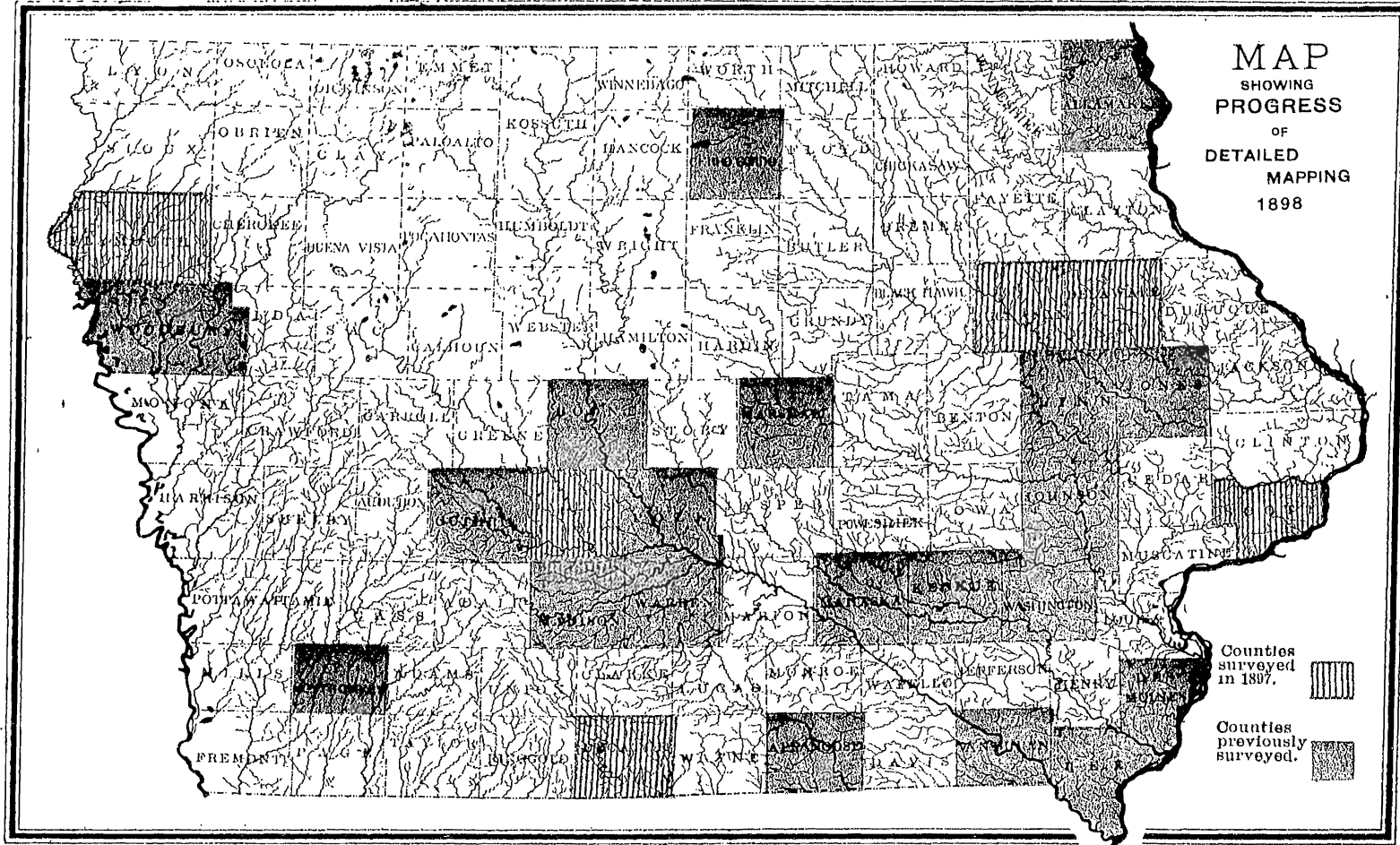

ADMINISTRATIVE REPORTS.







SIXTH ANNUAL
Report of the State Geologist.

IOWA GEOLOGICAL SURVEY, }
DES MOINES, December 31, 1897. }

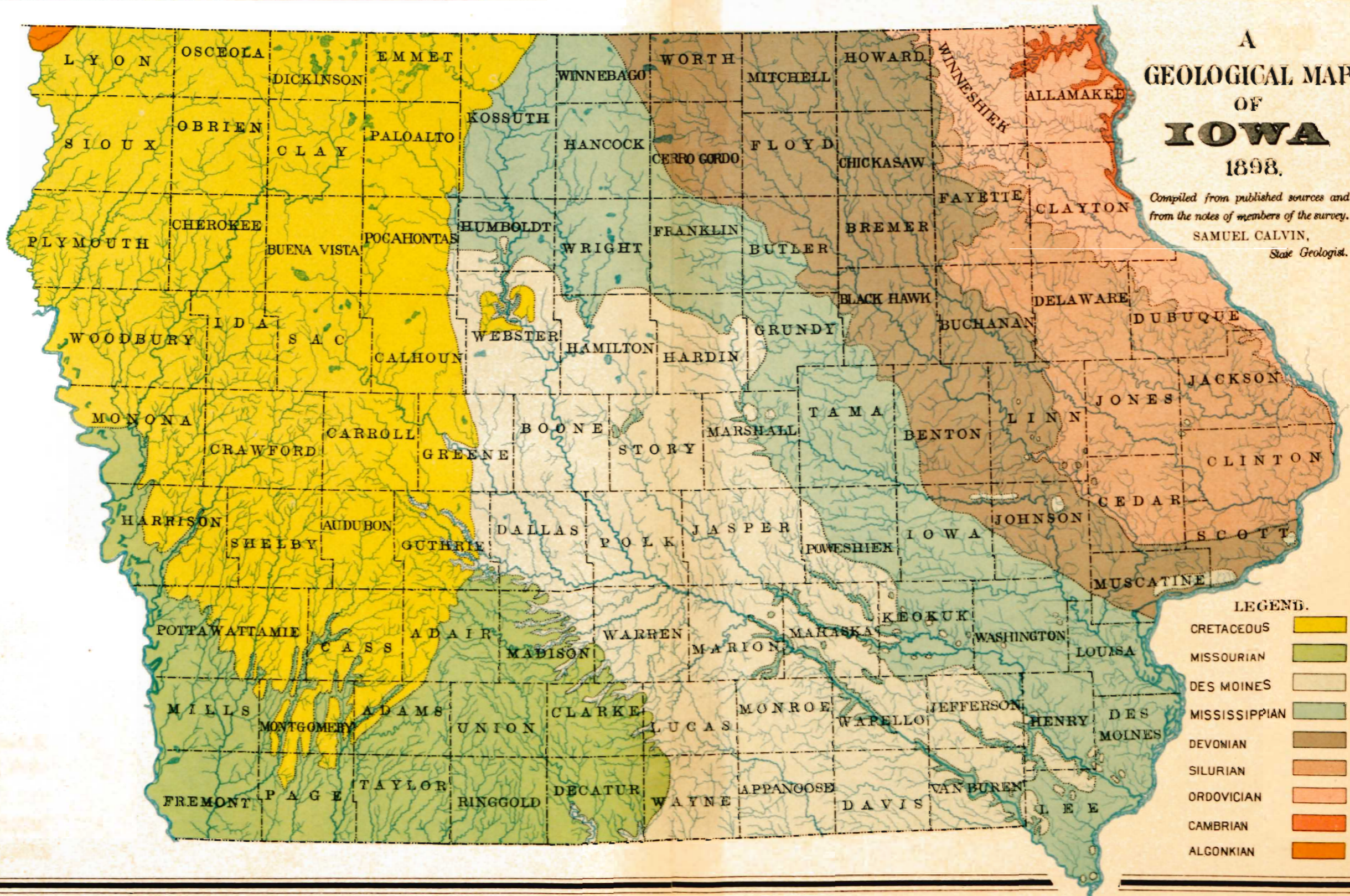
To Governor Francis M. Drake and Members of the Geological Board:

GENTLEMEN—The work of the Iowa Geological Survey for the year 1897 has followed, in general, the plans submitted and approved at the beginning of the year. The relation of the Survey to the public, however, is such that it is impossible to provide by any general scheme beforehand for all the lines of work that must necessarily be followed during any given year. Special cases arise, unexpected problems are met from time to time, and each must be dealt with promptly in accordance with the degree of importance that it seems to possess. The past year has been no exception. It has brought its share of new problems, and more than the usual share of work not foreseen when the general plans were made at the beginning of the season.

The areal work has been fully completed in accordance with the original plans. Mr. A. G. Leonard finished the survey of Dallas county, and has submitted a full manuscript report with the necessary maps and illustrations. Prof. W. H. Norton devoted the field season to making a thorough survey of Scott county, though the written report is not yet in hand. Mr. H. F. Bain completed the work in Decatur and Plymouth counties; and I was able to finish the survey of Delaware and Buchanan counties. Reports on the counties mentioned are

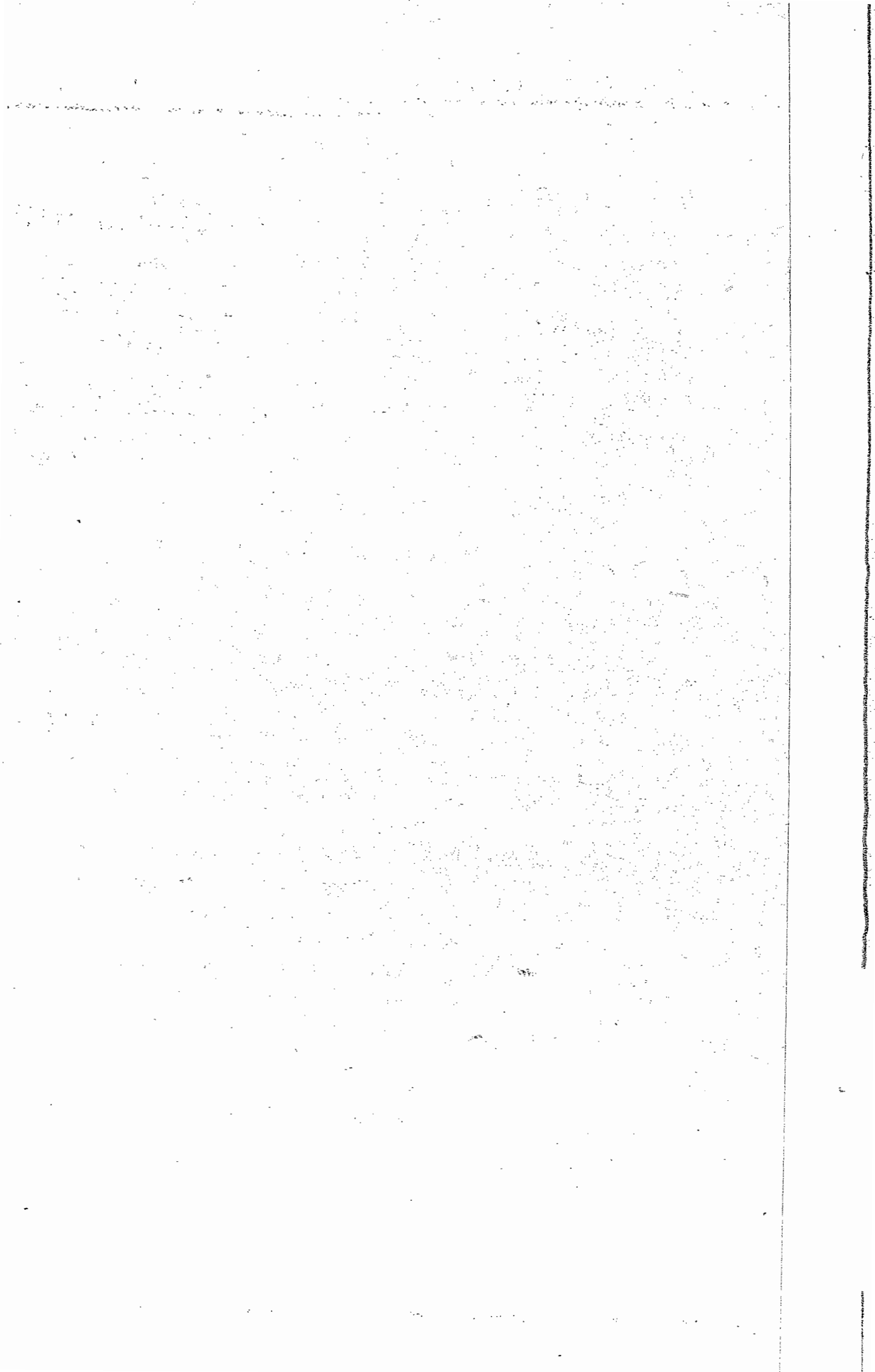
A GEOLOGICAL MAP OF IOWA 1898.

Compiled from published sources and
from the notes of members of the survey.
SAMUEL CALVIN,
State Geologist.



LEGEND.

- CRETACEOUS
- MISSOURIAN
- DES MOINES
- MISSISSIPPIAN
- DEVONIAN
- SILURIAN
- ORDOVICIAN
- CAMBRIAN
- ALGONKIAN



herewith submitted, and their publication as volume VIII of the reports of the Iowa Geological Survey is recommended.

With the work of the present year the mapping has been completed in twenty-six counties. The area so surveyed is indicated on the accompanying map (plate i). It is to be understood that only those counties in which the areal work has been completed are indicated. Some work has been done in every county in the state, and in many it will require but little additional work to make a complete report. It should also be noted that the map shows only the progress of the areal work. The special studies of coal, clay, artesian waters, gypsum, lead, zinc, etc., which have quite legitimately absorbed so considerable a portion of the funds and time of the Survey, have been in addition to the work of mapping.

The regular office work of the Survey has been carried on as heretofore. During the first six months Mr. Leonard remained in charge, but at the end of that time Mr. Bain's leave of absence expired, and he resumed active duties. During the entire year Miss Newman has as usual been employed in the work of correspondence, distributing reports, checking exchanges, type-writing manuscripts, and attending to other routine work inseparable from effective office management.

□ Within the year the final portion of volume VI was printed and the volume has been distributed. Volume VII has been printed and bound, and has been partially distributed. Both volumes have met with a very cordial reception. Volume VI especially has been widely reviewed and generously commended by scientists and practical engineers who are devoting themselves to problems of water supply, in all parts of the country. The report of Mr. Bain on the geology of Polk county, in volume VII, is one of the most important so far published, from an economic point of view, and it is a pleasure to note that it has received the public recognition which it deserves. The report on Cerro Gordo county was regarded as of so much local importance as to deserve publication almost entire, in the newspapers of Mason City, and each of the other reports in

this volume has been welcomed locally as a contribution to knowledge of the highest practical value. Beyond the limits of the state the reception has been no less flattering, and the many letters of commendation received give assurance that the work of the Survey is meeting the just expectations of the people of Iowa in disseminating a knowledge of the great resources of our matchless state.

In connection with three of the formations incidentally brought under view in following out the original plans relating to areal geology, a large amount of unexpected field work was rendered necessary. In company with Mr. Bain I spent several days in Madison and Guthrie counties, making detailed studies, chiefly for purposes of correlation in other counties, on the limestones of the upper coal measures. In this work we were accompanied part of the time by Professor Tilton of Indianola. Problems connected with the Rockville conglomerate and other formations in Delaware county, necessitated investigations in Dubuque and Allamakee counties. In part of this work I was assisted by Mr. Bain, and in Delaware and Dubuque counties we had the advantage of being accompanied by Professor Salisbury of the United States Geological Survey. Mr. Leverett, special assistant in Pleistocene geology on the United States Survey, joined us in an investigation of the drift and associated deposits in Muscatine and Scott counties. We also had the assistance here of Professor Udden, of Augusta College, whose special knowledge of the region was of great value. The work of Mr. Bain in Plymouth county could not be satisfactorily completed without extended observations in a number of adjacent counties, of which observations an account will be found in his annual report hereto appended.

As in the preceding years, a considerable portion of our time has been spent in the study of problems connected with the drift, and very gratifying progress has been made. It has been our object to map the different drift sheets and surface formations as a preliminary step toward making an accurate soil map of the state. By the close of the present

field season it was felt that the work had progressed sufficiently to warrant the undertaking of soil studies *per se*. The Survey itself has, however, neither the funds nor the laboratory necessary for this work, so an application for assistance was made to the United States Department of Agriculture and proposals for co-operation in the work submitted. The chief of the division of soils, Prof. Milton Whitney, readily agreed to take up the work as soon as the means at his disposal would allow it, and has incorporated in his requests for the coming year an item with reference to the Iowa work. If this be allowed, the more direct work of soil study will be immediately taken up and the characteristics and proper treatment of the soils resulting from the various formations outlined on our maps, will be determined.

Some unforeseen work became necessary on account of the meeting of the International Gold Mining convention, in the early part of July last, at Denver, Col. At the request of Governor Drake, I prepared a paper on the "Mining Resources of Iowa," and attended the convention in person as a delegate from this state. On the organization of the convention, however, it was ruled that only papers relating directly to gold mining should have a place on the program; but though the paper could not be formally presented to the convention, it was widely published in the journals of Iowa, as well as in some located outside the state.

By request, a paper on the Pleistocene history of our state was contributed to the Annals of Iowa, and another dealing with the history and genesis of our soils was prepared for the meeting of the State Horticultural society.

Mr. Bain was asked to prepare for the London meeting of the Federated Institution of Mining Engineers, a paper upon "Coal Mining by Machinery in Iowa," a subject to which he had devoted some attention. The paper was prepared and read, though Mr. Bain was unable to attend the meeting in person. It is now being printed in the transactions of that body and it is hoped ultimately that this and other phases of

mining as carried on in Iowa may be adequately treated in one of the Survey reports. The fact that some of the first mining machines were tried in Iowa mines, and that some of the most successful have been invented here, makes the subject one of particular interest.

A not unimportant portion of the work of the Survey consists of answering inquiries relative to the location of deposits of various minerals in the state and their possible development. On the one hand, various citizens send to the Survey office samples of clay, stone, coal, sand or other minerals which they think are valuable, and on the other, intending investors inquire with reference to the location of deposits which they are interested in developing. It is the province of the Survey to bring these two classes together; a work which is greatly aided by the industrial departments of the various railway lines. It is not possible, of course, in every case to give a favorable report, but if the sample selected is of good quality and the other factors which must be taken into account in any development seem favorable, a personal inspection of the deposits as far as possible, is made; and the matter is then brought to the attention of parties likely to be interested. There are many inquiries, of course, for substances which do not occur in the state, but within the year inquiries have been received relating to the following substances, all of which occur, and probably at no distant date may be developed: Cement, chalk, clay, coal, flint, gypsum, lime, marble, ochre, stone, lead, iron, mineral paint, peat, and limestone pure enough for use in connection with the manufacture of beet sugar. In certain cases our work has led directly to placing orders with Iowa firms, and in other cases negotiations are now under way for the opening up of hitherto unworked deposits. The office has received many letters of thanks for such services, showing that our efforts are appreciated by those interested.

It should not be forgotten that a report by a disinterested state officer receives much more consideration than any given by local commercial bodies or interested parties; and, that

entirely aside from these immediate and special instances, the resources of the state are being widely advertised in the best possible way by the regular reports of the Survey. Indeed these special inquiries usually follow the purchase of one or more of the Survey reports. Several of the substances noted above are in great demand and the Survey can readily interest capital in the development of most of them if the beds are up to the standard in quality. We would be glad to have notes on deposits of any of the minerals mentioned, since in the large portion of the state yet unsurveyed, there must be many beds worthy of development. In this work we have been somewhat hampered by reason of the fact that we have neither a well equipped laboratory nor sufficient funds for the exhaustive chemical and physical tests so often desirable. In many cases, however, the latter are not necessary, and much can be done even with the present facilities.

Early in the spring a local company was organized at Stuart for the purpose of prospecting for coal. Mr. Bain visited Stuart and consulted with the officers of this company with regard to the work. He told them that there was coal in the region, and that extensive prospecting would probably develop a good field, but that a few drill holes would not be decisive either way. The company decided to spend a small sum at least in the work, and two holes were put down. The first was evidently in an abandoned river channel as is shown by the record inserted in the Guthrie county report while the latter was in press*. The second showed slightly thicker coal. The prospecting was not extensive enough to settle the question of the presence or absence of workable coal in the region, but the results, so far as the work went, are on the whole favorable.

In accordance with resolutions passed at your July meeting, statistics of production of various minerals mined in the state are now being collected. Blanks have been made out and mailed to the various producers, and the returns so far

*Vol. VII, p. 476.

made indicate that the report will be general and hearty. There has heretofore been in Iowa no regular bureau for the collection of such statistics year by year, except in the case of coal, where the returns are made for the fiscal year and are published biennially. The statistics collected by outside agencies are necessarily incomplete, and each year injustice is done to the Iowa fields, thereby discouraging investment and making it more difficult to obtain adequate capital for the development of the resources of the state. It is believed that the careful collection and prompt publication of statistics, showing the production and value of the various minerals for each calendar year, and so allowing comparisons with other states to be made, will be of very great benefit to the state. Such a result can only be accomplished with the assistance of the producers themselves. We wish to do full justice to all interests, and have urged upon them the necessity of co-operation. In no case will the facts relating to the details of private business be published or disclosed. It is desired to publish the totals for the state, and to show the products county by county, whenever this can be done without disclosing facts of private character.

The importance of this work is very great. The collection and prompt publication of statistics allows something of an estimate to be made of the probable demand for the ensuing year. It also shows the growth of the various industries and so encourages investment and opens up the way for the development of new industries. The educational value is inestimable. By some peculiar trait of mind, we constantly minimize the value of the mining development going on around us, while the much more hazardous risk of investment in gold mines far away exerts a seductive influence hard to withstand. It is undoubtedly true that the best policy for any people is the fullest and most complete development of the natural resources of their own territory, and anything promoting that development deserves their hearty support. In the present case the producers are quite uniformly aiding the

Survey in its work, and as from year to year the mailing lists become more complete, it is hoped that the statistics may be more and more accurate. It is too early to give results more than to say that there has in general been a gratifying increase in business in several lines. Many brick companies report the trade for 1897 from 40 to 100 per cent better than for 1896; but in a large number of cases considerable stocks had been carried over from the preceding year. The paving brick industry has expanded remarkably. The gypsum industry is in a healthy condition, the Duncombe mill having been rebuilt with increased capacity and a new company having begun work. It is hoped that full statistics will be in hand before this volume has gone through the press, so that they may be published in it. Otherwise, they will be published as a special bulletin designed for immediate distribution. The work of collecting and tabulating the figures has been placed in the hands of Miss Newman.

The topographic work in Iowa, which was renewed last year by the United States Geological Survey, was continued during the working season of 1897. The territory covered by the United States topographers embraces a part of Dubuque county lying within the Driftless Area, and it is a pleasure to report that it is the purpose of the Director of the United States Survey to continue the work until the whole of the Driftless Area included in Iowa has been topographically mapped. It is also a pleasure to note here the care being taken in making these maps, and their great accuracy. It is impossible to estimate the importance of this work to the Iowa Survey. A good topographic base map is absolutely essential to successful geological work in such a region as the Driftless Area. It would be impossible, under present conditions, for the Iowa Survey to bear the great expense involved in making such a map, and yet without it we are practically prohibited from taking up work in some of the most important counties in Iowa. In the drift covered portions of the state there is no very intimate relation between topography and

geological structure; in the Driftless Area topography and geological structure are inseparable. In the extreme north-western portion of the state mapping has also been carried on, portions of Lyon and Sioux counties having been covered this season.

The officers of the Survey have been in communication with the Iowa Commission of the Omaha and Trans-Mississippi Exposition, relative to co-operation between the two organizations in the work of securing for Iowa an adequate representation of her mineral wealth. It is thought to be particularly important that the mineral resources of the state be fully displayed, since the exposition, being distinctly a western affair, will naturally attract many mining engineers and mine owners; men who, it is particularly desired, should have clear ideas of the importance of our coals, clays, cement rocks, etc., since they can be of especial assistance in securing the adequate development of these beds. It is also important to correct the misapprehension, widespread in the popular mind, that Iowa possesses no important sources of wealth other than agricultural. While the state must always depend largely upon its soils, its mining interests are by no means unimportant. When our mineral resources are fully developed, the disparity will be even less. I believe it to be within the province of the survey, in its work of educating the people of the state and advertising our resources to outsiders, to undertake an exhibit at Omaha, and I would respectfully urge upon your honorable body the advisability of taking some action looking to that end. The commission has shown itself very ready to co-operate with the Survey in the work, and it is believed that a fitting exhibit can be made at comparatively low cost. To this end I would respectfully ask that permission be given to lend for this purpose such specimens, cases, maps, photographs and data as may seem advisable, provided that the matter can be arranged without diverting the funds appropriated for the regular work of the Survey; and provided, also, that suitable guarantees be given for the safe

return of the property. I would also ask that the officers of the Survey be allowed to spend such time as may be necessary in this connection, provided the matter can be arranged without interrupting the regular Survey work.

The Museum.—Additions of scientific and economic importance have been made to the museum during the past year, but it should be understood that the Survey is not prepared at present to expend much effort in making geological collections. The collection of specimens suitable for museum purposes requires time, and our field parties have usually been compelled to devote all the time at their command during the field season, to simply observing and recording the phenomena presented by the area they are directed to cover. In the second place parties in the field are not provided with means for transporting heavy material from the geological exposures to the railway stations. The cleaning, labeling and arranging of specimens in the museum is a task of no small magnitude, and it is believed that other lines of work are just now more pressing and better deserve the attention of the force in the office. Lastly, our present quarters are too small to afford space for the display of collections. Nevertheless some specimens are gathered as a matter of necessity, for there are many things that can only be satisfactorily studied in the office or the laboratory. Those that are of permanent value are added to the collections, but some are of no further use after they have been determined. In all cases parties in the field are directed to preserve specimens of more than usual interest, and the economic side of geology, as far as our space permits, is well represented by materials kindly contributed by manufacturers and quarrymen. A large amount of valuable material, in the form of the well borings collected and studied by Professor Norton in the preparation of his monograph on Artesian Wells, has been deposited at the office of the Survey, but this cannot be displayed, nor even made accessible to students at present, for lack of space.

As in previous years no effort has been made to build up by

purchase the Survey library. The excellent facilities offered by the state library and the continued co-operation of the State Librarian have relieved the Survey from this drain upon its funds. Nevertheless we are receiving in exchange for our reports a considerable number of books and pamphlets, many of which could not be obtained by purchase, and all of which are valuable. The leading mining and geological publications both of this country and Europe come regularly to the office of the Survey, and are of great service in its work. A list of the more important serials, aside from the publications of the national and various state surveys, is appended. Many not found in this list come to the state library and in such cases no effort has been made to effect an exchange:

- Archi. Sci. Phys. et Nat. (Genève.)
- Acta Regia Soc. Physiog. (Lund.)
- Amer. Manf. Iron World. (Pittsburg.)
- Ann. Rep. Dept. Mines, Agri. N. S. W. (Sydney.)
- Ann. Rep. Min. Mines Brit. Col. (Victoria.)
- Atti. Soc. Ital. Sci. Natur. (Milano.)
- Ber. Thät. St. Gallischen Nat. Wis. Gesell. (St. Gall.)
- Black Diamond. (Chicago.)
- Bol. Inst. Geol. Mexico. (Mexico.)
- Bol. Soc. Geog. Italiana. (Roma.)
- Mem. idem. (Roma.)
- Brickbuilder. (Boston.)
- British Columbia Mining Record. (Victoria.)
- Bul. Com. Géol. Finlande. (Helsingfors.)
- Bul. Geol. Inst. Upsala. (Upsala.)
- Bul. Lib. Mus. St. Laurent Col. (Montreal.)
- Bul. Minnesota Acad. Nat. Sci. (Minneapolis.)
- Bul. Nat. Hist. Soc. New Brunswick. (St. Johns.)
- Bul. Soc. Géol. de Normandie. (Havre.)
- Canadian Geol. Surv. Reports. (Ottawa.)
- Cement Eng. News. (Chicago.)
- Chicago Acad. Sci. Bul. (Chicago.)
- Clay Record. (Chicago.)
- Clay Worker. (Indianapolis.)
- Coal Trade Journal. (New York.)
- Colorado College Studies. (Colorado Springs.)
- El Minero Mexico. (Mexico.)
- Eng. Min Journal. (New York.)

- Festsch. Naturfor. Ges. Zurich. (Zurich.)
 Geol. Comm. Cape Good Hope Repts. (Cape Town.)
 Helios. (Berlin.)
 Industrial Advocate. (Halifax.)
 Iowa Agri. Ex. Sta. Bul. (Ames.)
 Johns Hopk. Univ. Circulars. (Baltimore.)
 Jour. Cincinnati Soc. Nat. Hist. (Cincinnati.)
 Kansas Univ. Quart. (Lawrence.)
 Liverpool Geol. As. Jour. (Liverpool.)
 Meddel. fran Industries Finland. (Helsingfors.)
 Meded. Omtr. Geol. Van Nederland. (Amsterdam.)
 Mem. Soc. Géol. du Nord. (Lille.)
 Mem. and Proc. Manchester Lit. Philos. Soc. (Manchester.)
 Mines and Minerals. (Scranton.)
 Mining. (Spokane.)
 Mining Bulletin. (Sta. Col. Pa.)
 Mit. Min. Mus. Univ. (Bonn.)
 Mit. Nat. Wis. Ver. Steiermark. (Graz.)
 Mon. Rev. Iowa Weather Ser. (Des Moines.)
 Mus. Civ. Storia Nat. (Milano.)
 Proc. Amer. As. Adv. Sci. (Salem.)
 Proc. Calif. Acad. Sci. (San Francisco.)
 Proc. Colorado Sci. Soc. (Denver.)
 Proc. Portland Acad. Sci. (Portland.)
 Proc. Rochester Acad. Sci. (Rochester.)
 Repts. Dep. Mines Victoria. (Melbourne.)
 Repts. Govt. Geologist Queensland. (Brisbane.)
 Sitzber. k. Böhm. Gesel. Wiss. (Prag.)
 Societatum Litteræ. (Frankfurt, A. O.)
 Stone. (Chicago.)
 Term. Fuz. Magyar Tudos. Akad. Segelyerel. (Buda Pest.)
 Trans. Amer. Inst. Min. Eng. (New York.)
 Trans. N. of E. Inst. M. M. E. (Newcastle-upon-Tyne.)
 Trans. Roy. Geol. Soc. Cornwall. (Penzance.)
 Trav. Sec. Géol. du Cab. de Sa Maj. (St. Petersburg.)
 Univ. Calif. Bul. Dept. Geol. (Berkeley.)
 Univ. Idaho Exper. Sta. Bul. (Moscow.)
 Verh. Schweizerischen Natfor. Gesell. (Zurich.)
 Vierteljahr. Natfor. Gesell. (Zurich.)

It is gratifying to note the increased use of the reports of the Survey, as works of reference, or works for general study, in high schools and other educational institutions. Progressive teachers have been quick to recognize the educational value of trustworthy texts relating to the physical geography

and geological phenomena of regions with which the students are personally acquainted. The economic problems treated in the reports are subjects with which all persons of liberal culture should become familiar before leaving the schools and entering business pursuits. A man of broad information relating to the actual structure of the earth's crust in his own locality, one who looks at the world intelligently and knows what geological products of economic value may with reason be expected to occur, and what may not, will be a far more useful citizen than he who without intelligence organizes companies and wastes means in attempts to exploit natural products where such products could not, by any possibility, exist. Untold sums of money have been wasted in searching for oil, gas, coal, lead and other useful substances in regions where such substances could not occur. All the waste of such energy and means, and all the consequent disappointment might have been spared had the persons concerned possessed the information which a survey, such as is now in progress, places within the reach of every individual of ordinary intelligence. Knowledge is vastly more valuable to every community than ignorance, and to the extent that the Survey reports diffuse knowledge, to that extent, if in no other way, are they performing a mission of incalculable value to the state of Iowa. And so I repeat that it is gratifying to note the increasing use of our reports as texts in institutions devoted to higher education. Applications for reports for use in classes, coming from high school men, are very numerous, and normal schools and colleges are using them in a way that promises a more intelligent appreciation of the natural resources of our grand state by the generation soon to become the leaders in business and other lines of human activity.

I have the honor to remain, gentlemen, with great respect,

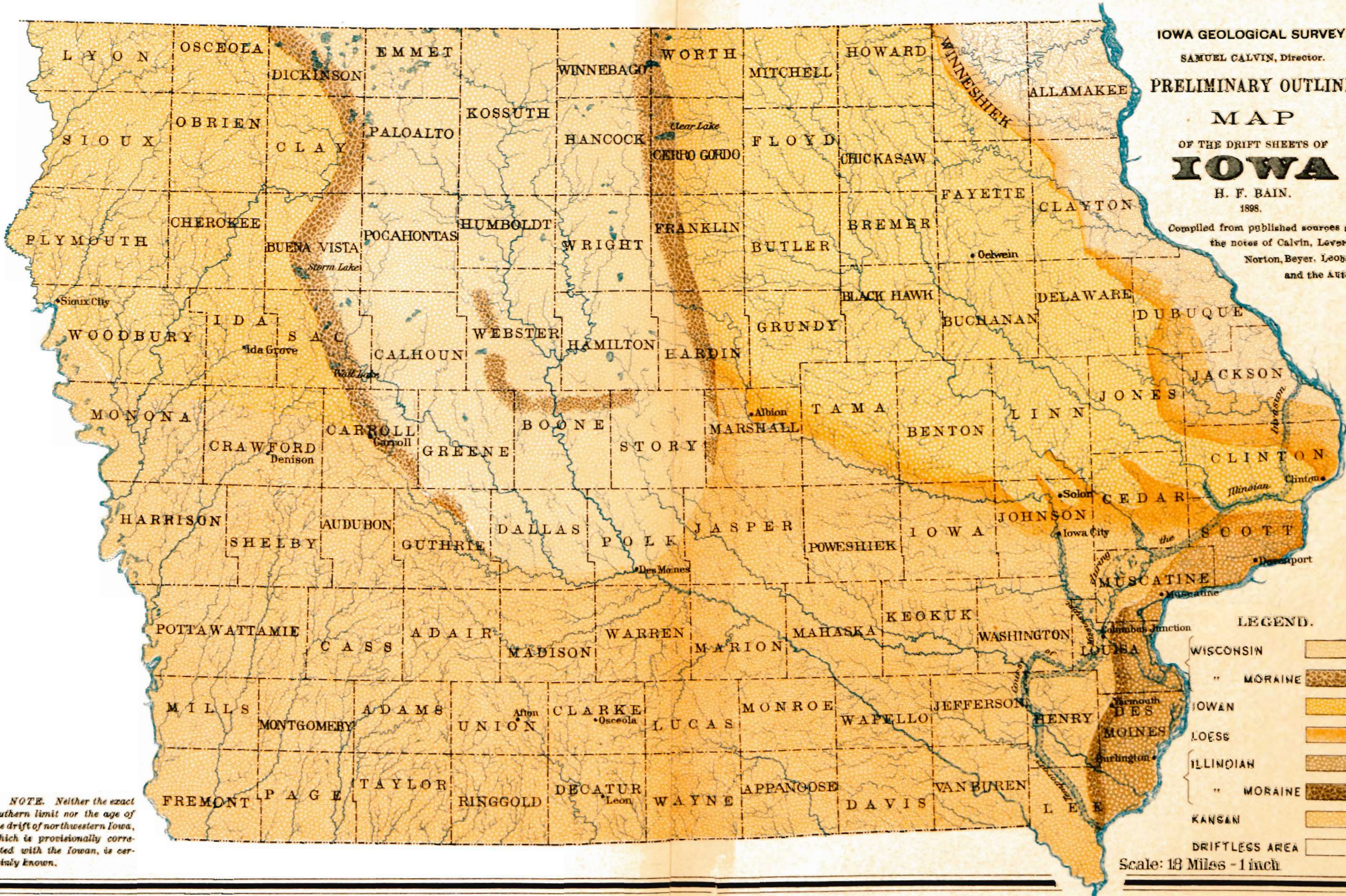
Your obedient servant,

SAMUEL CALVIN,
State Geologist.

IOWA GEOLOGICAL SURVEY,
SAMUEL CALVIN, Director.
PRELIMINARY OUTLINE

MAP
OF THE DRIFT SHEETS OF
IOWA
H. F. BAIN.
1898.

Compiled from published sources and
the notes of Calvin, Leveque,
Norton, Beyer, Leonard
and the Author.



LEGEND.

- WISCONSIN
- " MORAINE
- IOWAN
- LOESS
- ILLINOIAN
- " MORAINE
- KANSAN
- DRIFTLESS AREA

Scale: 18 Miles - 1 inch

NOTE. Neither the exact southern limit nor the age of the drift of northwestern Iowa, which is provisionally correlated with the Iowan, is certainly known.

The first of these is the fact that the United States is a young nation. It has only been about 150 years since it was founded. This is a very short time in the history of the world. The second is the fact that the United States is a large nation. It covers a vast area of land and has a large population. The third is the fact that the United States is a rich nation. It has many natural resources and a high standard of living. The fourth is the fact that the United States is a powerful nation. It has a strong military and a large economy. The fifth is the fact that the United States is a free nation. It has a long tradition of freedom and democracy.

The sixth is the fact that the United States is a diverse nation. It has many different ethnic groups and cultures. The seventh is the fact that the United States is a peaceful nation. It has a long history of peace and stability. The eighth is the fact that the United States is a progressive nation. It has many new ideas and inventions. The ninth is the fact that the United States is a democratic nation. It has a system of government that is based on the principles of democracy.

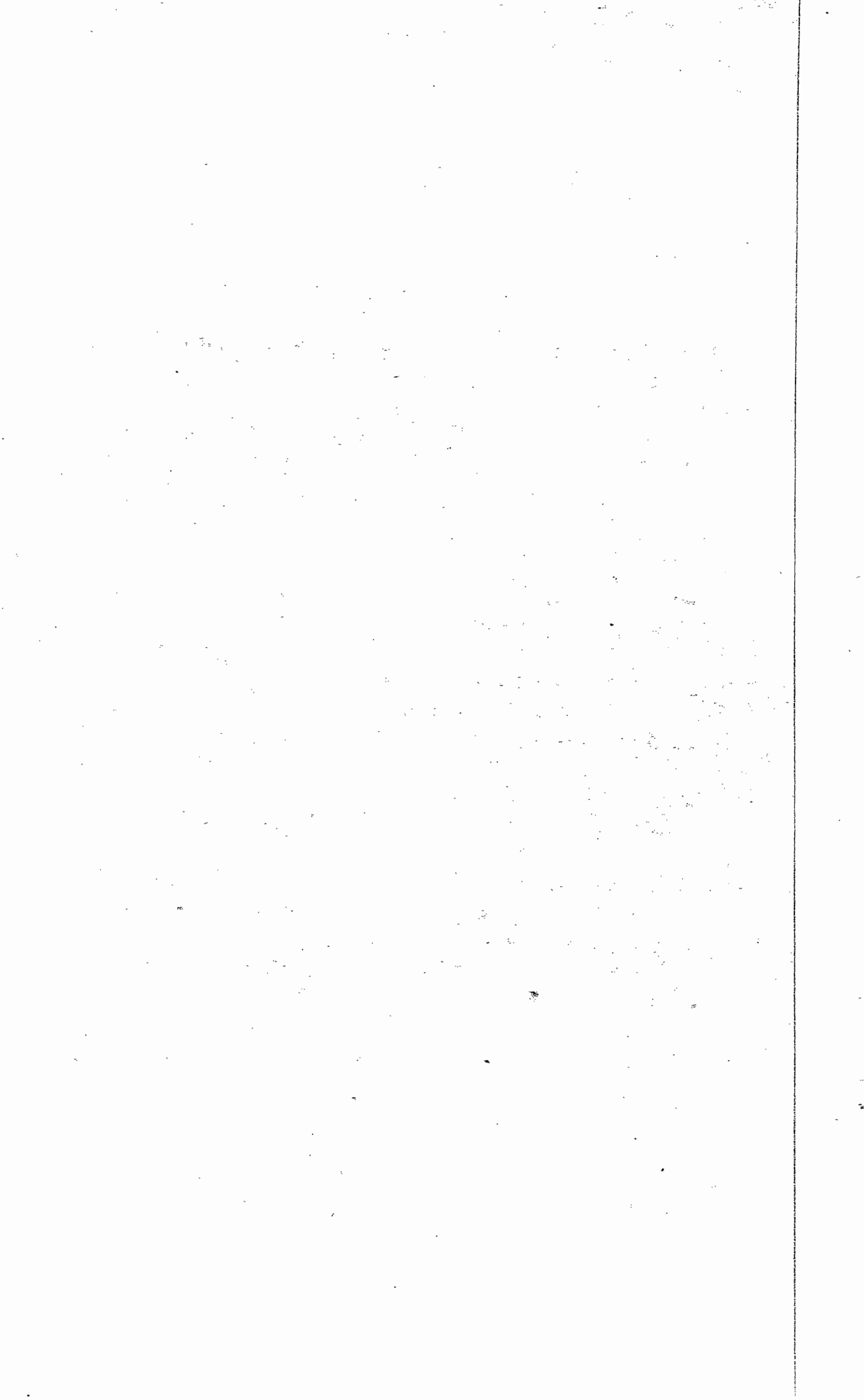
The tenth is the fact that the United States is a nation of opportunity. It has many chances for people to improve their lives. The eleventh is the fact that the United States is a nation of hope. It has a bright future. The twelfth is the fact that the United States is a nation of love. It has many people who care for each other. The thirteenth is the fact that the United States is a nation of justice. It has a system of laws that is fair and just. The fourteenth is the fact that the United States is a nation of freedom. It has a system of government that protects the rights of all people.

The fifteenth is the fact that the United States is a nation of progress. It has many new ideas and inventions. The sixteenth is the fact that the United States is a nation of peace. It has a long history of peace and stability. The seventeenth is the fact that the United States is a nation of justice. It has a system of laws that is fair and just. The eighteenth is the fact that the United States is a nation of freedom. It has a system of government that protects the rights of all people.

The nineteenth is the fact that the United States is a nation of opportunity. It has many chances for people to improve their lives. The twentieth is the fact that the United States is a nation of hope. It has a bright future. The twenty-first is the fact that the United States is a nation of love. It has many people who care for each other. The twenty-second is the fact that the United States is a nation of justice. It has a system of laws that is fair and just. The twenty-third is the fact that the United States is a nation of freedom. It has a system of government that protects the rights of all people.

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REPORT OF THE ASSISTANT STATE GEOLOGIST.

IOWA GEOLOGICAL SURVEY, }
DES MOINES, December 31, 1897. }

MY DEAR SIR—Upon my return to Des Moines in June, I assumed charge of the office work, at that time in the hands of Mr. Leonard. I have since been employed as usual in the routine work of the office and museum. Such time as could be spared has been spent in the field. Two general classes of problems have been under study. The first related especially to the Carboniferous of the southern and southwestern portion of the state, the second to the drift exposures of the northwestern counties. In connection with the former, the drift of the southern counties was to some extent studied, and the latter afforded the opportunity to add something to our knowledge of the Cretaceous.

After a review of the Carboniferous exposures of Madison county, a trip down Grand river, starting at Afton in Union county, was made for the purpose of correlating the Missourian rocks of the southern portion of the state with those found in the central portion. The section first made out in company with yourself and Professor Tilton in Madison county, and consisting of the four limestones called the Fusulina, Winterset, Earlham and Fragmental, were easily recognized as far south as Bethany, Mo., the typical locality for the Bethany limestone. In later excursions, the limestone and underlying beds were studied and mapped in detail in Decatur county, and have been less exactly mapped in Clarke county.

The study of the gravels and associated deposits at Afton was taken up early in the season, and several field trips were

made through Union county, the reconnoissance work being carried as far as Bridgewater in Adair county and Albia in Monroe county. It was found that, except by taking more time than seemed advisable just at this time, it would be impossible to make a full report upon the subject within the present year; and, accordingly, after consultation with you, the field of operations was changed from Union to Decatur county. A full report upon the latter has been completed and is herewith submitted. A preliminary report upon the Aftonian beds was prepared and read before the winter meeting of the Iowa State Academy of Sciences. Incidentally, but in connection with the study of the drift, some attention was paid to the ballast clays burned at Maxon, Brush and Davis City. The clay ballast industry is rapidly making headway. The introduction of improved machinery, largely invented in Iowa, has cheapened the cost so much that the material, under certain conditions, competes with gravel by virtue of this alone. Over much of southern Iowa gravel is very rare or entirely absent, so that in this region burned clay must always be the main reliance of railway engineers. Its many peculiar advantages make it a welcome substitute for gravel, and will, in time, doubtless lead to its wide use on country roads, as well as in railway construction and maintenance. It is pleasant to be able to report that the supply of suitable material is, so far as Iowa is concerned, very widely distributed and practically inexhaustible. A paper upon the subject has been prepared for the Mineral Industry, with a view to attracting attention to our resources in this line. In connection with the work in this region, a careful study was made of the coal fields of Lucas county, and advice to certain parties prospecting there, relative to depths of holes and similar matters, given. The results have been all that could be desired, as the drill located workable coal to the extent of between two and three million tons.

In the work in the northwestern portion of the state, the

main results have been (1) the discovery of certain chalk and clay beds near Le Mars, the second important exposure of these beds found east of the Missouri-Big Sioux valley; (2) the approximate determination of the southern limits of the Iowan (?) drift sheet in the region, and (3) the gaining of considerable light upon the physiography of the region and the history of the loess deposits. A detailed report upon Plymouth county has been written and is now being illustrated.

In addition to the work in Plymouth and Decatur counties, together including 1,394 square miles, work has been carried on in various counties as given below:

Union.—A study of the drift at Afton Junction and Thayer has been made. The Carboniferous rocks along Grand river have been visited and correlated. The clay pits of the entire county have been visited and some attention has been paid to the surface materials near Creston and in the western portion of the county.

Adair.—A reconnoissance trip was made to Bridgewater and notes on the surface formations collected.

Clarke.—The quarries of the county were visited and the eastern edge of the Missourian mapped in detail over most of the county. The buried gumbo east of Osceola was carefully studied. The ballast pit at Brush was visited.

Madison.—A general review of the rocks, particularly of the eastern portion of the county, was made.

Monroe.—The ballast pit at Maxon was visited and notes collected upon the surface deposits of the vicinity.

Sac.—The limits of the Wisconsin drift near Wall Lake and Carnarvon were made out, something was learned of the history of the lake and the upper Boyer, and the presence of the Iowan at Carnarvon and its relations to the loess were determined.

Carroll.—In excursions south and west of Carroll the presence of the Kansan was proven and notes on the loess and certain clays collected.

Ida.—The presence of the Iowan at Ida Grove, and for some considerable distance south, was determined.

Crawford.—The presence of certain old gravels, in the Boyer valley near Denison, and of the Kansan with typical characteristics as far north as the northern tier of townships, was determined.

Woodbury.—The presence of Iowan near Correctionville and at Sioux City was noted and the southern limit of the formation accordingly considerably extended.

Sioux.—The gravels, clays, and soils near Hawarden and southeast of Orange City were especially studied. The noting of the presence of beds resembling the Pierre in the bluffs opposite Hawarden makes more certain the previous reference of the Hawarden beds to that formation. The character of the drift and the distribution of the loess in the eastern portion of the county was noted.

Lyon.—The presence of Iowan drift and a later loess, at several points near Rock Rapids was noted, harmonizing the work in the neighboring counties. The exposures along the Big Sioux and near Sioux Falls, suggest that this will prove one of the crucial counties in the study of the drift as it has in the work on the underlying rocks.

Cherokee.—The Wisconsin gravel train at Cherokee and southward was studied; the famous Pilot Rock, a large Sioux quartzite erratic, was visited, and the relations of the loess and Iowan drift noted.

Buena Vista.—The character of the Altamont moraine in and near Storm Lake was noted and the presence immediately outside of it of a fresh (Iowan) drift and a later loess was determined. At one point within the moraine undecisive evidence of a loess under the Wisconsin was noted.

Jasper.—The limit of the Wisconsin was traced across the northwestern corner of the county.

Hardin.—The age of the Eldora sandstone was determined to be Des Moines.

In addition certain general field trips were taken in your company and certain other rapid journeys, in which notes on the physiography of the regions passed through, were made. The usual letters of inquiry were answered, specimens examined and intending investors advised. The general volume of the latter work is rapidly increasing as the facilities of the Survey become better known and the general commercial situation improves. Respectfully yours,

H. F. BAIN,
Assistant State Geologist.

TO PROF. SAMUEL CALVIN,
State Geologist.

REPORT OF THE SECRETARY ON MINERAL
PRODUCTION.

IOWA GEOLOGICAL SURVEY, }
DES MOINES, February 23, 1898. }

DEAR SIR—I submit herewith tables showing the production of the principal minerals mined in Iowa in 1897. In all cases the short ton, 2,000 pounds, has been used. No attempt has been made to calculate the tonnage or amount of stone or clay, though the number of thousands of brick will be found. Wherever in the tables a blank is left, the fact indicates that but a single producer in that county is reported for 1897.

Respectfully yours,

NELLIE E. NEWMAN,

TO PROFESSOR SAMUEL CALVIN,

Secretary.

State Geologist.

INTRODUCTION.

(BY H. F. BAIN.)

The importance of accurate statistics of production is now recognized by the masters of all great lines of industry. Their value is so well known that it would be superfluous to dilate on the subject. Most of the great mining interests of the country esteem such figures so highly that by combination and co-operation they provide for their collection at their own expense. This is not true, however, for all the mining industries, and particularly in the case of stone, clay and similar materials, where the production is scattered and the individual operations small, no very reliable agency for collecting statistics has existed. For local details one has been obliged to rely mainly on the infrequent census returns. It is true that for some years the United States Geological survey has collected statistics of the stone industry, and has more recently extended its work so as to cover the clay interests. The publication of these highly valuable returns, however, is so frequently delayed, and the reports reach so small a proportion of our own citizens, that there is a distinct want which they do not fill. The compilations of the Mineral Industry and the Engineering and Mining Journal have also the drawback that they reach a very small proportion of the citizens of Iowa. It has been felt for some time that there was an important work here which should be undertaken by some one of the state bureaus, and that it was particularly within the province of the Geological Survey. The difficulties in the way were, however, so considerable, and the time of the officers of the Survey so taken up, that some hesitation

was felt as to the advisability of taking up the work. Furthermore, we already have carefully collected statistics of the coal industry through the office of the State Mine Inspectors, and it was recognized that the filling of numerous blanks is not a thing which operators especially delight in. Nevertheless, when it was finally decided to undertake the work, it was thought better to include coal in the subjects inquired after for several reasons. In the first place, the report of the Mine Inspector is required by law to be made biennially, and, while earlier returns have always been given the newspapers, details are not at hand for the use of the operator except every second year. Again, the reports heretofore published include only lump coal, a fact not usually noted in quoting them, so that the state is not credited abroad with its full production. It is also true that returns from many of the states, and in all other industries, are made up for the calendar year, so that for purposes of comparison it is best to have statistics for the same period. The fiscal year on the other hand accords more nearly with the mining year, so that for purposes of showing the growth of the industry, figures for that period are better. Each set of figures has a value and for certain purposes each has its use.

The very prompt and hearty co-operation shown by the operators deserves, and has, the fullest thanks of the Survey. They have, almost without exception, either sent in the returns asked, or written explaining the cause, delay in making up the books, change of firm, or other reason, why they could not yet do so. Not a single important clay or stone producer in the state has failed to give us the figures asked for. The returns for these industries and for lead and zinc are believed to be practically complete; certainly so within one or two per cent. In the figures given for coal there is an estimate of about nine per cent, very carefully made and believed to represent minimum figures. Most of the returns here estimated have been promised, but it is believed better not to longer delay publication by waiting for them. The

gypsum returns are largely estimated by one familiar with the industry, but are believed to be close.

The hearty response which the Survey has met in this work indicates apparently that there is a demand for it, not in opposition to agencies already engaged in the task, but supplementary thereto.

MINERAL PRODUCTION OF IOWA IN 1897.

Total Production.

The value of the total mineral production of the state in 1897 was \$7,446,800.42, distributed as follows:

Coal	\$5,098,103.84
Clay	1,591,866.00
Stone	587,144.58
Gypsum	195,000.00
Lead and zinc	5,616.00
Iron	250.00
	<hr/>
Total	\$7,477,800.42

The production is shown by counties in table I.

TABLE I.

Total value of mineral production by counties.

COUNTIES.	Total clay.	Total coal.	Total stone.	Miscellaneous.
Adair.....	*	\$ 5,000.00		
Adams.....	\$ 10,350.00	16,967.00		
Allamakee.....			\$ 8,237.50	\$ 336.00
Appanoose.....	12,600.00	738,266.29	20.90	
Aububon.....	*			
Benton.....	7,200.00		3,564.00	
Black Hawk.....	11,255.00		2,667.50	
Boone.....	36,212.00	421,766.87		
Bremer.....	*			
Buchanan.....	*		175.00	
Buena Vista.....	*			
Butler.....	*			
Calhoun.....	3,850.00			
Carroll.....	3,600.00			
Cass.....	8,055.00			
Cedar.....	*		105,552.59	
Cerro Gordo.....	*		6,408.64	
Cherokee.....	*			
Chickasaw.....				
Clarke.....	*		1,347.50	
Clay.....	*			
Clayton.....	*		7,434.50	800.00
Clinton.....	7,090.00		3,051.00	
Crawford.....	9,300.00			
Dallas.....	35,107.00	22,281.16		
Davis.....	*	4,471.80		
Decatur.....	2,760.00		10,102.00	
Delaware.....	*			
Des Moines.....	38,053.00		82,179.60	
Dickinson.....				
Dubuque.....	25,479.00		33,072.85	2,680.00
Emmet.....				
Fayette.....	*		2,475.00	
Floyd.....	*		4,709.60	
Franklin.....	*			
Fremont.....	8,365.00			
Greene.....		29,892.32		
Grundy.....				
Guthrie.....	32,635.00	31,072.14		
Hamilton.....	51,725.00			
Hancock.....				
Hardin.....	20,445.00		9,850.00	
Harrison.....	5,380.00			
Henry.....	15,400.00		1,850.00	
Howard.....	*		1,755.00	
Humboldt.....				
Ida.....	*			
Iowa.....	13,375.00			
Jackson.....	*		59,070.00	
Jasper.....	12,314.00	172,747.08	4,350.00	

TABLE I—CONTINUED.

COUNTIES.	Total clay.	Total coal.	Total stone.	Miscellaneous.
Jefferson.....		\$ 1,237.08	\$ 3,400.00	
Johnson.....	\$ 19,930.00		2,616.50	
Jones.....	*		44,141.45	
Keokuk.....	13,380.00	264,434.10	1,364.50	
Kossuth.....	*			
Lee.....	13,675.00		32,009.85	
Linn.....	14,824.00		10,095.00	
Louisa.....			2,275.00	
Lucas.....	3,400.00	14,530.00		
Lyon.....				
Madison.....	2,600.00		14,945.60	
Mahaska.....	41,284.00	1,402,929.15	5,285.00	
Marion.....	5,300.00	114,750.09	990.00	
Marshall.....	145,387.00		59,467.50	
Mills.....	13,510.00			
Mitchell.....			2,955.00	
Monona.....				
Monroe.....	600.00	542,206.17		
Montgomery.....	24,050.00		1,030.00	
Muscatine.....	13,000.00		213.75	
O'Brien.....				
Osceola.....				
Page.....	11,400.00	4,940.00		
Palo Alto.....				
Plymouth.....	*			
Pocahontas.....				
Polk.....	362,526.00	700,758.20		
Pottawattamie.....	28,283.00			
Poweshiek.....	7,770.00			
Ringgold.....	7,550.00			
Sac.....	*			
Scott.....	42,524.00	5,435.34	47,634.20	
Shelby.....	7,400.00			
Sioux.....	*			
Story.....	6,170.00	19,445.85		
Tama.....	37,150.00		575.00	
Taylor.....	*	16,330.02		
Union.....	6,140.00			
Van Buren.....	3,300.00	7,438.39	4,050.00	
Wapello.....	46,176.00	263,956.00	5,975.00	
Warren.....		13,622.18		
Washington.....	23,785.00		4,750.00	
Wayne.....	*	77,811.51		
Webster.....	61,183.00	205,810.10	1,600.00	\$ 195,000.00
Winnebago.....				
Winneshiek.....	*			
Woodbury.....	122,920.00			
Worth.....				
Wright.....	11,350.00			
Single producers.....	107,474.00			
Estimated additions.....	20,000.00		2,000.00	
Total.....	\$1,591,886.00	\$5,098,103.84	\$587,144.58	\$ 195,000.00

*Single procedures in 1897.

COAL.

The year was, so far as tonnage was concerned, one of the best the Iowa field has yet experienced. Prices, however, were low, dropping a little below those of preceding years. The year opened dull and the summer trade was even lighter than usual. The fall trade was, however, heavy enough to redeem the year. The strike in Illinois threw considerable trade into the hands of Iowa operators and the heavy hauling in the fall largely increased railroad sales. A few cases of car famine were reported. From the tables given below it will be seen that 49 per cent of the Iowa coal is used by the railways; and 8 per cent is used at the mines or sold to local dealers. The remainder is sold at points within and without the state where there are no mines. In Table II is given the number of mines reporting, total tonnage, average value and total value.

TABLE II.

Coal output by counties.

COUNTIES.	Mines reporting.	Tons.	Price per ton.	Value.
Adams	16	8,555	\$ 1.94	\$ 16,967.00
Adair		2,500	2.00	5,000.00
Appanoose	44	653,333	1.13	738,266.29
Boone	14	261,967	1.61	421,766.87
Dallas	7	14,102	1.58	22,281.16
Davis	3	3,084	1.45	4,471.80
Greene	2	19,666	1.52	29,892.32
Guthrie	9	15,693	1.98	31,072.14
Jasper	11	159,951	1.08	172,747.08
Jefferson	3	1,014	1.22	1,237.08
Keokuk	6	251,842	1.05	264,434.10
Lucas	4	7,265	2.00	14,530.00
Mahaska	19	1,336,123	1.05	1,402,929.15
Marion	8	126,099	.91	114,750.09
Monroe	14	547,683	.99	542,206.17
Page	2	3,800	1.30	4,940.00
Polk	16	620,140	1.13	700,758.20
Scott	5	3,462	1.57	5,435.34
Story	1	12,097	1.61	19,445.85
Taylor	2	9,226	1.77	16,330.02
Van Buren	5	5,857	1.27	7,438.39
Wapello	12	239,960	1.10	263,956.00
Warren	9	9,526	1.43	13,622.18
Wayne	5	60,319	1.29	77,811.51
Webster	8	150,230	1.37	205,815.10
Total	225	4,523,494	\$ 1.12½	\$ 5,098,103.84

In Table III is the percentage of lump, nut and slack and the percentage of local shipping and railway sales by inspection districts.

TABLE III.

DISTRICTS.	SIZES, PER CENT.			SALES, PER CENT.		
	Lump.	Nut.	Slack.	Local.	Shipping.	Railway.
No. 1.....	79	10	11	7	46	47
No. 2.....	80	7	13	5	14	63
No. 3.....	81	9	10	25	48	18
State.....	80	10	10	8	43	49

In comparing the figures in Table II with those of former years it must be remembered that the figures are for all coal and for the calendar year. The best obtainable figures on the same basis for former years is given below.

TABLE IV.

YEARS.	TONS.	PRICE.	VALUE.	AUTHORITY.
1892	3,918,491	\$ 1.32	\$ 5,175,060	U. S. G. S.
1893	3,972,229	1.30	5,110,460	U. S. G. S.
1894	3,967,253	1.26	4,997,939	U. S. G. S.
1895	4,156,074	1.20	4,982,102	U. S. G. S.
1896	3,954,028	1.17	4,628,022	U. S. G. S.
1897	4,523,494	1.12½	5,098,104	Iowa Survey.

Since the growth in the production is in the case of coal better shown by reports for the fiscal year the following table compiled from the reports of the State Mine Inspector is reproduced:

TABLE V.

Lump coal production in tons for the fiscal years 1892-1897.

COUNTIES.	June 30, 1892	June 30, 1893	June 30, 1894	June 30, 1895	June 30, 1896	June 30, 1897
Adams	13,940	18,925	30,640	35,000	21,220	30,500
Adair			2,500	2,642	1,600	2,500
Appanoose	524,400	631,875	528,640	350,000	346,453	372,402
Boone	202,507	185,916	189,000	191,972	286,763	229,285
Dallas	31,841	36,188	17,500	16,503	18,701	16,781
Davis	2,065	2,220	2,520	2,900	2,800	3,120
Greene	29,012	49,453	14,000	38,296	10,328	17,085
Guthrie	12,042	14,000	12,340	11,240	10,840	11,340
Jasper	293,255	292,000	240,985	160,300	121,200	153,000
Jefferson	5,020	4,940	4,840	4,000	4,200	5,000
Keokuk	312,250	272,150	215,625	260,000	222,300	201,000
Lucas	7,495	10,200	7,564	12,000	8,500	9,055
Mahaska	1,048,030	1,172,530	965,676	902,430	1,100,900	1,184,850
Marion	219,411	233,582	172,847	150,361	198,554	138,019
Monroe	521,785	641,805	512,240	315,354	401,650	389,706
Page		1,450		4,200	6,420	7,250
Polk	371,389	466,408	355,000	334,881	415,695	572,895
Scott	9,850	14,500	13,500	10,100	13,100	13,500
Story				4,620	10,340	12,240
Taylor	14,930	35,170	35,475	13,000	10,100	13,200
Van Buren	27,330	28,680	22,000	11,000	15,000	14,300
Wapello	253,075	279,160	186,748	205,900	150,405	152,203
Warren	9,570	14,575	25,454	12,000	12,120	16,150
Wayne	33,600	61,835	68,330	45,700	30,100	32,120
Webster	104,679	145,274	153,247	103,349	106,201	101,643
Total	4,047,479	4,612,872	3,776,691	3,195,836	3,525,490	3,799,734

According to the United States Geological Survey the average number of days worked in recent years has been as follows:

1892	236
1893	204
1894	170
1895	189
1896	178

In 1897 the average was 190, ranging by counties from 88 to 254. Only a few of the largest mines having big railway contracts worked full time. There was a wide variation in the price of coal, as is shown by the table already given. Lump

coal averaged \$1.25. It is impossible to give a very good estimate of the nut and smaller sizes, as the coal is not all screened alike and much is sold as mine run. The percentages of sizes given were obtained by including only the coal reported separately. They do not mean necessarily that 80 per cent of the coal was actually sold as lump. There is a wide variation in these percentages, depending on the character of coal, arrangement of screens and care in handling. The range, was, lump, 65.93 per cent; nut, 20.8 per cent; pea and slack 18.4 per cent.

According to the United States Geological Survey, Iowa in 1895 ranked sixth in bituminous coal tonnage, and first among the states west of the Mississippi. The production for the ten leading states was as follows:

	TONS.	VALUE.
1. Pennsylvania.....	50,217,228	\$ 35,980,357
2. Illinois.....	17,735,864	14,239,157
3. Ohio.....	13,335,806	10,618,477
4. West Virginia.....	11,387,961	7,710,575
5. Alabama.....	5,693,775	5,126,822
6. Iowa.....	4,156,074	4,982,102
7. Indiana.....	3,995,892	3,642,623
8. Maryland.....	3,915,585	3,160,592
9. Kentucky.....	3,357,770	2,890,247
10. Colorado.....	3,082,982	3,675,185

In 1896 Maryland went ahead, though Iowa remained the leading state west of the Mississippi. The figures for the latter year are as follows:

	TONS.	VALUE.
1. Pennsylvania.....	49,557,453	\$ 35,368,249
2. Illinois.....	19,789,626	15,809,736
3. West Virginia.....	12,876,296	8,336,685
4. Ohio.....	12,875,202	10,253,461
5. Alabama.....	5,748,697	5,174,135
6. Maryland.....	4,143,936	3,299,928
7. Iowa.....	3,954,028	4,628,022
8. Indiana.....	3,905,779	3,261,737
9. Kentucky.....	3,333,478	2,299,928
10. Colorado.....	3,112,400	3,606,642

CLAY.

The trade in clay products is in the most satisfactory condition which it has been since 1893. The outlook for the paving brick industry is especially encouraging. The Des Moines producers, for example, in 1896 marketed 18,000,000 pavers, a large portion being old stock and very little manufacturing being done. In 1897 the same plants turned out and sold 36,300,000 brick for the handsome sum of \$252,984. The Northwestern Sewer Pipe works at Sioux City this year turned their attention to pavers and could have sold three times their actual output. In the building brick industry producers report trade from twenty to forty per cent better, except in the case of small producers shut out of the general market. The year started with heavy stocks carried over and dull trade, but soon livened up and the old stocks went off rapidly. Many plants which had been shut down half or full time in 1896, ran full time in 1897. The demand was for low priced goods. The fancy grades of brick have never had a large sale in Iowa, and for the present are a drug on the market. One large and well equipped plant, after a hard struggle to develop a trade in these lines, has gone out of the market and other manufacturers are turning their attention to common grades. The long haul to foreign markets and the absence of large local cities makes it impossible at present to develop a trade, despite the fact that the best of goods are offered.

The returns show 284 plants in operation this season, and give the total value of the brick produced at \$1,142,014, and of all clay products, \$1,562,886. These amounts are distributed as follows:

	NO. THOUSANDS.	PRICE PER M.	VALUE.
Common brick.....	141,032	\$ 4.80	\$ 678,208
Stock pressed and enameled.....	10,669	6.10	66,058
Pavers.....	56,315	7.14	402,018
Fire brick.....	269	17.58	4,730
Drain tile.....			303,524
Sewer pipe.....			47,165
Terra Cotta hollow brick, etc			41,155
Miscellaneous			11,121
Raw clay.....			2,032
Pottery			15,875
Total.....			\$1,571,886
Estimated additional.....			20,000
Total.....			\$1,591,886

The totals for 1894 and 1895 as given by the United States Geological Survey were as follows:

	1894.	1895.	1896.
Common brick.....		\$ 1,095,074	\$ 1,003,624
Stock, pressed and fancy..	\$ 1,320,423	89,430	47,386
Pavers.....	376,951	243,928	112,985
Fire brick.....	36,000	5,900	5,198
Tile and Terra cotta.....	566,407	309,809	659,391
Sewer pipe	58,000	55,131	73,039
Pottery.....		25,600	43,035
Miscellaneous	21,200	45,400	
Total	\$ 2,379,506	\$ 1,870,292	\$ 1,944,658

In 1894 the average price of common and pressed brick is given as \$6.33, while pavers brought \$8.29. In 1895 common brick were \$6.07, pressed brick \$7.81 and pavers \$7.69. In 1896 the corresponding figures were \$5.83, \$7.78, and \$7.85.

The production by counties is given in Table VI. Counties in which but one plant is reported as active in 1897 are mentioned in their proper order, but their production is not given separately.

TABLE VI.

	COUNTY.	THOUSANDS.		VALUE.		
		Common brick.	Total brick.	Common brick.	Total brick.	Total clay.
1	Polk.....	9,443	45,748	\$ 58,527	\$ 311,611	\$ 362,526
2	Marshall.....	15,310	21,360	64,207	95,462	145,387
3	Woodbury.....	14,100	20,730	69,500	116,470	122,920
4	Webster.....	4,500	5,350	21,200	28,200	61,183
5	Hamilton.....	2,050	2,050	12,350	12,350	51,725
6	Wapello.....	3,045	7,285	15,995	44,676	46,176
7	Scott.....	2,310	6,063	25,030	42,254	42,524
8	Mahaska.....	2,600	4,612	17,400	32,484	41,284
9	Des Moines.....	2,490	5,290	11,678	34,078	38,053
10	Tama.....	4,350	4,975	22,250	27,400	37,150
11	Boone.....	1,337	3,212	7,612	23,287	36,212
12	Dallas.....	1,033	2,145	9,631	19,684	35,107
13	Guthrie.....	1,457	1,457	8,680	8,680	32,635
14	Cerro Gordo.....					
15	Pottawattamie.....	4,897	5,397	23,883	27,883	28,283
16	Dubuque.....	5,995	6,015	25,359	25,479	25,479
17	Montgomery.....	3,030	3,020	17,200	17,500	23,050
18	Washington.....	2,405	2,405	14,580	14,580	23,785
19	Hardin.....	383	583	2,523	3,143	20,445
20	Johnson.....	2,835	2,835	14,300	14,300	19,930
21	Greene.....					
22	Henry.....	1,130	1,130	6,400	6,400	15,400
23	Linn.....	1,550	1,550	9,870	9,870	14,824
24	Lee.....	2,400	2,500	12,550	13,350	13,675
25	Mills.....	2,070	2,070	13,510	13,510	13,510
26	Keokuk.....	1,147	1,147	6,830	6,830	13,380
27	Iowa.....	850	850	5,225	5,225	13,375
28	Muscatine.....	900	900	4,500	4,500	13,000
29	Appanoose.....	400	1,900	2,000	12,000	12,600
30	Jasper.....	1,398	1,398	7,914	7,914	12,314
31	Wright.....	400	400	2,650	2,650	11,350
32	Page.....	1,100	1,100	6,600	6,600	11,400
33	Black Hawk.....	20,060	20,060	10,300	10,300	11,255
34	Adams.....	2,000	2,000	10,050	10,050	10,350
35	Wayne.....					
36	Crawford.....	1,300	1,320	9,100	9,300	9,300
37	Fremont.....	1,420	1,480	7,945	8,365	8,365
38	Cass.....	1,072	1,072	8,065	8,065	8,065
39	Poweshiek.....	500	500	3,000	3,000	7,770
40	Ringgold.....	950	950	6,500	6,500	7,550
41	Shelby.....	1,200	1,200	7,200	7,200	7,400
42	Benton.....	700	700	3,600	3,600	7,200
43	Cedar.....					
44	Clinton.....	415	415	2,840	2,840	7,090
45	Story.....	340	340	2,420	2,420	6,170
46	Union.....	856	856	5,965	5,965	6,140
47	Harrison.....	776	776	4,630	4,630	5,380
48	Cherokee.....					
49	Marion.....					
50	Delaware.....	300	300	1,800	1,800	5,185
51	Jefferson.....					
52	Adair.....					

TABLE VI—CONTINUED.

	COUNTY.	THOUSANDS.		VALUE.		
		Common brick.	Total brick.	Common brick.	Total brick.	Total clay.
53	Franklin.....					
54	Calhoun.....	6	6	50	50	3,850
55	Carroll.....	600	600	3,600	3,600	3,600
56	Lucas.....	550	550	3,400	3,400	3,400
57	Van Buren.....	100	104	700	1,500	3,300
58	Taylor.....					
59	Decatur.....	460	460	2,760	2,760	2,760
60	Fayette.....					
61	Jackson.....					
62	Jones.....					
63	Bremer.....					
64	Floyd.....					
65	Davis.....					
66	Winneshiek.....					
67	Clayton.....					
68	Howard.....					
69	Clay.....					
70	Ida.....					
71	Buena Vista.....					
72	Plymouth.....					
73	Clarke.....					
74	Kossuth.....					
75	Audubon.....					
76	Warren.....					
77	Sioux.....					
78	Monroe.....	120	120	600	600	600
79	Buchanan.....					
80	Sac.....					
81	Butler.....					
82	Single producers.....	10,312	10,312	63,729	66,749	107,474
	Total.....	140,032	208,098	\$673,208	\$1,142,014	\$1,562,886

It is impossible as yet to state what the rank of Iowa in 1897 was. In 1895 it was ninth in the total value of its clay goods, and in 1895 fifth in the value of its paving brick. In 1896 it stood seventh in the latter. These facts are shown by the following tables, taken from the reports of the United States Geological Survey.

TABLE VII.

Total clay, 1895.

STATES.	Number of firms.	Value.	Per cent of total.
Ohio	980	\$10,649,382	16.30
Pennsylvania.....	513	8,807,161	13.48
Illinois.....	678	7,619,884	11.67
New York.....	280	5,889,496	9.02
New Jersey.....	130	4,899,120	7.50
Indiana.....	659	3,117,520	4.77
Missouri.....	221	2,799,218	4.29
Massachusetts.....	112	2,221,590	3.40
Iowa.....	412	1,870,292	2.86
California.....	94	1,421,154	2.18

Total clay, 1896.

Ohio.....	1,021	\$ 9,949,571	15.96
Pennsylvania.....	536	9,063,313	14.54
New York.....	295	6,414,206	10.29
Illinois.....	836	5,863,247	9.40
New Jersey.....	140	4,728,003	7.58
Missouri.....	290	2,680,245	4.30
Indiana.....	827	2,674,325	4.29
Massachusetts.....	125	2,262,974	3.63
Iowa.....	519	1,944,658	3.12
Maryland.....	137	1,450,055	2.33

TABLE VIII.

Paving brick in 1895.

STATES.	Thousands.	Value.	Price per M.
Ohio.....	96,555	\$ 787,878	\$ 8.16
Illinois.....	82,526	643,997	7.80
West Virginia.....	62,330	449,388	7.21
Pennsylvania.....	36,268	305,035	8.41
Iowa.....	31,704	243,928	7.69
Indiana.....	22,313	204,000	9.14
New York.....	10,896	121,892	11.19
Kansas.....	7,902	62,190	7.87
Missouri.....	6,816	54,640	8.01
Rhode Island.....	4,000	48,000	12.00
United States.....	381,591	3,130,472	8.20

Paving brick in 1896.

Ohio	72,254	\$ 619,463	\$ 8.57
Illinois.....	60,955	486,519	7.98
Pennsylvania.....	47,229	404,182	8.57
New York.....	23,723	259,550	10.94
Indiana.....	41,292	175,670	4.25
Kansas.....	16,934	125,293	7.39
Iowa.....	14,385	112,985	7.15
Kentucky.....	7,000	70,000	10.00
Missouri.....	7,500	61,500	8.20
Rhode Island.....	4,000	48,000	12.00
United States.....	347,167	2,794,585	8.05

STONE.

The quarries of Iowa are mostly small. The stone quarried includes limestone, dolomite and a limited amount of sandstone. The industry is yet in its infancy and there are many excellent quarry sites yet unoccupied. Returns from 242 producers, including every important quarry in the state and most of the small ones, show that \$584,944.58 worth of stone was marketed in 1897. To this may be added \$2,000 as the value of stone from small quarries not yet reported. This production was distributed as follows:

Rough and rubble.....	\$ 130,005.69
Dimension stone.....	66,792.30
Crushed for concrete and road use.....	74,862.95
Lime.....	123,193.65
Miscellaneous.....	156,531.74
Unspecified.....	33,758.25
Total.....	\$ 585,144.58
Estimated addition.....	2,000.00
Total.....	\$ 587,144.58

The stone used for miscellaneous purposes was mainly quarried for rip-rap in the Mississippi river improvements.

The production by counties is given below.

TABLE IX.

Value of stone produced in Iowa in 1897.

COUNTIES.	Total.	Rough and rubble.	Dimensions.	Concrete and road use.	Lime.	Miscellaneous
Cedar.....	\$ 105,552.59	\$ 4,156.45	\$ 934.95	\$ 6,579.30	\$ 22,620.15	\$ 71,261.74
Des Moines.....	82,179.60	14,062.00	7,017.60	3,500.00	300.00	57,300.00
Marshall.....	59,467.50	1,557.00	16,800.00	27,093.50	58,550.00	.....
Jackson.....	59,070.00	460.00	.....	60.00	.....	.....
Scott.....	47,634.20	14,501.20	300.00	10,158.00	675.00	22,000.00
Jones.....	44,141.45	9,736.50	14,082.25	3,228.25	.....	250.00
Dubuque.....	33,072.85	17,537.85	3,600.00	1,250.00	10,500.00	185.00
Lee.....	32,009.85	14,097.85	3,275.00	9,137.00	.....	5,500.00
Madison.....	14,945.65	4,984.85	1,000.00	8,920.80	40.00	.....
Linn.....	10,095.00	2,425.00	2,570.00	100.00	5,000.00	.....
Hardin.....	9,850.00	8,100.00	400.00	150.00	1,200.00	.....
Allamakee.....	8,237.50	600.00	7,400.00	.....	237.50	.....
Clayton.....	7,434.50	3,268.50	542.50	12.50	3,611.00	.....
Cerro Gordo.....	6,408.64	2,186.64	198.00	24.00	4,000.00	.....
Wapello.....	5,975.00	5,250.00	500.00	.....	250.00	.....
Mahaska.....	5,285.00	2,095.00	40.00	.....	3,150.00	.....
Washington.....	4,750.00	2,925.00	1,825.00	.....	.....	.....
Floyd.....	4,709.60	1,550.00	600.00	1,509.60	1,050.00	.....
Jasper.....	4,350.00	950.00	500.00	900.00	.....	.....
Van Buren.....	4,050.00	2,250.00	.....	.....	1,800.00	.....
Benton.....	3,564.00	500.00	64.00	.....	3,000.00	.....
Jefferson.....	3,400.00	1,150.00	2,250.00	.....	.....	.....
Clinton.....	3,051.00	1,376.00	.....	.....	1,675.00	.....
Mitchell.....	2,955.00	735.00	45.00	125.00	2,050.00	.....
Black Hawk.....	2,667.50	2,577.50	30.00	15.00	45.00	.....
Johnson.....	2,616.50	1,842.00	109.50	265.00	400.00	.....
Fayette.....	2,475.00	.....	.....	.....	2,475.00	.....
Louisa.....	2,275.00	2,025.00	250.00	.....	.....	.....

TABLE IX—CONTINUED.

COUNTIES.	Total.	Rough and rubble.	Dimensions.	Concrete and road use.	Lime.	Miscellaneous
Henry	1,850.00	450.00	500 00	.....	.....	.....
Howard	1,755.00	1,470.00	85.00	200.00	.....	.....
Webster	1,600.00	1,400.00	.....	200.00	.....	.....
Keokuk	1,364.50	789.70	385 00	150.00	40.00	.....
Clarke	1,347.50	237.50	1,075.00	.....	.....	35.00
Montgomery	1,030.00	630.00	300.00	100.00	.....	.....
Decatur	1,002.00	857.50	.....	145.00	.....	.....
Marion	990.00	650.00	100.00	40.00	200.00	.....
Tama	575.00	350.00	.....	.....	225 00	.....
Muscatine	213.75	213.75	.....	.....	.....	.....
Buchanan	175.00	45.00	500.00	.....	125.00	.....
Appanoose	20.90	12.90	8.00	.....	.....	.....
Total	\$ 585,144.58	\$ 130,005.69	\$ 66,792.30	\$ 74,862.95	\$ 123,193 65	\$ 156,531.74

REPORT OF THE SECRETARY.

In general the trade conditions in stone were not greatly different from those of 1896. The small quarries report larger sales and there seems to have been a general, though slight, increase in the amount of stone taken out for building purposes. There was no great change in the amount of rock used for concrete and road uses.

In 1896 the state ranked nineteenth among the stone producers, and contributed $1\frac{1}{2}$ per cent of the total.

The value of the stone produced in Iowa in recent years, according to the U. S. Geological Survey, has been as follows:

1893.....	\$565,374
1894.....	673,269
1895.....	468,826
1896.....	462,128

The production for 1896 was distributed as follows:

Limestone—	
Building and road making.	\$329,123
Lime.....	80,914
Marble.....	39,740
Sandstone.....	12,351
Total.....	<u>\$462,128</u>

According to these figures there was a considerable increase in 1897, particularly in the production of lime. This seems, however, to have taken place in the minor rather than in the chief lime-burning centers where the trade is reported little, if any, better than in 1896.

LEAD AND ZINC IN 1897.

The Iowa lead and zinc field is continuous with that of Wisconsin and Illinois. The ores are found mainly in the Trenton-Galena limestone, but one mine takes ore from the Oneota (Lower Magnesian). Of recent years the production has been small, lead mining which once gave importance to the Dubuque mines having almost ceased. Zinc is now the

principal ore. In 1897 a total of 3,600 pounds of lead, valued at \$736, was mined in three counties. This was reduced in part at Dubuque, but in the main went to Chicago and Aurora, Ill. Zinc was mined at four points; a total of 14,800 pounds of ore was raised. The total value was \$4,880. The ores went to Mineral Point, Wis., and brought an average of \$6.59 per ton. Most of the ore brings at current prices \$7, but one mine ships a lower grade of ore which reduces the average to the figures given. This property, the Durango mine, has not been heavily worked since 1891, when it shipped 310 tons in one month. There is a large amount of ore in sight which can be cheaply mined. The company expects to considerably enlarge their output in 1898. The Buena Vista mine in Clayton county has recently passed into the hands of the E. T. Goldthorp & Sons Mining Co., and has been thoroughly overhauled. This property includes a large body of ore. It was discovered in 1857, but has not been much worked of recent years. It can easily produce 100 tons per month of zinc and 2,000 pounds of lead with a small force of men, and if present prices are maintained it may be expected to yield well up to the limit.

An interesting development in the region is the opening by the Limonite Ore Co. of a body of low grade iron ore for mineral paint. This mine was opened in 1896 and 1897, and 250 tons at \$1 per ton were shipped. The work is yet in an experimental state. There are in the region considerable bodies of limonite which may prove of considerable value in this connection. Analyses of sample lots are as follows:

NUMBER.	IRON.	SULPHUR.	PHOSPHOROUS.
275	54.32	None	1.30
278	66.92	.047	.503
279	58.68	None	1.15

