the strictures of contract study and other dictated research that plague us now. Some of his stratigraphic research, to be true, was an outgrowth of consultancy to oil companies, but the geomorphic studies were a labor of love. His geomorphic publications were mostly published in the *Proceedings* of the Indiana Academy of Science and general appreciation of his exposition and carefully documented ideas has occurred only since his death. Among his finer works are his analytical and philosophical studies of erosion, the concept of base-level, and classification of valley forms, published as Indiana University studies, and his beautifully documented paper on the drainage of Lost River in Orange County, appearing in the Indiana Academy *Proceedings* for 1951. Shrock has stated that Malott's publications, views, and works might be called provincial, but so fundamentally and logically and so

carefully fashioned they ultimately become classics. This writer concurs with this statement, although in some respects his private work, posthumously published, on the stratigraphy of the Ste. Genevieve and Lower Chester rocks of Indiana, is perhaps his finest contribution to Indiana geology.

Paris B. Stockdale, a native Hoosier and accomplished violinist as well as geologist, received his training at Indiana University, and his published doctoral thesis, a monographic study of the Borden strata, remains a classic investigation of this sequence of fine-grained, sparsely fossiliferous clastic and carbonate rocks that dominate the Lower Mississippian section of Indiana. Modeled on previous work by Charles Butts in the Appalachians, Stockdale conducted virtually an inch-by-inch study of the Borden rocks, recognizing facies and giving them names. Though we now recognize flaws in some of his interpretations, he laid the groundwork for appreciation of sedimentary facies everywhere; Charles Schuchert credited him as a prophet of stratigraphic changes to come. In later years, he continued study of Borden equivalents in Ohio, Kentucky, and Tennessee and published the detailed results in Special Paper 22 of the Geological Society of America. All subsequent studies of Borden or equivalent strata have their roots in Stockdale's pioneer study. In addition, he was able to prove the solution origin of stylolites that characterize the Mississippian limestones, showing that insoluble residues are in exact proportion to the degree of penetration of the stylolite and that composition of the residue is precisely the same as in soils overlying the Mississippian carbonates.

J. J. Galloway, a native of Noble County, studied under E. R. Cumings at Indiana University, completing his dissertation on the stratigraphy and paleontology of the rocks of the Cincinnati Series in 1913. After a brief stint as an instructor at Indiana University, he went to Columbia University in New York where he was Curator of Paleontology and Professor from 1916 to 1931. Thereafter he returned to Indiana University to spend the remainder of his professional career. Starting with a rigorous and systematic examination of fossil bryozoans, he progressed through foraminifera, then blastoids, and finally stromatoporoids. Study of these latter, poorly-known phylogenetic orphans consumed most of his time after his retirement from active teaching in 1953. It is regrettable that his lifetime was not triple the normal span, for if it had, he might have progressively worked his way through an equally exhaustive appraisal of all the invertebrate phyla. He was the first man to teach micropaleontology in America, and his book *A Manual of Foraminifera*, published in 1933, has remained a standard text and reference for over 30 years. His teaching standards were high and his demands on his students equally high. His flare for the dramatic, whether on scientific or social questions, was typically accompanied by a varied assortment of four-letter words which tended to highlight rather than vulgarize his orations in the ears of the listeners. He excelled at chess and was an extremely good but unorthodox bridge player, verbally overpowering either partner or opponents if the caliber of their play did not meet the exacting standards he set for both scientific and social occasions.

Colleges and Universities

As demonstrated, the history of geologic investigation at Indiana University is intertwined with that of the various state geological surveys. Only three other Indiana schools—DePauw University, Earlham College, and Hanover College—have actively contributed research and publication to the advancement of Indiana geology. Other schools either have never emphasized geology in their curriculum and thus lacked professional geologists on their faculties, or are recent arrivals on the geologic scene. Emphasis at most schools has been strongly keyed to undergraduate education, their faculties heavily burdened with course instruction with correspondingly minor time and funds for wide-scale research. Nevertheless, their contribution to a total knowledge of Indiana geology has been substantial, even if of limited geographic or subjectual extent; in many respects their work represents the ideal combination of teaching and research. Among such contributors must be mentioned Ryland T. Brown, Ernest Rice Smith, and the late Charles L. Bieber of DePauw University; Joseph Moore, A. D. Hole and others at Earlham College; and Glenn Culbertson and Grant Wickwire at Hanover College. Geologic instruction remains a viable part of teaching at these schools, and further contributions from them is assured.

Brief mention also should be made of the substantial contributions of Indiana State University in Physical Geography, a field so closely allied to if not an integral part of geology. The work in physiography of Charles R. Dryer, William A. McBeth, and F. J. Breeze, among others, is a valuable part of our scientific heritage.

Miscellaneous Work

Our predecessor historian, Blatchley, has described in detail the work accomplished during the period of 1869 to 1910 by individuals and organizations not connected with the various geological surveys of the state. The U. S. Geological Survey has devoted perhaps less attention to most aspects of Indiana geology since 1910 than before that date, although the progenitor of the Federal survey had its origin in the early days of the New Harmony colony. After 1910, numerous volumes of the different report series of the U. S. Geological Survey contain articles that deal with some aspect of Indiana geology as part of a regional study of coal, building stone, ground water or other economic mineral commodity. One specific contribution is such an important source item as to merit citation. Monograph 53, published in 1915, deals with the Pleistocene deposits of Indiana and Michigan and the history of the Great Lakes and is particularly important to our story. Not only does much of the report deal with the topography and glacial history of Indiana, as described by Frank Leverett, but the junior author, Frank B. Taylor, was a native and long-time resident of Fort Wayne. Taylor's chronological framework and interpretation of the evolutionary history of the Great Lakes is, with appropriate modifications, used today.

Other publications by other authors grace the pages of professional journals and organizational reports at a pace equal to the knowledge explosion of the last half century. For example, an average of four to

five geological or geologically related articles have appeared in the annual proceedings of this Academy each year for the past thirty years, yet our geological inquiry has scarcely more than scratched the surface of the unknown. Would that I could name all who have contributed. Most of those I have named are now gone, and new ones have taken their places.

The Next Half-Century

It is tempting to peer into the future and ask the question, whither Indiana geology and Indiana geologists? Changing times bring changing needs, and change is not difficult if the proper foundations are established and fundamental observations completed. In Indiana, unfortunately, we are not as prepared to cope with changing needs as we ought to be because the fundamental studies are not yet completed.

The completion in 1963 of the cooperative topographic mapping program of the state has been the first step towards establishing a proper foundation for future geologic studies. This set of over 750 topographic quadrangle maps provides an adequate base for geologic mapping, and detailed geologic mapping must be accomplished before geology can attain its highest goal—maximum service to mankind. The true value and objectives of geologic research were recognized long ago by Maurice Thompson (7) who said:

“Geology is but a dry and useless science, fit only for the crooning of the hermit, specialist, and the dusty-brained theorist, if it can not afford practical aid to the masses of the people. Of what use is all this study of the rocks if it be but to satisfy curiosity or to furnish links in idle theories?”

The highest aim of every science should be the permanent betterment of human life. Geology is not without this aim, and it has contributed and will continue to contribute to the store-house of practical human benefits by informing the people upon subjects that lie close to their material prosperity, while at the same time it has never, and it never must, let go the other strand of its usefulness which attaches to the purely scientific study of the Earth's contents.”

It has often been said that geology ignores political and geographic boundaries, and this is indeed true. Thus in recent times artificial limits have been ignored and research has tended to be devoted to intense analysis of discrete geologic units, mineral commodities, or other rigidly structured areas of investigation. In the future, however, it is probable that the attention of many geologists will be diverted from the traditional search for minerals or petroleum into other applications of geology more germane to late 20th century needs—urban planning and zoning, water and air pollution, structural design, transportation, public health, and water resources. To meet these changing needs, geological considerations no longer can ignore political and geographic boundaries abhorred before. Thus we return, full circle, to recognition of the need for comprehensive, detailed geologic mapping of individual quadrangles, counties, and regions of the state. This must be done without reference to an immediate monetary return, and it may

never be possible to be able to calculate, in the traditional sense, exactly what the dollar return is per dollar invested; certainly it will require greater numbers of geologists and a greater sum of money than has been invested in the entire previous century and a half of Indiana geology that we have just reviewed. Thompson's and Blatchley's predictions and anticipations have come true, at least in part; it would be pleasant to look backwards from the vantage point of a half century hence and see if the writer's predictions and anticipations are validated.

Literature Cited

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