History of the State Geological Survey of Iowa

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by Jean Cutler Prior

HISTORICAL SEQUENCE OF ORGANIZATIONAL NAME:

The Geological Survey of Iowa, 1855-58
State Geological Survey, 1866-69
Iowa Geological Survey, 1892-1986
Geological Survey Bureau, Iowa Department of Natural Resources, 1986-2002
Iowa Geological Survey, 2002-present

NAMES AND TITLES OF ORGANIZATIONAL DIRECTORS AND DATES SERVED:

James Hall, State Geologist, 1855-58
Charles A. White, M.D., State Geologist, 1866-69
Samuel Calvin, State Geologist and Director, 1892-1904
Frank A. Wilder, State Geologist and Director, 1904-06
Samuel Calvin, State Geologist and Director, 1906-11
George F. Kay, State Geologist and Director, 1911-34
Arthur C. Trowbridge, State Geologist and Director, 1934-47
H. Garland Hershey, State Geologist and Director, 1947-69
Samuel J. Tuthill, State Geologist and Director, 1969-75
Stanley C. Grant, State Geologist and Director, 1975-80
Donald L. Koch, State Geologist and Director, 1980-86;
State Geologist and Bureau Chief, 1986-2002
Robert D. Libra, State Geologist, 2002-present

INTRODUCTION

State geological surveys are permanently woven into the fabric of geological sciences in the United States. Their contributions have helped to advance the study and application of geology, and their existence reflects a long tradition on the part of individual states in recognizing the importance of geologic conditions to their economic and environmental welfare. The following quote by David Dale Owen sets the tone for a chapter titled "Necessary for Welfare and Progress, 1855-1861" in Mary Rabbitt's (1979) detailed history of events leading to the founding of the U.S. Geological Survey.

Is it not incumbent on every country and every state of this Union, to adopt measures calculated, first to develop their resources in the various raw materials necessary for their welfare and progress, and having done so, to direct public attention to their stores of mineral wealth? . . . What better method can a State adopt for this purpose than to

institute and support with liberality a well-conducted and judiciously managed geological survey. (David Dale Owen, as quoted in Rabbitt, 1979)

Her title based on his quote clearly identifies characteristics that have been the mainstay of state geological surveys - an emphasis on the practical application of geology to the resource issues of the time. Writing for the Geological Society of America centennial about the contributions of state geological surveys, Gordon Oakeshott (1985) concludes, "The state geological surveys are economically and politically responsive to state authority and therefore have developed a unique capability to serve directly the geological needs of the public."

The origins of state geological surveys can be traced to the early 19th century and the influence of Benjamin Silliman of Yale and his student Amos Eaton (Oakeshott, 1985). Eaton's lectures to the New York State Legislature led to the establishment of that state's survey in 1836. The first state geological surveys west of the Mississippi were established in the 1850's. In 1906, H. Foster Bain, an Assistant State Geologist with the Iowa Geological Survey in the late 1890's and then with the Illinois Geological Survey, organized a regional coalition of state geologists which eventually became the Association of American State Geologists - the group sponsoring this compendium of state histories.

Despite their widespread geographic distribution, state geological surveys have experienced similar patterns of development. These patterns were shaped both by developing concepts in the field of geology and by changing trends in the national experience. Yet each state, because of its restricted borders, also has a unique history, colored by its individual geologic setting and resources, and by the individual geologists who spend all or part of their careers within its borders. The state geological survey in Iowa, first established in 1855, mirrored those beginning in other states and employed geologists whose influence and contributions were important to other state surveys as well. Today, the continuing examination of Iowa's geology by Survey geologists provides valuable interpretations to science, as well as important information and direction to the state's resource assessment, environmental protection, and economic development.

THE EARLY YEARS

The Mississippi and Missouri Rivers, which form Iowa's eastern and western borders, were primary avenues of exploration into the continent's interior. Marquette and Joliet (1673), Julien Dubuque (1788), Zebulon Pike (1805), Henry Schoolcraft (1820), and George Catlin (1835) are strongly associated with the Mississippi River, while Lewis and Clark (1804) and Prince Maximilian and Karl Bodmer (1833) are associated with the Missouri. Basic observations about the land were entered in journals and drawn in sketch books, and these became the earliest references of Iowa's geology.

These two rivers were important, not only as early routes of exploration but, as avenues for developing concepts in New World geology. In 1809, English naturalist Thomas Nuttall examined limestone outcrops along the Mississippi River valley between Prairie du Chien, Wisconsin, and St. Louis. He determined, for the first time in this country, the presence of Carboniferous rocks on the basis of their fossil content, and he correlated these limestones with those of the Pennine Range of northern England (Keyes, 1919, p. 409). The following year Nuttall ascended the Missouri River, and at an Omaha Indian settlement below the mouth of the Big Sioux (where Sioux City is now located), he examined strata in the bluffs. Keyes wrote that on the basis of fossils and lithology, Nuttall compared these strata to the "Chalk Division" of northern France and southern England - the earliest recognition of Cretaceous rocks in America (Keyes, 1919, p. 410). This intercontinental correlation of geologic deposits was a significant departure from the geological thinking of the day and represented one of the earliest applications of principles which form the basis of modern geology.

This exploratory era was followed by settlement and by more purposeful geological reconnaissance and mapping. The settlers of the Black Hawk Purchase petitioned Congress to organize them into a separate territory. Following establishment of the Iowa Territory on July 4, 1838, French geographer Jean N. Nicollet was selected to lead a party of the U.S. Army Engineering Corps in the preparation of a detailed map of the region, which included Iowa, most of Minnesota, and all of the Dakotas. This map (1843) was regarded as a major contribution to American geography.

Then in the fall of 1839, Dr. David Dale Owen was commissioned by the General Land Office to make a geological reconnaissance of about 11,000 square miles in Wisconsin, Iowa, and Illinois for the purpose of collecting information needed to assist the President and Congress in preparing a plan for the disposal of public mineral lands. Between mid-August and mid-November of 1839, Owen marshaled provisions, engaged 139 assistants, instructed them in the needed principles of geology, organized 24 working corps, and proceeded to examine and map every quarter-section in the three-state area comprising the mineral lands of Dubuque, Mineral Point, and Galena districts, as well as to collect and label several thousand specimens. This remarkable accomplishment is a tribute to Owen's organizational and logistical skills (Merrill, 1924, p. 196-199).

Owen's work is regarded as the first official geologic investigation in Iowa. The results of this and later, more extensive investigations of lands drained by the Upper Mississippi River system (1847-51), directed by the U.S. Treasury Department, were published in 1852 under the title *Report of a Geological Survey of Wisconsin, Iowa and Minnesota; and Incidentally of a Portion of Nebraska Territory.* This 639-page monograph was published in Philadelphia (Lippincott, Grambo and Co.) and is richly illustrated with stylized sketches of landscapes, finely detailed drawings of fossils, and colored maps of cross-sectional valley profiles, including the Mississippi and Des Moines Rivers. Most of the illustrations, prepared as wood-cuts or engravings on copper, steel, or stone, are from original sketches drawn in the field by either D.D. Owen or his brother, Richard. In addition to his much-sought talents in geological reconnaissance, he was a skilled artist, and like many of the early geologists of this period, he received his education in science

through the study of medicine. During his career, Owen also served as State Geologist of Indiana, Kentucky, and Arkansas.

 **James Hall, *1855-58***

Iowa was admitted to the Union on December 28, 1846. The first geologic inquiry publicly undertaken by the State was under the authority of legislation proposed by Governor James W. Grimes and passed in 1855 which provided for a geological survey of the state. Looking eastward for talent and to New York as the model for geologic investigations of the day, James Hall of Albany was appointed State Geologist. Hall's friend Josiah D. Whitney of Massachusetts (subsequently State Geologist of California) was named as Chemist and Mineralogist, and Amos H. Worthen (subsequently State Geologist of Illinois) was engaged as an Assistant in paleontology. This work was funded for three years, and the results were published in a two-part volume in 1858. Part I focused on the general geology and stratigraphy of the eastern half of the state, including regional comparisons between the Paleozoic strata of the midwest and that of New York and Pennsylvania, as well as information on the chemistry of coals and the distribution of lead/zinc and iron ores. Part II was devoted exclusively to the paleontology of this region and was regarded as a benchmark contribution to the knowledge of Carboniferous crinoids and echinoderms. The beautifully detailed line drawings which illustrate the plates in this section were drawn by Fielding B. Meek. Hall's energy and domineering, egotistical personality are legendary (Dott, 1985). Always short of funds, seldom in Iowa because of other involvements, and single-minded as well as devious in his quest for fossil collections, he still was unquestionably one of the most prominent scientists of his day and left a lasting influence on American paleontology, geological organizations, and state geological surveys.

In 1853, Hall sent Meek and Dr. Ferdinand V. Hayden on their first trip up the Missouri River to study the geology of the Dakota Badlands and collect fossils for him (Rabbitt, 1979). Thus began their well known expeditions into the western territories. The Cretaceous exposures they examined in the Sioux City area were among the first rocks of this age to be studied in America, and Meek and Hayden's "Upper Missouri Section" described there (1862) remains a keystone in the formulation of Cretaceous stratigraphic nomenclature.

 **Charles A. White, M.D., *1866-69***

The Geological Survey of Iowa was reactivated from 1866 to 1869 under the direction of Charles A. White, also an M.D., and largely self-educated in the study of natural history. White engaged Orestes H. St. John, on the strength of a recommendation by Louis Agassiz, as Assistant Geologist and Rush Emory as Chemist. Agassiz, the renowned Swiss naturalist, visited Iowa City in the summer of 1866 and with White and others examined the Devonian outcrops upstream along the Iowa River (Stromsten, 1950). Since Hall's work was devoted largely to eastern Iowa, White and his colleagues concentrated on the western part of the state. White and St. John also accompanied F.B. Meek on a traverse across southern Iowa in 1867 to help correlate the coal-bearing formations of Iowa with those which Meek and Hayden were mapping in Nebraska (St. John later joined the Hayden surveys of Wyoming, Colorado, and New Mexico). A final report in two volumes was published in 1870, and included information on coal, gypsum, peat, and building materials as well as geological summaries of the western counties. White's generous acknowledgment of his coworkers in this report supports impressions that he was a kindly man, always ready to help and encourage others (Merrill, 1924), and he was highly respected by his students and colleagues at the State University of Iowa.

Among the illustrations in the 1870 report are 13 long-admired landscape lithographs known to have been drawn by St. John. In 1975, Ian Campbell, then with the California Academy of Sciences in San Francisco, forwarded six original pencil sketches which were found there and had been dated, signed, and annotated by St. John. Five of these sketches are of Iowa; four are the original field sketches for four of the lithograph illustrations in the 1870 report; the fifth sketch was drawn at one of the illustrated locations but of an opposite view (Prior and Milligan, 1985). St. John, like Owen and other geologists of the period, relied on his own artistic skills to document significant geologic characteristics of the regions he studied.

These two forerunners to the establishment of a permanent geological survey in Iowa were similarly broad in their mandated scope of work. Their charge, to carry out a complete geological and mineralogical survey, included examination of rocks, fossils, ores, coals, and the quality of soils for agricultural purposes. Information on prairie and woodland vegetation, climate, and the potential of streams for navigation or power-generation was also included. Reports, maps, and specimens were to be assembled and the information communicated, in order "to give the people of the State the greatest amount of practical information in relation to its resources" (White, 1870, p. 8).

Geological work under the auspices of the State lapsed again, this time until 1892. In the meantime, a report of "The Pleistocene History of Northeastern Iowa" was prepared by W. J. McGee, an Iowa native, and published in 1891 in the Eleventh Annual Report of the U.S. Geological Survey. This detailed and interestingly written account was regarded as the most important contribution to Iowa geology to follow White's reports. In addition, its appeal to the general public is credited with broadening the base of interest in geology and with developing an appreciation of the need for and support for a more comprehensive geological survey of the state (Arey, 1912). Other important contributions of this interim period included St. John's work on Paleozoic fishes of the midwest (1875), with many of the study collections from Iowa; T.C. Chamberlin and R.D. Salisbury's

report on the Driftless Area of the Upper Mississippi Valley (1886) which included part of Iowa; and Charles Wachsmuth and Frank Springer's three-volume work on North American crinoids (1895), which was based on the prolific occurrence of these fossils in the Mississippi Valley region. In fact, the great sequence of limestones along the river bluffs in the vicinity of Burlington, Iowa, are also historically significant as the starting point for the classification of the "Lower Carboniferous" limestone, and thus compose the type locality for the Mississippian System, one of the basic divisions of geologic time recognized throughout the world (Wilmarth, 1925).

This early reconnaissance activity and these pioneering geological reports were of great value. They called attention to features and places of special interest in the state, and they established a preliminary framework of Iowa's geology and its relationship to adjacent states that provided a valuable foundation for the more detailed studies that followed. Samuel Calvin, who was to lead the state geological survey of Iowa for almost the next 20 years remarked, "Considering the limitations under which the earlier geologists labored, the extent and accuracy of their observations are matters of constant surprise to their successors" (Calvin, 1909, p. 11). Looking today at the work of Calvin and his colleagues, we too admire the scope and value of their achievements under what we often regard as trying circumstances.


Samuel Calvin, ***1892-1904, 1906-11***

A PERMANENT GEOLOGICAL SURVEY ESTABLISHED

A permanent geological survey, as a separate agency of state government, was established in 1892. In accordance with the legislative provisions, a Geological Board also was established to govern the broad administrative policies of the Survey and to appoint the State Geologist. (This Board was dissolved in December 1980, and the State Geologist was to be appointed directly by the Governor.) The Board was composed of the Governor, the State Auditor, and the presidents of Iowa State University, the University of Iowa, and the Iowa Academy of Science. They elected Professor Samuel Calvin, Chairman of the Department of Geology at the University of Iowa, as State Geologist, and from that time until 1947 (through the Wilder, Kay, and Trowbridge administrations), both positions were held by the same individual. Offices were maintained in Des Moines and overseen by the Assistant State Geologist until 1934 when state budget cuts resulted in placing the headquarters permanently in Iowa City, where most of the actual work was done. Since that time, the Survey has been housed on the University of Iowa campus, but with no administrative ties to the University. Initially the staff occupied limited space in the geology building (Calvin Hall), and then in 1938 moved next door to the "Geology Annex," a former Botany Department greenhouse and laboratory. According to former State Geologist H. Garland Hershey, on the day of this

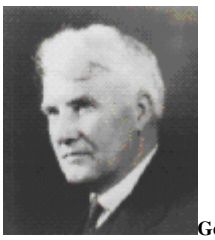
move all the well-sample cuttings were put in the greenhouse. A hailstorm a few hours later demolished most of the panes, and considerable time was spent separating glass from samples, and later, building storage space under the greenhouse slab. In 1951, an addition to the main building was constructed over this space. In 1963, arrangements for off-campus warehouse facilities were completed. In 1975, the Survey and the Geology Department both moved into Trowbridge Hall, and in 1979 the sample library, publications and archives, laboratory facilities, and additional offices were installed on the University's satellite "Oakdale Campus" in northwest Iowa City.

It is interesting to note that the 1892 legislative mandate for the Geological Survey called for (in addition to classical geological pursuits):

...investigating the characters of the various soils and their capacities for agricultural purposes; the growth of timber, the animal and plant life of the state, the streams and water power, and other scientific and natural history matters that may be of practical importance and interest.

It is not unusual to see the individual county geological reports published in the Annual Report Series supplemented with extensive botanical reports on prairie and forest flora, as well as meteorological records or information on archaeological remains. In fact, the Bulletin Series (1901-30) devotes entire volumes to the grasses, weed flora, rodents, raptorial birds, and honey plants of Iowa. This broad approach to natural science characterized individual geologists as well as the role of geological institutions of the time. Men such as Calvin, Thomas MacBride, and Bohumil Shimek were equally at home in several fields of natural history now regarded as separate scientific disciplines. Louis H. Pammel, Ada Hayden, and Charlotte M. King were recognized botanists who served as special assistants on the Survey staff. Charles R. Keyes, William H. Norton and H. Foster Bain were other geological authors whose highly readable county reports were written in a personal, almost poetic style seldom seen in today's technical literature.

As noted, Iowa's counties became the geographical unit in which the state's more detailed geological information was compiled. By 1941, 38 volumes in the Annual Report Series were published (only 5 out of the state's 99 counties were not completed), and to a large degree the history of the Iowa Geological Survey during this period is contained within them. In addition to the county reports, these volumes were also devoted to special topics such as, bibliography of Iowa geology, coal, gypsum, lead and zinc, artesian wells, clays, cement materials, quarry products, Devonian fishes of Iowa, peat, underground water resources, Pleistocene mammals, road and concrete materials, iron ore, origin of dolomite, the Des Moines Valley, Iowan drift, Pleistocene of northwestern Iowa, extinct Lake Calvin, Devonian echinoderms, Mississippian stratigraphy, trilobites, altitudes in Iowa, deep wells, pre-Illinoian Pleistocene geology, the Maquoketa Shale, the Dakota Stage, Pleistocene gravels, and Illinoian and post-Illinoian Pleistocene geology. This listing of some of the more lengthy reports demonstrates the growing diversity in geologic investigations as well as the attention devoted to economic aspects of the state's geology.


Frank A. Wilder, *1904-06*

George F. Kay, *1911-34*

Arthur C. Trowbridge, *1934-47*

These county reports also contain concepts important to the evolution of geologic thought in the United States, as well as worldwide. Iowa played an important role in presenting the stratigraphic facts which established the concept of multiple continental glaciations during the Pleistocene. The complexity of these glacial periods, including the existence of warm, interglacial episodes as interpreted from the "Aftonian" gravels of western Iowa and their classic fauna of Pleistocene mammals, was unraveled by such men as McGee, Chamberlin, Salisbury, Calvin, and Leverett. Confirmation of the windblown origin of loess, based in part on his study of land snails, was presented by Shimek in the Geology of Harrison and Monona Counties (1909). This emphasis on midwestern Pleistocene studies continued under George F. Kay and Arthur C. Trowbridge. Problems related to glacial drifts, gravels, buried soils, peats, and loess were inseparable from economic geology in Iowa. The adaptability of Iowa's terrain and soils to agriculture, and the importance of agriculture to Iowa's economy and as a factor in today's environmental issues ensure the continued justification for Quaternary research.

Together, these county reports admirably reflect Calvin's philosophy as set forth in 1892 when he wrote:

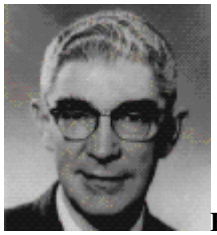
The work of the Survey is now fairly begun. The questions of greatest economic interest to the people of the State cannot all be fully settled at once...It must also be borne in mind that the determination of the economic problems, which must ever be kept in view as the end sought after in this Survey, is an impossibility without the preliminary determination of questions relating to the genesis and order of succession of the geological strata.

The significance of Calvin's influence is best summed up by Melvin F. Arey's comments in reference to the first twenty Annual Report volumes,

. . . which will ever stand as a worthy monument to the energy, scholarship, and eminent ability of the great souled man who planned the work and himself did no small part of it and who chose and directed as his assistants men who, in the midst of other heavy tasks, gladly gave themselves to the furtherance of the plans of their great leader, who for forty years was so identified with Iowa Geology that the one can scarcely be thought of apart from the other. (Arey, 1912, p. 70)

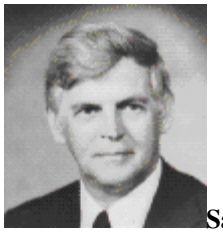
Since the Calvin administration, the Survey has maintained a long-standing association of cooperative programs with the U.S. Geological Survey, beginning with topographic mapping in 1907. In the 1930's stream and lake gaging projects with the surface-water branch, and water-level and chemical quality monitoring of wells with the groundwater

branch of the federal survey were initiated with regional staff based in Iowa City. In fact, the groundwater corps was directed for a time by State Geologist Hershey and shared the Geology Annex offices of the Iowa Survey until 1975 when all the USGS employees were combined in the new federal building downtown. Other cooperative projects include regional bedrock-topography maps, regional water atlases, water supply bulletins, and computerization of the well-log data base.


H. Garland Hershey, *1947-69*

In 1947, H. Garland Hershey succeeded Trowbridge with whom he served as Assistant State Geologist beginning in 1939. This was also the watershed year in which the Director of the Geological Survey and the Chairman of the Geology Department were separated into two full-time positions. Today the Geological Survey and the Geology Department continue to enjoy a beneficial association, sharing a good library and lab facilities, with the Survey providing opportunities for student employment, staff guidance on Iowa-based thesis projects, and occasionally filling the role of adjunct professor.

In his 22 years of service, Hershey greatly expanded the Survey's groundwater research and service functions. The post-war expansion of Iowa's economy included industry as well as agriculture, and Hershey observed that "One of the first needs of new industry locating in Iowa is a good water supply, usually obtained from wells they drill with the aid of information from our records" (Jensen, 1955). Those records now include over 30,000 wells, including sample sets of drill cuttings, drillers' logs, and rock cores. The collection and interpretation of these records is the heart of the Survey data base. They reflect a continuing cooperative association with the state's water-well drillers and are invaluable in the preparation of groundwater availability forecasts and in addressing water resource issues. This improved data base also made possible the siting of underground natural gas and liquid-petroleum-gas storage facilities in Iowa.


Samuel J. Tuthill, *1969-75*

Samuel J. Tuthill's career as State Geologist and Director began in 1969 and is notable for the creative application of the Survey's traditional research and service functions to the resource, environmental, and energy issues that faced Iowa in the early 1970s. A scientific investigation of Cold Water Cave was conducted to determine its potential as a scientific and public resource. New regulations governing site selection of sanitary

landfills were adopted based on geologic criteria designed to protect water resources. The Remote Sensing Laboratory was established within the Survey to apply information from aerial and satellite imagery to a broad range of interagency users. The first land-use map of the state was produced and new methods of flood-hazard assessment were inaugurated using this information base. The expansion and diversification of public services and interagency cooperation included his teaming with other agency administrators and the Governor's Office to coordinate Iowa's response to the 1973 Arab oil embargo. A coal-resources evaluation program and a drilling program to examine the hydrology of carbonate aquifers in the eastern Iowa groundwater district were also established. He focused public attention on the role of carbonate rocks and the impact of agriculture on groundwater problems. In a 1972 speech delivered to a seminar for community leaders he stated, "It is not the use of chemicals that serve agriculture, it is the chemicals that escape productive agricultural systems that damage water resources." This emphasis on the importance of understanding geologic systems in addressing the state's environmental concerns continues today as a concept fundamental to our existence.

Stanley C. Grant, ***1975-80***

Stanley C. Grant took over the reins of the Iowa Geological Survey in 1975. As the staff had grown from about 14 in 1965 to 41 in 1978, he initiated an internal reorganization into several management divisions reflecting the Survey's various programs and functions. An annual Newsletter joined the list of Survey publications in 1976 and in 1979 became known as Iowa Geology, a magazine of illustrated articles designed to communicate important and interesting information about the state's geology to the public. The Survey's advisory role to other state and federal agencies continued to expand in the areas of remote sensing applications, energy resources, data systems management, and "environmental geology," a term that came in vogue to describe this more intense and visible, practical application of geology to contemporary resources issues. Highlights of programs that continued or were initiated during this period included development of a state water plan, study of strippable coal reserves, availability of groundwater for irrigation, applied soils engineering and surficial geology studies, monitoring of earthquake activity, appraisal of groundwater occurrence and quality by aquifer and region, uses of Mississippi River dredge materials, geologic analysis of the Cherokee Archaeological Site, Missouri River landownership litigations, toxic waste problems, Plum River Fault zone mapping, Pleistocene stratigraphy, and improvements in data storage and retrieval systems.

 **Donald L. Koch, *1980-2002***

Donald L. Koch became Director and State Geologist in 1980, noting the Survey's improved capabilities in problem-solving and service functions as a result of refinements in data collection and interpretation over the years. Growing interest in the Midcontinent Rift Zone, a good example of refinements in geophysical techniques, resulted in the 1987 completion of the deepest well yet drilled in Iowa, the M.G. Eischeid No. 1 in Carroll County, an AMOCO Production Company oil and gas test to 17,851 feet. Also, 1987 was a milestone in terms of the completion of state-wide topographic map coverage by the USGS 7.5-minute quadrangle series. An abundant concentration of Mississippian amphibian fossils, perhaps the oldest known tetrapods in North America, was discovered in Keokuk County in 1985. Major studies also continue in water resources evaluation, especially the documentation of water-quality degradation in shallow carbonate and alluvial aquifers. Research efforts are oriented toward development of land treatment and management strategies that can be implemented to reduce groundwater contamination. Other studies include agricultural drainage wells, leakage from underground storage tanks, abandoned coal-mine lands and subsidence problems, geomorphological influences on the preservation of archaeological resources, Des Moines Lobe surficial geology, a municipal water-supply inventory, Plum River Fault Zone mineralization, and enhanced computer processing capabilities.

LOOKING TO THE FUTURE

The year 1992 marked the centennial of a state geological survey in Iowa. The U.S. Geological Survey celebrated its centennial in 1979. The Geological Society of America celebrated its centennial in 1988, with its ambitious *Decade of North American Geology* (DNAG) publications project now completed. Our staff's comprehensive stratigraphic review of the geologic section in Iowa was part of the DNAG contribution. The Association of American State Geologist's sponsorship of this volume of state geological survey histories is another example of the considerable interest sparked by these anniversaries in tracing the roots of geological science in this country and among the individual states. They have caused us to take a long look back, evaluate our current status, and consider the future. It is clear, as stated at the outset, that our existence and work is very much tied to the state's economic and political tides and to the state's definition of the geological needs of the public. Under plans to reorganize state government, the original Iowa Geological Survey was merged with three other state agencies to form a new Department of Natural Resources, effective July 1, 1986. This change reflects similar patterns experienced by other states and their geological surveys.

As this historical review becomes meshed with current events, the focus becomes closer and more detailed with a consequent clouding of broader perspectives. We have seen a shift from naturalist to specialist among geologists; a shift from drawings to cameras, aerial photography, and satellite imagery as a way of looking at the earth's resources; a shift in orientation of data acquisition from surface exploration, spurred by the 19th century influence of railroads in quest of routes and resources, to subsurface exploration spurred by the 20th century role of the water-well and petroleum industries.

The future of the state geological survey of Iowa will be closely tied to economic and environmental concerns. The inventory, development, management, and conservation of the state's geological resources are recognized as vital elements in Iowa's economic stability and future growth. There is a finite limit to these resources, and they are not uniformly distributed in quantity or quality. There are competing interests for their use. Sensitive geological environments exist which are vulnerable to contamination from man's activities. Iowa's diverse public interests need a technically qualified source of reliable information on water, mineral, rock, soil, and energy resources to aid the resolution of environmental issues and to develop assessments for resource development, protection, and management. This framework of needs will guide our future. Calvin (1909) wrote,

It has been the aim of the Survey to collect and furnish trustworthy information, the fullest possible, relative to the geological structure and resources of Iowa; but while the purely economic side of the subject has necessarily been emphasized in all the work so far done, any facts that could make knowledge clearer, broader, more definite, have not been neglected. . . . The pure science of today becomes the basis of the applied science of tomorrow, and enlightened states, the world over, realize that money expended for the prosecution and encouragement of scientific research, is money well invested. By the substitution of definite knowledge for vague uncertainty relative to water supplies . . . and all other natural products, the Survey has saved to the citizens of Iowa, many times over, all that the Survey has cost.

This philosophy also must be part of our future. Finally, communication of these research results to the public and to nongeologists needing geological information will be increasingly important. About this Calvin said,

. . . the Survey has earned its place as an important factor in contributing . . . to public education, helping the people to see and appreciate and correctly interpret the geological phenomena which lie all about them.

Calvin's well-articulated message, of responding to the state's economic resource needs, with information based on scientific research, and communicated effectively, is as valid today as it was over 100 years ago.

REFERENCES

Adapted from *The State Geological Surveys: A History 1988,* Association of American State Geologists, Arthur A. Socolow, Ed.