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# ADMINISTRATIVE REPORT

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TWENTY-THIRD ANNUAL  
Report of the State Geologist

IOWA GEOLOGICAL SURVEY,  
DES MOINES, DECEMBER 31, 1914.

*To Governor George W. Clarke and Members of the Geological Board:*

GENTLEMEN:—I have the honor to report that all the investigations which were approved by you at the beginning of the field season of 1914 have been carried forward successfully, and I am sure that the Board will be gratified to learn that there has been during the year an excellent spirit of co-operation among the men who were chosen to do the special lines of work which each, by his training and experience, was prepared to undertake. When it is recalled that the remuneration of the employees of the Survey has always been small for work which requires technical knowledge, it is somewhat surprising that year after year for many years the Survey has had the services of such an efficient corps of investigators. Moreover, I am sure that many citizens of Iowa do not fully appreciate the kind and amount of service that the Survey has been rendering to the State with appropriations that are considerably less than the appropriations of several other well-equipped Surveys of the country. At a time in our history when it is necessary to know fully our resources and the uses to which they can be put, the Geological Survey is an important factor in the development of the state. In this connection I wish to impress strongly the urgent need of good roads in Iowa and to call attention once more to volume XXIV of the reports of the Survey in which the available road and concrete materials of the state are fully described. The duties of the Director of the Survey have taken him into every county of Iowa, and thus he has had unusual opportunity to study the roads of the state. It is his conviction that if Iowa,

with her unparalleled agricultural resources, is to attain her true status among the progressive states of the country, proper consideration must be given at once to the lines of travel within her borders. If all the citizens of the state could but have the opportunity to see the real conditions in many parts of Iowa during certain seasons of the year, they would rise to the need and would see to it that the roads of Iowa were made to compare favorably with the best roads of the other states of the country. Fortunate indeed is our state in having in many of the counties ample supplies of gravel, sand, limestone, and other materials suitable for one or more types of road that have been found to be satisfactory in every way in other states where the conditions are similar to the conditions in Iowa.

Perhaps special attention should be called also to another feature that has impressed itself upon the Director of the Survey in recent years, more particularly during the year 1914, namely, the desire on the part of citizens of the state, and many persons outside the state, to secure reliable information regarding particular resources within the state. An unusually large correspondence has related to the probability of finding oil and gas. This question was discussed at some length in the administrative report which accompanies volume XXIII of the reports of the Survey. Many of the inquiries during the past year have had regard to oil and gas in southeastern Iowa, the recent interest having been related to the discovery of an oil field in western Illinois. With regard to southeastern Iowa, the Survey stated in volume XXIII, page xlv, that in that area there is evidence of upwarps of the nature of low domes in which the older terranes are much nearer to the surface than they would have been if the dome structure were absent, and that this dome or anticlinal structure is, as has been shown in many oil fields, one of the most favorable conditions for the accumulation of oil and gas. It was stated, however, that in none of the artesian wells that had been sunk had any oil or gas been found in the indurated rocks. Some gas has been found in sand pockets connected with the glacial deposits, but these are of little value commercially. The important artesian wells that have been sunk in southeastern Iowa, and in which no oil was found, although

these wells penetrated to depths below the horizon in which the oil has been found in western Illinois, include the following:

1. Crapo Park well, Burlington, which is 2430 feet deep, and penetrates rocks of Cambrian age.
2. Keokuk wells, which enter Saint Peter sandstone of Ordovician age.
3. Fort Madison wells, several of which, apparently penetrate rocks of Ordovician age.
4. Mount Pleasant well, which is 1100 feet deep, and penetrates rocks of Ordovician age.
5. Bloomfield well, which is 1817 feet deep, and penetrates rocks of Ordovician age.
6. Letts well, which is 1135 feet deep, and penetrates rocks of Ordovician age.

Since the discovery of the oil field in western Illinois, the Iowa Survey has studied the conditions there as published in the reports of the Illinois Geological Survey, and has compared these conditions with the known conditions in southeastern Iowa.

The western Illinois oil field is in the vicinity of Colmar, Illinois, which is somewhat more than the width of one county east from Keokuk. Here there are now several producing wells. Still nearer than this to Iowa in eastern Hancock county, considerable prospecting was done in 1914. Twenty holes were put down, in only one of which was oil found. The evidence indicates that in the Colmar field the oil is in lenses of sandrock in depressions on the old eroded surface of the Maquoketa formation of the Ordovician system. These sand lenses are very irregularly distributed. They vary in thickness and in other characteristics and, even where wells have penetrated such sand lenses, oil has not always been found. The rocks in this field show dome structure; the domes are small in area and in magnitude, the crests of many of them being not more than twenty to thirty feet high. In this area the best advice that the Illinois Geological Survey has been able to give to prospective drillers is that wells should be drilled in the known domes, in the hope that sand lenses containing oil may be found.

Now, our knowledge of the geology of southeastern Iowa, gained from a study of areal geology and from the deep wells, seems to indicate that the conditions in western Illinois may prevail in Iowa. In Iowa the Maquoketa shale has been found in the wells that have been drilled, and above it is the Niagaran formation within the basal part of which the oil has been found in western Illinois. It must be kept in mind, however, that since there are numerous unconformities within the rock section, the thicknesses and other features of the different formations may vary considerably within short distances. The conditions are such that even if oil does exist in certain places in southeastern Iowa, it is extremely difficult to direct intelligently where the drilling should be done in order to reach the oil. Undoubtedly the future will see wells drilled in southeastern Iowa for the purpose of finding oil. It is the hope of the Survey that when wells are drilled oil may be found, and its officers stand ready at all times to give the best advice possible from the evidence that is available. The locations of the test wells should be selected only by those who have full knowledge of all the geological factors involved. Even when this is done no definite assurance can be given that oil will be found; on the other hand, if all the geological factors are not taken fully into consideration large sums of money may be spent where it could have been shown before operations were begun that the attempt was doomed to failure.

The work of the Survey for 1914 may be summarized as follows:

#### AREAL GEOLOGY.

Detailed areal work and geological mapping was done by Professor Shimek in Audubon and Shelby counties, by Dr. James H. Lees in Crawford county, and by the Director of the Survey in Lucas and Union counties. Prof. J. L. Tilton completed his report on the geology of Clarke county, and Prof. J. E. Gow submitted his manuscript on the geology of Adair county. These reports will be published in the next volume of the Survey devoted to county reports.

## ARTESIAN WATERS.

A report on the Underground Waters of Iowa that has proved to be of great value to the people of the state in connection with water supplies for domestic and other purposes was published as volume XXI of the reports of the Survey. Since that report was issued Prof. W. H. Norton, the author of the volume on Underground Waters, has continued to collect and tabulate all available information regarding new wells that have been sunk in various parts of the state. By so doing the officers of the Survey, when called upon to do so, have been able to give the most up-to-date advice regarding the best sources of water in each locality where information was desired. Without such advice many thousands of dollars would have been spent in many municipalities without an adequate water supply having been secured.

## CO-OPERATIVE TOPOGRAPHIC MAPPING.

The Iowa Geological Survey in 1914 continued to co-operate with the United States Geological Survey in making topographic maps of areas selected by the Director of the Iowa Geological Survey. The plan of co-operation included the following articles of agreement which were signed by the Director of the United States Geological Survey and the State Geologist of Iowa:

1. The preparation of the map shall be under the supervision of the Director of the United States Geological Survey, who shall determine the methods of survey and map construction.
2. The order in which, in point of priority, different parts of the state shall be surveyed shall be agreed upon in detail by the Director of the Iowa Geological Survey and the Director of the United States Geological Survey, or their respective representatives.
3. The survey shall be executed in a manner sufficiently elaborate to prepare a map upon a scale of 1:62,500, exhibiting the hydrography, hypsography, and public culture, and all town and county boundary lines, township and section lines, as marked upon the ground at the time of its completion, in form similar to sheets already completed in the state of Iowa. The prelim-

inary field maps shall be on such scale as the Director of the United States Geological Survey shall select to secure accuracy in the construction of the final map.

4. The hypsography shall be shown by contour lines, with vertical intervals of 5 to 100 feet, as may hereafter be mutually agreed upon.

5. The heights of important points shall be determined and furnished to the Director of the Iowa Geological Survey.

6. The outlines of wooded areas shall be represented upon proofs of the engraved maps, to be furnished to the Director of the Iowa Geological Survey.

7. Under ordinary conditions the salaries of permanent employees doing field work shall be paid by the United States Geological Survey, while the traveling, subsistence and field expenses for the same time shall be paid by the State. During the office season the salaries shall be divided between the two agreeing parties in such a way as to equalize all expenses, provided that the total cost to the state of Iowa for field and office work shall be not less than one thousand seven hundred and fifty dollars (\$1,750), and provided, that the United States Geological Survey shall expend an equal amount upon the work before June 30, 1915, the Federal allotment to bear an approximate charge of 12½ per cent for the necessary expenses in connection with the proper execution of the field and office work. All accounts shall be approved by a representative of the United States Geological Survey before payment.

8. During the progress of the work free access to the field sheets and records of the topographers and draftsmen shall be afforded the Director of the Iowa Geological Survey, or his representative, for examination and criticism; and should the said Director of the Iowa Geological Survey deem that the work is not being executed in a satisfactory manner, then he may, on formal notice, terminate this agreement.

9. The resulting maps shall fully recognize the co-operation of the State of Iowa.

10. When the work is completed, the Director of the Iowa Geological Survey shall be furnished by the United States Geological Survey with photographic copies of the manuscript sheets; and when the engraving is completed, and at all times thereafter when desired, he shall be furnished by the said Survey with transfers from copper plates of the maps for use in printing editions of said maps.

The following is a summary of the field and office work accomplished during the period, January 1 to December 31, 1914, under the general direction of R. B. Marshall, Chief Geographer, and under the immediate supervision of W. H. Herron, Geographer of the Central Division:

*Field work.*

Quadrangles	Counties	For publication on scale of	Area mapped— square miles	Traverse		
				Primary miles	Per. marks	Secondary miles
Boone .....	Boone, Hamilton, Webster .....	1:62,500	29	.....	.....	80
Chariton .....	Lucas, Marion, War- ren .....	1:62,500	58	15	1	241
Melrose .....	Appanoose, Lucas, Monroe, Wayne ..	.....	.....	7	2	.....
Attica .....	Marion, Lucas, Monroe.....	.....	.....	36	6	.....
Humeston .....	Wayne, Lucas .....	.....	.....	10	2	.....
New Virginia.....	Warren, Lucas, Clarke .....	.....	.....	4	.....	.....
Albia .....	Mahaska, Marion, Monroe .....	.....	.....	10	2	.....
		.....	87	82	13	321

The following members of the United States Geological Survey were engaged in the field work:

*Topographic Mapping:*

W. L. Miller, Topographer.

*Primary Traverse:*

E. L. McNair, Topographic Engineer.

*Office Work:*

The office drafting of the Boone topographic map was begun, 80 per cent being finished on December 31, 1914.

The adjustment of the levels for the Attica and Chariton quadrangles was completed, the field notes typewritten and prepared for publication.

The topographic maps that have been issued by our Survey are proving to be, as has been stated frequently, of great value



to the people of the state, and it is much to be regretted that the Iowa Geological Survey does not have an appropriation of at least ten thousand dollars a year for topographic work. This amount, with an equal amount yearly from the Federal Survey, would enable Iowa to carry forward topographic mapping as rapidly as has been done in several of the other important states of the country. The urgent need of topographic maps was stated at some length in the last administrative report of the Survey, and it is thought well to repeat the following significant paragraph:

The development of the state in connection with a highway system, drainage projects, steam and interurban railways and in many other ways demands the preparation of topographic maps as rapidly as possible. Further delay will but add to the great financial loss that the state has already suffered through a lack of such maps. At the last meeting of the Iowa Engineering Society, and also at a recent meeting of the Iowa Academy of Science, resolutions were adopted urging that efforts be made to secure for the Iowa Geological Survey increased appropriations for this important work.

#### STRATIGRAPHIC GEOLOGY.

During the summer of 1914 Mr. F. M. Van Tuyl continued his studies of the Mississippian rocks, and Prof. A. O. Thomas continued his investigations of the stratigraphy and paleontology of the Devonian rocks of the state.

#### CO-OPERATIVE STREAM MEASUREMENTS.

During the summer of 1914 the Iowa Geological Survey continued to co-operate with the Water Resources Branch of the United States Geological Survey in the work of stream gaging and discharge measurements of the important streams of the state.

#### THE CLAYS OF THE STATE.

Under the direction of Dr. S. W. Beyer the investigations of the clays of the state were continued. Special attention was given to the study of ball and stoneware clays.

#### MINERAL STATISTICS.

As in past years the Iowa Geological Survey in 1914 co-operated with the United States Geological Survey in the prepa-

ration of statistics of mineral production in Iowa. It is gratifying to be able to state that the value of the output for the year was \$26,301,865, which is higher than any previous figure of record. In 1913 the value of the output was \$25,612,345 and in 1912 the value was \$22,910,066. A comparison of the value of the output in 1914 with that of 1905 shows that the value in 1914 exceeded that of 1905 by \$11,198,819, which is an increase of nearly seventy-five per cent in a decade. Coal continues to be the chief mineral produced. Its value at the mines in 1914 was \$13,364,070, which is \$132,640 less than the value for 1913. The five leading coal-producing counties in 1914 in order of tonnage were Monroe, Polk, Appanoose, Dallas and Marion. These five counties produced more than six million tons of the total tonnage, which was 7,451,022 tons, Monroe county alone producing 2,273,066 tons. The first three of the five counties mentioned have retained the same order of production for more than ten years. For many years previous to 1913, Mahaska county ranked fourth; in 1914 this county ranked sixth. In 1914 the average number of men employed in coal mining was 16,057, in 1913 the number was 15,757.

It is of interest to state that Iowa has one coal washing plant, which is located at Lakonta in Mahaska county.<sup>1</sup> In 1914 the quantity of coal washed at this plant was 25,706 tons, which yielded 18,000 tons of clean coal, and 7,706 tons of refuse.

The value of clay and clay products, which includes brick and tile, pottery and raw clay, was \$6,405,995 in 1914; in the previous year the value was \$5,575,581. In no year in the history of the state has the output of 1914 been exceeded. The values of the outputs in the three chief producing counties were as follows: Cerro Gordo county, \$1,555,944; Webster county, \$1,179,113; and Polk county, \$856,967. Iowa continues to lead all the states in the United States in the production of drainage tile. The value of this product sold in Iowa in 1914 was \$3,180,836. Wapello county leads in the production of pottery.

Since the year 1911 there have been three large modern cement plants in Iowa, two of which are located at Mason City,

<sup>1</sup>Kay, George F. The First Coal-washing Plant in Iowa. Iowa Academy of Science, volume XXII, pages 225 to 227.

the third at Des Moines. In 1914 the output of these three plants had a value of \$4,008,915. The highest figure previous to this year was in 1913, when the value of the output was \$3,972,876. Although the output has been increasing year by year there is every reason to believe that the maximum yearly output has not yet been reached. The three plants are thoroughly equipped and there are abundant supplies of limestone and shale, which are the materials being used in Iowa for cement making.

The gypsum industry in Iowa is in a most flourishing condition. In 1914 the value of the output from Webster county, the center of the industry, was \$1,321,547, the largest figure of record for the state.

The value of stone and lime in 1914 was \$594,681 compared with \$854,814 in the previous year. A large part of the stone was used for concrete and railroad ballast.

The value of sand and gravel produced in Iowa in 1914 was \$556,868; in 1913 the value of the output was \$528,066. The value of mineral waters in 1914 was \$30,179, and of other products including mineral paints, sand-lime brick and natural gas was \$19,700.

#### PLEISTOCENE GEOLOGY.

The geologists of the world who are especially interested in the Pleistocene have long recognized Iowa to be classic ground, and from time to time for more than twenty years the foremost geologists of both America and Europe have come to this state to see the interesting features that have been described by those who have made detailed studies of the glacial and interglacial deposits.

Among the many persons who, by their publications, have made known to the world the Pleistocene history of Iowa, no one has had a greater part than Doctor Calvin, who was for nearly twenty years Director of the Iowa Geological Survey. For many years, particularly from about 1895 until his death in 1911, important papers were written by him in the reports of the Iowa Geological Survey and in other channels of publication. It was he who, after he had done detailed work on the Pleistocene

of the northeastern and north-central parts of Iowa, became convinced that in this part of Iowa the evidence indicated that the ice had invaded the region, not twice only, as had been held formerly, but three times. To the uppermost of these drift sheets Doctor Calvin gave the name "Iowan," and in several publications he presented his arguments in favor of recognizing the Iowan as a distinct epoch in the Pleistocene. For a number of years the interpretations of Doctor Calvin were accepted, but a few years before his death some of the leading Pleistocene geologists of America, including Mr. Frank Leverett of the United States Geological Survey, who had spent several months in a field study of the problem, raised the question as to whether or not there was sufficient evidence to establish the glacial epoch, the Iowan, distinct from the Kansan. The matter was still in controversy at the time of Doctor Calvin's death in 1911. Since that time a favorable opportunity was awaited to secure a man who had a well established reputation as a Pleistocene geologist to review in the field all the evidence with reference to the Iowan problem and, if possible, to reach a judgment regarding this important phase of Pleistocene geology, which has been the source of so much difference of opinion. The Survey was fortunate indeed in 1914 in being able to secure in connection with this work the co-operation of the United States Geological Survey. An agreement was reached whereby Dr. W. C. Alden, Chief of the Pleistocene Section of the United States Geological Survey, should undertake the investigation. As the representative of the Iowa Geological Survey Mr. M. M. Leighton was appointed to assist him. Work was begun during the past summer and will be continued in 1915. It is hoped that when this investigation is completed a valuable report may be published in which the problem of the Iowan drift will be discussed fully, and that conclusions may be reached which will be satisfactory to all students of Pleistocene geology.

During the year Mr. M. M. Leighton has submitted for publication a very thorough paper on the Pleistocene History of Iowa River Valley, North and West of Iowa City in Johnson county, Iowa.

## PALEONTOLOGIC GEOLOGY.

An important paper entitled "Trilobites from the Maquoketa Beds of Fayette County, Iowa," has been furnished to our Survey for publication by Mr. Arthur W. Slocum, who was for many years connected with the paleontologic branch of the Field Museum of Natural History of Chicago. The thanks of the Survey are due the officers of the Field Museum and to Mr. Slocum for permitting our Survey to reprint, with the original illustrations, a valuable paper dealing with one of the ancient groups of life from an important stratigraphical horizon in our state.

## IRON ORE INVESTIGATIONS.

For many years the iron ore deposits at Waukon, Iowa, have been of scientific interest, and it has been hoped that with proper treatment these ores might be made of commercial importance. As a result of the thorough methods of investigation of the Waukon Iron Company this hope is, apparently, soon to be realized. During the past summer Jesse V. Howell made a detailed study of these interesting deposits, including their methods of occurrence, geological relations, their origin, and the probable quantity of ore. The results of Mr. Howell's investigation have been submitted for publication. His paper is an important contribution to the literature regarding the class of iron ore deposits to which the Waukon beds belong.

## THE ORIGIN OF DOLOMITE.

The origin of dolomite has been the subject of much investigation for many years, and yet the conclusions that have been reached by the several investigators have not been wholly in agreement. The Survey realized for many years that there was probably no better place in America for the study of the origin of dolomite than in Iowa, since dolomites and related limestones are well exposed in many parts of the state and at different stratigraphic horizons. It was, therefore, thought well to subject these interesting rocks to special study. Mr. F. M. Van Tuyl was chosen to carry forward the investigation. After much detailed work in the field and careful studies in the laboratory,

he has prepared a paper which, it is believed, will be considered, for some years to come, an authoritative work on dolomite and will be consulted freely by those who are interested in the subject with which it deals.

#### NATURAL HISTORY INVESTIGATIONS.

Bulletins on Natural History are now in preparation as follows:

Mollusca, by Prof. B. Shimek.

Rodents, by Mr. Dayton Stoner.

Hawks and Owls, by Dr. B. H. Bailey and Dr. T. C. Stephens.

Orthoptera, by Prof. M. P. Somes.

#### GEOLOGIC HISTORY OF DES MOINES VALLEY.

As a part of the larger plan of making a broad study of the surface geology of the state it was thought well to examine in detail the physical features of Des Moines valley, this being the largest river valley within the state and offering excellent opportunity for a study of the processes of valley formation and stream work. A few years ago, Dr. James H. Lees began this work and he has now prepared a report of his investigations. This report includes a description of the valley itself, a discussion of the forces which have shaped it and an outline of the geologic history through which it has passed. It is hoped that this paper will be of value in the study of Iowa physiography and will help to make plain the history of the development of the surface features of our state.

#### OFFICE WORK OF THE SURVEY.

The Iowa Geological Survey continues to be for the people of Iowa and for many persons outside the state a reliable source of information regarding the mineral resources and other geological features of the state. There has never been in the history of the Survey greater demand than during the past year for the services of the Survey. There has been correspondence in connection with many phases of the geology of the state, and

it has been the aim of the Survey at all times to furnish the information desired, whether it consisted only in naming a mineral that had been submitted for identification or in offering advice to those seeking investment in the state. The demand for the publications of the Survey has been so great that the editions of several of the reports and maps have been exhausted. In connection with the office work and in various other ways I wish to express my indebtedness to Dr. James H. Lees, Assistant State Geologist, and also to Miss Nellie E. Newman who has been for many years the efficient secretary of the Survey.

## REPORTS FOR PUBLICATION.

I take pleasure in submitting to you the following papers, and recommend that they be published as Volume XXV, which is the Twenty-third Annual Report of the Iowa Geological Survey:

Mineral Production for 1913 and 1914, by George F. Kay.

The Iron Ore Deposits near Waukon, Iowa, by Jesse V. Howell.

Pleistocene History of Iowa River Valley, North and West of Iowa City in Johnson County, by M. M. Leighton.

Trilobites from the Maquoketa Beds of Fayette County, Iowa, by Arthur Ware Slocom.

The Origin of Dolomite, by Francis M. Van Tuyl.

Physical Features and Geologic History of Des Moines Valley, by James H. Lees.

Respectfully submitted,

GEORGE F. KAY.

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The first part of the report is devoted to a description of the  
methods used in the investigation. The second part is devoted to  
a description of the results obtained. The third part is devoted to  
a discussion of the results and a comparison with the results  
obtained by other investigators. The fourth part is devoted to  
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