

Charles R. Keyes

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Assistant State Geologist of Iowa, 1892; State Geologist of Missouri, 1895.

THE GEOLOGICAL SURVEYS OF IOWA.

BY CHARLES ROLLIN KEYES, PH. D.

It is now a well established fact that the prosperity of a commonwealth is measurable by the amount and value of its natural production. A glance at the nations of Europe, for instance, shows that if they are arranged in order as they are powerful, their respective ranks correspond in a general way to the degree of development of their mineral contents. The same is, in great measure, true of the states of the Union. Among them, rank in wealth and importance is found to be not according to the probable total valuation of their natural resources, but in proportion as these are made to serve the industrial purposes of the community.

The method by which the natural wealth of a state is determined and placed before the world is by means of geological investigation. When undertaken by private corporations the work is always very local in character, the information obtained is carefully withheld from the public and the results, however valuable to the owners of the surrounding property, cannot be utilized. When the work is done under the auspices of the state it becomes geological surveying; and the official title of the government bureau having charge of the inquiry is commonly the Geological Survey.

Since private enterprise does not and cannot make an economic geological investigation in such a way that will be of general utility to the public, it becomes the duty of the state to undertake it and to vouch for its accomplishment. The direct benefits of a systematic inquiry of a state's natural possessions are very great and the indirect results are to a still greater extent far-reaching. So important are the facts obtained that it is now universally admitted that no outlay of public money brings back so large and immediate returns as that devoted to the prosecution of the geological surveys. This is amply attested by the fact that every civilized nation

on the face of the earth supports more or less liberally an institution, the express object of which is to inquire into the mineral resources. Nearly every state in the Union has lent aid in the same direction.

Until recently Iowa has been rather unfortunate with the investigation of her natural resources. Twice has she begun the work under favorable circumstances and twice has she deluded herself with the idea that it was something that she could well do without; and so after a brief existence support was withdrawn. The work so auspiciously started was unceremoniously cut off before it was fairly begun. Its able directors were practically driven from the state and were forced to find fields of labor in other states, where today they stand an honor to the places of their adoption, pre-eminent among the nation's men of greatness and well known the world over. It will ever remain a lasting regret that Iowa could not have shed a radiant lustre over her intellectual activity and progress. The chief glory must now be credited to other commonwealths.

In marked contrast to the two earlier attempts to carry on a geological survey of the state is the recent revival of the work. After a quarter of a century of cessation of official geological activities Iowa has at last come to appreciate not only the importance but the actual necessity of such work. As one who has long been actively employed in advancing the material interests of the state has well said: "The work is not to be regarded as a luxury which a rich state may afford, but which a poor state may dispense with; it is an investment which will yield good returns to the poor as well as to the rich; it is a work of improvement which will enhance the value of property; a work in harmony with the peace-loving spirit of the age, in accordance with which the energies of the state are being directed more and more toward industrial development." One of the chief arguments which was formerly urged against a geological survey, and which even now is occasionally echoed, is that the state is entirely agricultural and therefore needs no inquiry as to what lies beneath the surface. This objection was so self-evident to

many unthinking persons that it long retarded advancement along the lines of activity that were of the greatest importance to the whole community. Curiously enough, however, the history of state geological surveys has shown conclusively that it is the agricultural districts that derive the greatest benefits. And this fact has come to be so apparent, that it is not only widely upheld by the more thoughtful tillers of the soil, but by the people at large.

The Geological Survey of Iowa as it now exists owes its establishment to the liberality and patriotic sentiment of the Twenty-fourth General Assembly. Nor was this the only act which will make this legislature memorable in the educational annals of the state. At the same session it gave its authority for the organization, upon comprehensive lines, of a historical department of the state which had long been needed; it showed its appreciation for pure science in providing for the publication, under state auspices, of the memoirs read before the Iowa Academy of Sciences, a representative body of workers of the highest scientific attainments in the state; and it sustained liberally the several libraries belonging to the state. As time goes on history will fully demonstrate the truth of the statement that the Twenty-fourth was one of the most notable of all general assemblies during the first half-century of Iowa's existence as a state. As long as the great commonwealth lasts native posterity will look back with mingled feelings of joyous gratitude and swelling pride for the wisdom and foresight shown.

It will be a matter of not a little surprise to Iowans to learn that since the establishment of the Iowa Geological Survey four years ago, four other neighboring states have organized similar institutions after the plan here in operation, and an eastern state has likewise patterned after us in the same direction; as have also two far western states.

The third organization of the Geological Survey of Iowa was made possible through the efforts of two broad-minded and public-spirited citizens—members of the Twenty-fourth and Twenty-fifth General Assemblies. In the Senate the

bill for the establishment of the Survey was fathered by the Honorable John A. Greene, of Jones county, a native of Ireland, but for more than twenty-five years a resident of Iowa, a gentleman of sterling integrity, advanced views, and ever jealous of the welfare and amelioration of his adopted state. In the House of Representatives the Survey bill was under the tutelary guidance of the Honorable Henry Stone, of Marshall county, afterwards speaker. Marshall cannot be too highly commended for sending to the legislature such a representative, one not only possessing high attainments and thorough appreciation of all that pertains to the public good, but one who is keenly alert to all those things which tend to place his state in the first rank of those of the Union.

The first attempt to bring into notice the mineral resources of the region of which Iowa is a part was the expedition sent out by the Federal government, under the supervision of Dr. D. D. Owen. This reconnaissance was undertaken immediately after Iowa had been admitted to the Union and more than a decade before geological work was begun under state auspices. The trips, for they were little more than rapid canoe voyages on some of the more important streams, are especially noteworthy for the large amount of valuable information that was obtained in so short a time and the exactness with which the observations were made. The great fact was established that in the region of the vast treeless prairies, possessing a soil that was unsurpassed in fertility, there were inexhaustible quantities of mineral fuel within moderate distances beneath the surface. It was thoroughly demonstrated that lack of fuel was the least consideration to be feared by those who should look upon the rich agricultural lands for the location of future homes.

The official geological work under state auspices was first attempted in 1855, less than a decade after the admission of Iowa to the Union. Under the authority of the law providing for a geological survey of the state, Governor James W. Grimes appointed as State Geologist Prof. James Hall, of Albany, New York. Mr. Hall was well fitted to undertake the work. It is doubtful whether a better selection



James Hall
State Geologist.

JAMES HALL, LL. D.,
State Geologist of Iowa, 1855-7.

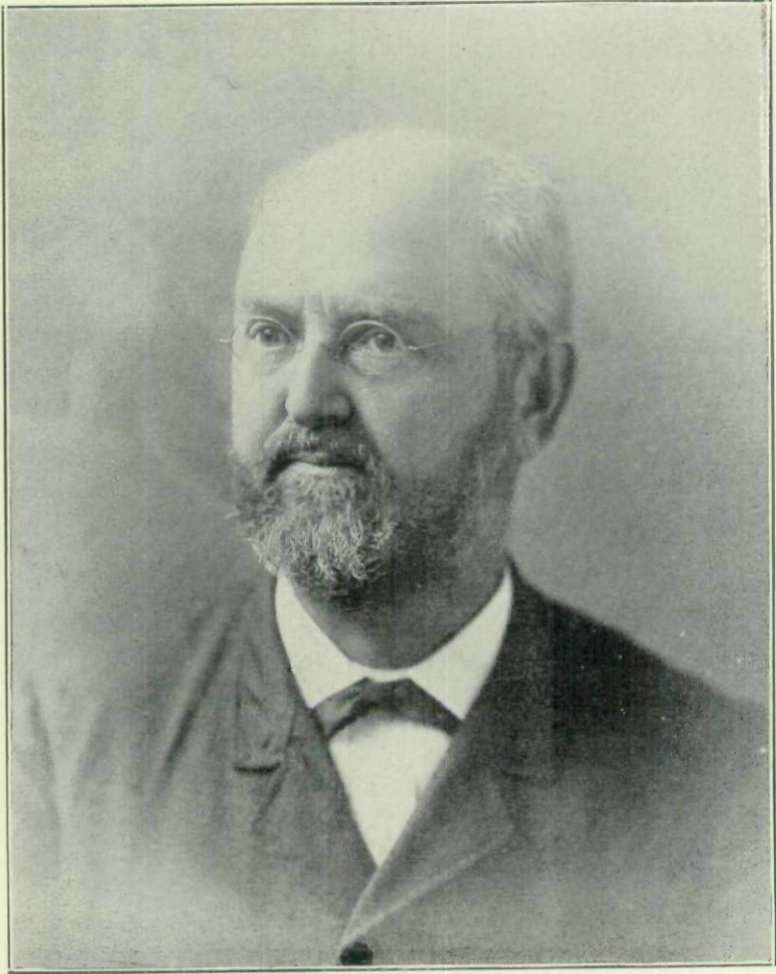
could have been made. He previously had charge of the geological work in the fourth district of the state of New York, a region which has since become classic and which is now the standard for comparison for the entire continent. He had also been geologist to several Federal exploring expeditions. The wide experience thus gained in other fields was put to good use in Iowa, as is well shown by the rapidity and exactness with which the general geology of the state was deciphered. Since leaving Iowa, Dr. Hall has become the foremost geologist of the country. For nearly a generation he has held the position of director of the New York Survey, in a geological way bringing that state into greater prominence than any other in the Union. Although now advanced in years beyond four score he still preserves the vigor of youth, and the ponderous tomes containing the matured results of his observations extending over more than half a century continue to leave the press at regular intervals.

As chemist and mineralogist selection was made of J. W. Whitney, afterwards State Geologist of California and now senior professor of geology in Harvard university, Cambridge. As regular assistants there were A. H. Worthen, afterwards, for more than twenty years, State Geologist of Illinois, and E. A. Cooley, of Marion. B. J. Hall, of Burlington, and E. Hungerford, were volunteer assistants.

Although the work was conducted for a period of not much over two years great activity was displayed. The principal results are embodied in two octavo volumes, one of which is devoted to the geology and the other to fossils. These two reports were printed and distributed by the state, but there were other results which were obtained in the prosecution of the work which the state did not publish. These were issued at private expense by the author after he returned to New York. While the Survey was scarcely more than a reconnaissance of the eastern half of the state the foundations were laid upon which all future work was to be based. Briefly, the chief objects accomplished were: the determination of the character and relations of the general geological features of the region; an investigation of the lead

and zinc deposits; a preliminary examination of the coal fields along the chief line of transportation; a detailed consideration of the resources of six counties; and a description of the characteristic fossils of the several geological horizons.

It was nearly a decade before geological work in the state was renewed. Notwithstanding the fact that it was originally contemplated in the act of 1855 to survey the whole state, lack of support by a subsequent legislature necessitated the suspension of the work. Owing to the unfinished condition of the investigation which had been confined to the eastern half of the state the Eleventh General Assembly by an act which went into effect in April, 1866, provided for the completion of the work under direction of Dr. Charles A. White. Previous to his acceptance of the post of State Geologist Dr. White had spent several years in southeastern Iowa in pursuing geological investigations and had published several important papers on observations made in Des Moines county. So energetically was the work pushed and so valuable was the outcome that the published results brought both the director and his state into great prominence. In the latter half of the period during which he was connected with the survey, Dr. White also held the chair of natural history in the State University. Afterwards he was called to Bowdoin college, Maine, where he remained three years. In 1874 he became paleontologist to the U. S. Geographical and Geological Survey West of the 100th Meridian, in charge of Lieut. G. M. Wheeler. Since that time he has been connected with various Federal surveys either as paleontologist or geologist. During this period he has restricted his work almost entirely to the Mesozoic formations of America. His review of the Cretaceous of the United States is one of the most celebrated of a series of correlation essays which have been prepared under the auspices of the geological bureau of the general government. Dr. White is a member of many learned societies both at home and abroad. In several of these he has held important official positions. In recognition of his high at-



Faithfully yours, C. A. White

CHARLES A. WHITE, M. D., LL. D., IOWA STATE GEOLOGIST, 1866-1870.

tainments in scientific research he has been elected a member of the National Academy of Science, a very small and select organization, admitting to its folds only those who have attained the greatest pre-eminence in scientific work in this country, and corresponding to the famous society of similar character in France. He is the first and only Iowan who has been so recognized. Dr. White is a voluminous writer and his published scientific contributions number upwards of one hundred and fifty.

With the aid of O. H. St. John, of Waterloo, as chief assistant, and Prof. Rush Emery, of Iowa City, as chemist, field work was continued for nearly four years, when adverse legislative action again necessitated a discontinuance of operations. As originally planned the reorganization of the Geological Survey was to do for the western half of the state what the previous attempt had done for the eastern district, thus completing a reconnaissance of the entire area. The investigation, though brief, was much more than a general examination of the whole field. Many districts were examined in detail. Reports were made upon the natural resources of many counties. The coal counties in particular received attention. These were all described as fully as was possible at that time. In addition much miscellaneous work was done that was of great value, and chemical analyses were made of a large number of samples of coal, clays, rocks and building materials. Although cut off so soon the published results form two large volumes of the size and same general character as the two previously issued reports by Hall.

As stated in the published reports the first two organizations were practically reconnaissance surveys, the one of the eastern half of the state and the other of the western half. Yet nearly a quarter of a century passed before any attempt was made to continue the work so ably begun. During this time the state had increased greatly in population, railroads had reached into every county, and manufactories had started up everywhere. The demand for a better knowledge of those things with which Nature had endowed the state

became so urgent that finally it devolved upon the Twenty-fourth General Assembly to give its authority to have inaugurated a geological inquiry into our natural resources.

The bill providing for a complete survey having passed both branches of the legislature, received on the eighth day of April, 1892, the approval of the governor and became a law. By the provisions of the law, the governing board was made to consist of, *ex-officio*, five members. As organized at the beginning there were, His Excellency Horace Boies, Governor of Iowa, the Honorable J. A. Lyons, Auditor of State, Dr. Charles A. Shaeffer, President of the State University, Dr. William M. Beardshear, President of the State Agricultural College, and Prof. C. C. Nutting, President of the Iowa Academy of Sciences. The composition of the board was an especially happy one for preserving the high scientific standard of the work and for preventing the rapid change of policy so often highly detrimental to scientific investigations.

On the eighth day of July the governor, who was President of the Board, called the members of the commission together for the purpose of initiating the work. Prof. Samuel Calvin was selected to direct the survey. Prof. Calvin, though born in Scotland, had come to Iowa at an early age and had ever since made it his home. He had been connected with Lenox college at Hopkinton, was afterwards in charge of the Dubuque public schools, and for twenty years had held the chair of zoology and geology in the Iowa State University. During this period he had devoted much attention to the geological features of the state, undertaking many investigations at his own expense, and had published numerous papers of high merit upon the observations he had made. Besides, he had accumulated a large amount of information which had not yet been given to the public and which was of great value in the prosecution of the survey. Probably no person could have been found possessing greater fitness for the post. Prof. Calvin had also acquired more than a national reputation as one of the editors and founders of the *American Geologist*, the first exclusively geological

magazine to be published in America and long one of the leading scientific journals in the country. In recognition of his services he was honored by being elected in 1894 vice-president of the American Association for the Advancement of Science, presiding over section E at the Brooklyn meeting of the society. His address as a presiding officer attracted wide attention both here and in Europe, the theme being the Niobrara Chalks of our own State.

By the selection of Prof. Calvin it was believed that the headquarters could be located at Iowa City and the survey made a valuable adjunct to the university, a plan which had been in operation in other states, and which had proved advantageous to both institutions on account of the close relations of the instruction of the school and the advanced work of original inquiry that is conducted by the survey. The board however finally concluded that the interests of the state would be better served by having the central office of the survey at the capitol. Arrangements, however, were made by which, without interfering with his university work, Prof. Calvin could devote an equivalent of one-half of his time to the survey work.

The plans by which the geological investigations could be begun having been approved the work of organization was commenced at once, both as regards the personnel of the survey and the field work. Charles R. Keyes was appointed assistant state geologist, and placed in charge of the headquarters at Des Moines, and Prof. G. E. Patrick, of the Agricultural college at Ames, was appointed chemist. During the first biennial period the permanent assistants were Mr. H. F. Bain, who succeeded Mr. Keyes, when the latter resigned to become director of the Missouri Geological Survey; Prof. S. W. Beyer, N. E. Newman, E. H. Lonsdale, A. C. Spencer and A. G. Leonard. As local and temporary assistants there were Professors C. D. Jamison, G. L. Houser, W. H. Norton, J. L. Tilton and J. P. Farnsworth, and Messrs. F. M. Fultz, F. Hesse, C. H. Gordon and F. C. Tate.

The investigations which were energetically begun were carried on along broad lines. Not only was a scientific and

systematic plan adhered to but the practical aspects of the work were given special prominence. So well was the work of the first biennial period carried out and so satisfactory was it to the people of the state generally that the demand became urgent that the inquiry should not be interrupted until a thorough survey of the whole state had been completed. With this in view the Twenty-fifth General Assembly placed the geological survey on a permanent foundation by making its appropriation an annual one until repealed by a special act.

Although the appropriation is not one-half as large as it should be to meet all the urgent demands from all parts of the state, nor as large as could be used to great advantage, the amount of good work that has been done in the four years of the survey's existence, is highly creditable to the state and of great value to its people. It demonstrates beyond a doubt not only the utility of the investigation but the wisdom of having it carried on to completion. Six large and handsome royal octavo volumes are already issued. They are profusely illustrated with cuts, photographic reproductions and colored maps. No better idea of their wide scope and worth can be obtained, without direct perusal, than by listing their contents.

VOLUME I (*480 pages, 10 plates, 26 figures*).

CONTENTS.

- Administrative Report of the State Geologist.
- Administrative Report of the Assistant State Geologist.
- Geological Formations of Iowa; by Charles Rollin Keyes.
- Cretaceous Deposits of Woodbury and Plymouth Counties, With Observations on Their Economic Uses; by Samuel Calvin.
- Ancient Lava Flows in Northwestern Iowa; by Samuel W. Beyer.
- Distribution and Relations of the Saint Louis Limestone in Mahaska County, Iowa; by H. Foster Bain.
- Annotated Catalogue of Minerals; by Charles Rollin Keyes.
- Some Niagara Lime-burning Dolomites, and Dolomitic Building Stones of Iowa; by Gilbert L. Houser.
- Bibliography of Iowa Geology; by Charles Rollin Keyes.

VOLUME II (*536 pages, 18 plates, 221 figures*).

COAL DEPOSITS; BY CHARLES ROLLIN KEYES.

CONTENTS.

- Chapter I. Introduction.
- Chapter II. Origin of Coal.
- Chapter III. Carboniferous Basin of the Mississippi Valley.
- Chapter IV. General Geology of the Coal Region.

- Chapter V. Lithology of the Coal Measures.
- Chapter VI. Stratigraphy of the Coal Measures.
- Chapter VII. The Coal Beds.
- Chapter VIII. Description of the Coal Beds now Operated in North-Central Iowa.
- Chapter IX. Description of the Coal Beds in Central Iowa.
- Chapter X. Description of the Coal Beds of Southeastern Iowa.
- Chapter XI. Description of the Coal Beds in Southwestern Iowa.
- Chapter XII. Description of the Coal Beds of the Outliers in Eastern Iowa.
- Chapter XIII. Composition of Iowa Coals.
- Chapter XIV. Waste in Coal Mining.
- Chapter XV. The Coal Industry.

VOLUME III (*501 pages, 37 plates, 34 figures*).

CONTENTS.

- Administrative Report of the State Geologist.
- Administrative Report of the Assistant State Geologist.
- Administrative Report of the Chemist.
- Work and Scope of the Geological Survey; by Charles Rollin Keyes.
- Cretaceous Deposits of the Sioux Valley; by H. Foster Bain.
- Certain Devonian and Carboniferous Outliers in Eastern Iowa; by William Harmon Norton.
- Geological Section along Middle River in Central Iowa; by J. L. Tilton.
- Glacial Scorings in Iowa; by Charles Rollin Keyes.
- Thickness of the Paleozoic Strata of Northeastern Iowa; by William Harmon Norton.
- Composition and Origin of Iowa Chalk; by Samuel Calvin.
- Buried River Channels in Southeastern Iowa; by C. H. Gordon.
- Gypsum Deposits of Iowa; by Charles Rollin Keyes.
- Geology of Lee County; by Charles Rollin Keyes.
- Geology of Des Moines County; by Charles Rollin Keyes.

VOLUME IV (*467 pages, 11 plates, 54 figures, 6 maps*).

CONTENTS.

- Administrative Reports.
- Geology of Allamakee County; by Samuel Calvin.
- Geology of Linn County; by W. H. Norton.
- Geology of Van Buren County; by C. H. Gordon.
- Geology of Keokuk County; by H. Foster Bain.
- Geology of Mahaska County; by H. Foster Bain.
- Geology of Montgomery County; by E. H. Lonsdale.

VOLUME V (*450 pages, 14 plates, 72 figures, 6 maps*).

CONTENTS.

- Administrative Reports.
- Geology of Jones County; by Samuel Calvin.
- Geology of Washington County; by H. Foster Bain.
- Geology of Boone County; by Samuel Walker Beyer.
- Geology of Woodbury County; by H. Foster Bain.
- Geology of Warren County; J. L. Tilton.
- Geology of Appanoose County; by H. Foster Bain.

VOLUME VI (*460 pages, 15 plates, 60 figures, about*).

CONTENTS.

- Lead and Zinc Deposits; by Arthur G. Leonard.
- Sioux Quartzite and Associated Rocks; by Samuel Walker Beyer.
- Artesian Wells of Iowa; by William H. Norton.
- Relations of the Wisconsin and Kansan Drift Sheets in Central Iowa and Related Phenomena; by H. Foster Bain.

From an examination of the various reports it will be seen that when the survey shall have been completed there will be attained for the state:

1. The provision of a suitable foundation for detailed and intelligent search for mineral wealth. One of the benefits resulting from this work is the limitation of different mineral-bearing areas in which prospecting may be profitably undertaken. It may be a matter of considerable surprise to learn that carefully made estimates show that more money has often been wasted in many counties in a single year, through ill-advised and poorly conducted efforts to discover coal and other minerals, than would annually support a systematic investigation of the entire state. Numberless abandoned diggings are met with, most of which mark fruitless efforts to obtain minerals in places where success is as utterly hopeless as can be imagined. All this useless expenditure of capital and labor might have been largely avoided had some authoritative information concerning the geological features of the particular localities been accessible at the time.

2. The assurance of permanency in the development of resources already known. Means are provided by which, without encountering repeated failures and inconveniences, each one may know how to turn his discoveries to best account, how to work the deposits to the best advantage, and how to prepare the product in the most suitable manner for market. The properties of the different substances and the uses to which they may be put having been determined in a practical way, the further advancement of the dependent industries is greatly simplified. On the completion of the work on any subject, all information possible is brought together, so that when a person engages in any mining enterprise or business connected with the natural resources of the region, he can hardly fail to find in the particular report something which will greatly assist him in his efforts and prevent a useless waste of time and money.

3. The establishment of an official guaranty respecting the natural wealth of the state. Information given by disin-

terested persons concerning the state's possessions is always regarded as more trustworthy than when imparted by private individuals. Citizens at home as well as abroad have confidence in making investments, and feel that they are not entering into mere speculative fields.

4. The formation on a scientific basis of a standard by which the geological features of the region may be compared with those of other districts. There is a wide demand for something of this kind for purposes of instruction in schools and colleges. Text books commonly used consider only the principles of science; the reports of the survey supplement this outline by giving detailed information of local application.

5. An advancement of agricultural and horticultural interests and the placing of them upon a firmer basis.

I HAD not been long out, before a bear fell from a tree, and rose erect, about twenty yards before me. He was in the act of looking up to the branch from which he had slipped, when I fired, and lodged a ball in his groin. He staggered, and leant against a tree; but recovering a little from the pain and surprise, he deliberately stooped to pick up a quantity of clean leaves; which with the utmost precaution he stuffed into the wound, and thus stopped the flow of blood. I was prepared to fire a second time, but my heart failed me; I was overcome by the firmness which he showed on receiving the shot, and the means he employed to correct its injury. He tried to climb the tree once more, but could not; the vital stream again rushed out; he fell to the ground, uttered a deep cry, and almost immediately expired. He was a very large animal; his tusks being five inches long, and his paw fifteen inches by five.—*Ashe's Travels in America*, 1806.

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