ADMINISTRATIVE REPORTS.

FOURTH ANNUAL

Report of the State Geologist.

IOWA GEOLOGICAL SURVEY,
DES MOINES, December 31, 1895.

To Governor Frank D. Jackson and Members of the Geological Board:

GENTLEMEN—Pursuant to provisions of the statute organizing the Iowa Geological survey I have the honor to report on the work done by this branch of the public service during the year 1895.

In accordance with the purpose expressed in the report of last year, the energies of the survey have been chiefly directed to areal geology, taking the several counties as the areal units. The third annual report, issued during the year, is the first volume devoted wholly to county reports, and it will serve to illustrate the plan which it is proposed to carry out in setting forth fully and exhaustively the geological resources of the several counties of the state.

In addition to county work there are still, however, a number of general problems of especial interest to the people generally without respect to county lines. These general problems embrace questions relating to water supplies, lead and zinc ores, coal, clays, building materials of every kind from quarry stones to mortars and cements, and these as will presently appear, have not been neglected.

The work of administration has been greatly lightened by the very helpful and efficient aid of the assistant state geologist, Mr. H. Foster Bain. Mr. Bain has had charge of the headquarters of the survey at Des Moines. On him has fallen the burden of attending to the numerous executive details inseparably connected with the central office. He has superintended the publication and distribution of reports, has corrected proof, received and installed collections, and in many other ways has performed the larger share of the unproductive administrative work. His thoroughness and efficiency in discharging all the duties assigned him, whether in the office or in the field, it gives me pleasure hereby to acknowledge.

My own time has been very fully occupied with a great variety of duties, embracing details of administration and office correspondence that cannot be assigned to anyone else. My work in the field during the season was directed to the accomplishment of three things. First, I have been aware for some time that the geological maps of Iowa, published some years ago, and which formed in part the basis for our preliminary map, needed rectification so far as relates to the eastern edge of the Devonian in Buchanan, Fayette, Howard and Winneshiek counties. In some cases the margin of the Devonian was located from fifteen to twenty miles too far to the east, while in other cases it was nearly as far out of the way toward the west. Beds of Galena limestone on the one hand, and beds of dolomitized Devonian on the other, have been incorrectly mapped as belonging to the Niagara series. My first field work of the season had reference therefore, to collecting the data for making the necessary corrections on the future geological maps of the state. The dolomitization of the Devonian in the northern part of the state, and the abrupt feathering out of both the Niagara limestone and Maquoketa shales before reaching the Minnesota line are facts of no small degree of economic importance. Second, it was desired to prosecute definite areal work as

vigorously as possible. To this end the field work for Jones county, begun two years before, was completed, some portions of Delaware county were reviewed, and detailed work in Buchanan and Johnson counties was taken up and practically finished. The work in Jones county made it necessary to investigate in some detail certain phases of the LeClaire and Anamosa limestones in Cedar and Scott. Third, the soils of Iowa, which are among the most important geological deposits of the state, vary with the nature of the drift and the modifications to which it has been subjected. In the northern part of the area covered by the season's field work, there are two drift sheets; in the southern part there is but one. Some time was devoted to tracing the margin of the second drift sheet beyond the limits of the counties under immediate investigation.

Apart from the unavoidable details of administration and correspondence, the unproductive work of the office consumed a large amount of time devoted to editing and revising manuscript reports submitted by other members of the survey. The more directly productive work was devoted to preparing for publication the results of investigations made in the field. The report on Jones county is finished and is submitted as part of the accompanying volume, and reports on the other counties studied will soon be ready for submission. A number of articles containing general information on a variety of subjects, were prepared and have been widely published in the newspapers of the state. These articles treated on such subjects as Natural Gas in Iowa, Uses for Iowa Chalk and Coal Slack, Some Iowa Building Stones, and the History and Genesis of Iowa Soils. Besides furnishing articles on subjects of popular interest to the newspapers, it was deemed worth an effort to call public attention to Picturesque Iowa, in articles contributed to an Iowa magazine.

The work accomplished by Mr. Bain is fully set forth in his administrative report, which is hereto appended.

Prof. A. G. Leonard has continued his work on lead and zinc. His administrative report shows the progress made in the investigation of the subjects assigned him.

Prof. W. H. Norton has spent such time as he could spare from his duties at Cornell College upon the Artesian Well report. Very satisfactory progress has been made, and it is expected that the completed manuscript will be in hand in February. A full statement of the work undertaken, and the progress so far made by Professor Norton, appears in his administrative report.

Prof. G. E. Patrick, chemist to the survey, offered his resignation, which was accepted in May. The board then authorized the state geologist to make suitable arrangements regarding chemical work. Satisfactory arrangements have been made with Dr. J. B. Weems of the agricultural experiment station, and he will in future have charge of this line of work. But little chemical work has been done this year, though Dr. Weems is about to undertake the analyses of a series of artesian waters in connection with Professor Norton's work on that subject.

Dr. S. W. Beyer has finished his study of the Sioux quartzite and has prepared a very interesting and valuable report upon this formation and certain associated eruptive rocks. The report is now being prepared for the press, and will probably form a portion of Vol. VI. Dr. Beyer has also continued his work on Boone and Story counties. Owing to illness during the summer months the report on Boone county has but recently been completed, and the completion of the reports on Story and Marshall must be left to a later date.

Prof. J. L. Tilton has continued work on Warren county. His report, which has been submitted and is now ready for the printer, is particularly interesting in that he has discussed quite fully the origin of the drainage system. The results of his work as a whole are of the highest interest. His studies of the coal horizons are likely to prove of considerable economic importance. Since his sections were drawn, but before

they were published, a new mine has been opened upon a bed of coal indicated by the sections, though otherwise unknown. The importance of the study of coal horizons as distinct from coal beds is emphasized by this occurrence.

The general preparation of the maps and illustrations has been in the hands of Mr. F. C. Tate, of the Iowa Engraving company, under the direction of Mr. Bain. In this work Mr. Tate has been at times assisted by Mr. C. F. Wilcox, Miss Charlotte M. King and Mr. James Hedge. The general excellence of the work is in the main due to Mr. Tate's skill and care. Within the year the maps of Allamakee, Keokuk, Mahaska, Jones, Warren, Boone, Appanoose, Woodbury and Washington counties have been drawn, as well as most of the minor illustrations appearing in volumes IV and V.

The reproduction of the Allamakee county map by photo-engraving from a series of tracings thoroughly proved the capabilities of this method of work. The success which attended the effort, which was in no small degree due to Messrs. A. Hoen & Co., who made the reproductions and printed the maps, has confirmed me in my determination to use the process in the future work of the survey. The saving, as compared with engravings on stone, is, as has already been pointed out, fully 40 per cent.

Miss Nellie E. Newman has continued to be the efficient secretary of the survey.

Satisfactory progress has been made in the publication of the results of the survey. Four volumes have so far been distributed, and have met with hearty reception. They have been very favorably commented upon by the leading geological and engineering magazines of this and foreign countries, and have brought to the office of the survey letters of commendation from the leading geologists of all countries. The statements as to the resources of Iowa, as given by the survey reports, are finding their way into trade journals and text-books, and thus the reports form the best possible advertisement for the state. Not only outside, but within the state,

the reports have received full recognition. Numerous local papers have published long extracts from them, and in a few instances the county reports have been republished entire by local papers.

The four volumes so far issued contain the following papers:

VOLUME I. FIRST ANNUAL REPORT, 1892.

CONTENTS:

VOLUME II. COAL DEPOSITS.

BY CHARLES ROLLIN KEYES.

CONTENTS:

VOLUME III. SECOND ANNUAL REPORT, 1893.

CONTENTS:

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

VOLUME IV. THIRD ANNUAL REPORT, 1894.

CONTENTS:

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

Volume V, which is herewith submitted, contains, in addition to the administrative reports, the following:

Geology of Jones County; by Samuel Calvin.
Geology of Washington County; by H. F. Bain.
Geology of Boone County; by S. W. Beyer.
Geology of Woodbury County; by H. F. Bain.
Geology of Warren County; by J. L. Tilton.
Geology of Appanoose County; by H. F. Bain.

Volume VI, which will soon be ready for the printer, will contain the following papers:

The Sioux Quartzite and Associated Rocks, with Especial Reference to an Intrusive Diabase Sill; by S. W. Beyer.
The Lead and Zinc Deposits of Iowa; by A. G. Leonard.
Report on the Artesian Wells of Iowa; by W. H. Norton.

In addition, a number of other papers, by various members of the survey corps, are in an advanced stage of completion.

Since the inauguration of the survey, it has been the practice to furnish to the newspapers of the state preliminary

notes on the results of survey work while it was still in progress. These reports have been quite generally used by the papers, and have been an important aid in bringing to the notice of the people of any community the results of the work in their region. Among the papers so published, in addition to preliminary notes on the reports on the various counties, have been such papers as, "The Soils of Northeastern Iowa," "The Essential Properties of Building Stones," "Some Iowa Dolomites," "Geologic Conditions of Economic Mining in Iowa," "Coal Mining by Machinery in Iowa," and numerous others.

During the last two years it has been the policy especially to push to as early completion as might be consistent with good work, the reports on the various counties. With that end in view the work has been concentrated in certain counties. Some of these offered special facilities for work, by reason of their easy accessibility or because they were the residence counties of local assistants. In other cases counties have been selected because their geologic structure furnished the key to neighboring regions, or because they contained deposits of prominent and generally recognized economic importance that seemed to demand immediate attention. So far reports on eight counties have been completed and published, six more are completed and are submitted with this report, and a considerable additional number are in an advanced stage of progress.

Professor Tilton has the work in Madison county well under way and will doubtless be able to finish it within the next year.

Dr. Beyer has begun work in both Marshall and Story counties.

Mr. Bain has the work in Polk county in hand, and is, in addition, engaged in a study, preparatory to finishing up the work in that area, of the notes which Messrs. Jones and Lonsdale collected in 1893 and 1894 in Guthrie county.

I have the work in Delaware, Buchanan and Johnson counties practically finished, and have made preliminary recon-

noissances in Winneshiek, Howard, Fayette, Cerro Gordo, Cedar, and Scott.

Building Stones.—The collection of materials and notes for a study of the building stones of the state has been carried forward. By the co-operation of Professors Ross and Higgins and Mr. H. B. Murray of Drake University, and Prof. A. Marston of the Agricultural College, it has been possible to begin the testing of samples of quarry stones. Owing to the limited time at the disposal of those co-operating with the survey in this work, it was thought impracticable to undertake a complete study of the building stones of the state at this time. A circular letter was, in October, addressed to a number of quarrymen in different parts of the state, asking their assistance in the work. The responses have been most hearty and generous. It is proposed to collect for immediate study a series of the typical and better known stones now marketed from Iowa. These will be subjected to absorption, compression and shearing tests, and in certain cases chemical analyses will be made. With the results of this work as a guide, later and more elaborate studies may be undertaken.

The work along this line has already begun, and the results will be made public as early as possible. In the meantime the work of the county surveys is affording considerable material for later study, and is pointing out the vast number of excellent ledges not yet opened up.

During the year a series of short articles have been furnished to the local press bearing on various phases of the building stone industry. Among other papers a brief communication giving the results of work on the several counties studied, so far as relates to quarry stone, was furnished to the United States Geological Survey, and published in the sixteenth annual report of that organization. The undeveloped and recently developed quarry resources of Iowa were by this means brought to the attention of a large number of interested readers.

Cement.—The fact that Iowa contains vast quantities of material suitable for manufacture into the best grades of cement is becoming rapidly known, and we may reasonably hope to see a large cement industry grow up in the state within the next few years. The survey has already pointed out the ready availability of the deposits along the Big Sioux river, and has, during the year, been called upon to answer many letters of inquiry regarding them. An arrangement has been entered into whereby Mr. S. B. Newberry, manager of the Sandusky Portland Cement company, of Sandusky, Ohio, has undertaken to make for the survey the fullest practical tests of various cement deposits. Some material has been shipped to Mr. Newberry, and more will be sent as soon as it can be collected.

Coal.—A large share of the energies of the survey during the period of its existence has been devoted to investigations on coal. The work of the last year has been no exception, though in this case the investigations have been carried on in connection with the county work. Of the fourteen counties upon which reports have already been prepared, nine have been in the coal field, and one other has, in the past, produced coal. The effort has been, from the first, to give that subject the fullest possible consideration. With this end in view, the counties which lie along the eastern border of the coal field have been examined and reported upon first. Along much of the eastern border of the Iowa coal field the deposits are thin, and frequently have been cut off from the main body of the coal measures by erosion. The entire region is drift covered, and, hence, the exact limits of the coal measures are not easily defined. It is but natural under such circumstances, that in the past considerable sums of money have been spent in prospecting areas lying wholly without the coal measures. For this reason it has been considered important that the first work of the survey should be directed to tracing the eastern margin of the coal field, so that the ground which may legitimately be prospected can be

known from that which is surely barren. With this end in view, the maps of Lee, Des Moines, Keokuk, Mahaska and Van Buren counties have been published, and a similar map of Washington county accompanies this report.

In the course of work in the coal-bearing counties, important data relating to the conditions of deposition and formation of coal, and the methods of working it economically, are being collected. From time to time brief articles, bearing on these subjects, have been furnished to the press, and when the work is completed, the facts will be published as part of the final report.

Museum.—In connection with the office of the survey at Des Moines, a museum has been established which is designed to show to the best advantage the present material resources of the state. This collection is receiving constant additions through the efforts of the members of the survey corps, and the generosity of individual producers. Within the last year several important additions have been made. The collection of clay products includes samples from every clay-working plant in the state; brick yards, tile yards and potteries being alike represented. The collection of building stones, while important, is not yet so complete. The collection of minerals, particularly from the lead and zinc regions, is quite complete, and makes a striking and attractive exhibit.

A few of the larger and more important building stone and clay producers have made attractive individual displays, and room is held for a few more. Among those who have recently installed exhibits are Hon. J. A. Green, proprietor of the Champion Quarries, at Stone City, the Platt Brick Co., and the Sargents Bluffs & Sioux City Brick Co. The value of an attractive display in the capitol building, where it is visited by large numbers every day, is being recognized, and the limited space at the disposal of the survey for such purposes will soon be completely occupied.

The collection of photographs grows rapidly. While the views are taken primarily for the immediate purpose of the

survey work, they afford excellent illustrations of the natural features of the state, and can be made of large service in teaching geography and kindred studies. Recognizing this fact, and wishing to encourage in every possible way the movement toward better teaching, a list of the photographs available was prepared last February and sent with the following explanatory letter to such as it was thought would be interested.

IOWA GEOLOGICAL SURVEY.

S. CALVIN, State Geologist.
H. F. BAIN, Assistant Geologist.

DES MOINES, January 10, 1895.

SIR—The law governing the geological survey of this state makes provision whereby duplicate specimens may be distributed to the various colleges. It is believed to be in accord with the spirit of this provision that the following statement is made:

In the course of the regular work of the survey a considerable number of photographic negatives has accumulated. Some of these views possess more or less educational value in connection with instruction in geology and geography, and prints of them are offered at the mere cost of production. The negatives will be placed in the hands of a competent photographer, who will fill all orders at a uniform price of 12½ cents each. They will be in part 4½x7½ and in part 6x8, with a few of larger size. They will be printed on American aristo paper, and mounted on heavy white cards 8x10.

The list offered is neither complete nor systematic, but it is hoped it may prove serviceable. There is a supplementary list of views in the Black Hills, which are the personal property of the state geologist, and which may be obtained upon the same terms.

Please order by number, and address all communications to

SAMUEL CALVIN,
State Geologist.

A considerable number of responses have been received, and it is thought that, as the offer becomes more widely known, it will be taken advantage of by a larger number of teachers.

The museum affords an opportunity, by means of various special charts and diagrams, to set forth graphically the various resources of the state. Certain of these charts have been prepared, and as the work of the survey progresses these can be made from time to time more exact and useful.

The library of the survey has continued to grow by donation and exchange. The reports of the various state and certain foreign surveys, as well as the proceedings of numerous learned societies, are being regularly received in exchange for the volumes published by the Iowa survey. These reports, together with the books afforded by the state library, make a satisfactory working collection. The liberality of the state librarian and the board of trustees of the state library, in purchasing the books needed by the survey officers, has made it unnecessary to spend more than a small sum of money in this direction. It is a pleasure to acknowledge this hearty and much valued co-operation.

In the general conduct of the survey it has been the effort to direct the work along those lines which should be productive of the most practical economic benefits. It has been recognized that a survey paid for by the state can only justify its existence in proportion as it is a benefit to the state. So long as problems of fundamental economic import remain to be solved, the energies of the survey should be directed to them rather than to the elucidation of equally interesting, though less directly valuable, problems of pure science. It should not, however, be forgotten for one moment that the truest and most practical results are only attained by the most careful and exact scientific investigation of all the significant phases of a question. A right understanding of the problems of deeper water supplies, and the ability to make estimates of the distance to water and the rate of its flow to any point, which the survey is constantly asked to do, can only be had by a thorough investigation of the character and stratigraphy of the Paleozoic beds of eastern Iowa. One bore hole, even if driven to China, will not settle the question of gas or oil supply for the state or any considerable part of it, and anyone at all familiar with practical prospecting in the best known portions of the Iowa coal fields knows that neither one nor a dozen deep bore holes will settle the question of deeper coal seams in the southwestern part of the state. Yet

careful stratigraphic studies may, and doubtless will, shed much light upon the subject. After these investigations it will be possible to direct prospecting to the best advantage. It is the proper duty of the geological survey, as outlined in the law under which it was organized, to make these investigations. Yet it must not be thought that the survey is primarily or even principally a "bureau of research." Its duty has been interpreted by the present corps to be first to find out exactly what resources of economic importance the state possesses, and second to make these resources as widely known as possible. If the reports of the survey accomplished nothing but the latter, the return to the state would still be large in proportion to the sum spent on the work.

It is not generally recognized to what an extent the reports of a geological survey are quoted and accepted as authority. Statements taken from such reports are reprinted in technical and trade text-books, journals, encyclopedias, etc. Coming from the state they are accepted as official and hence carry far more weight than similar statements or statistics put forth by any other authority. A new geography which will be largely used in Iowa schools is now being prepared, and the editor is making use of the reports of the survey in compiling his facts. The data collected by the survey are widely used, quoted and re-quoted. One of our leading coal companies put on its advertising calendar last year a sentence quoted from the "report of the state geologist." A minor article furnished by a member of the survey corps for local publication was copied entire by three of the leading trade journals of the United States. Letters of inquiry are constantly received from all parts of the country, so that as an advertisement of the resources of the state alone the reports have a high value.

I am glad to believe that the work has other values as well. The increased and more exact knowledge of our coal fields, our zinc, lead, gypsum and clay deposits, the better underderstanding of our soils, building stones and water supplies,

and the discovery of important cement beds cannot but result in large economic gains to the state as a whole. A large and well equipped lime burning plant has been put up at a point suggested by one of the assistants on the survey. At another an important brick plant has been installed after consultation with the survey officers. A number of other new enterprises are known to be under consideration and have only been held back by the present unfortunate financial conditions of the country.

Respectfully,

SAMUEL CALVIN,
State Geologist.

REPORT OF MR. H. F. BAIN.

IOWA GEOLOGICAL SURVEY,
DES MOINES, December 31, 1895.

SIR—I have the honor to submit herewith a report of my personal work during the year past.

The amount of administrative and office work placed in my charge has prevented the accomplishment of as much in the field as during former field seasons. Much of the months of January and February was spent in superintending the printing and distribution of the final pages of Volume III. March, April and part of May were spent in the preparation of the manuscript, illustrations and maps appearing in Volume IV, which was printed during the latter part of May, the month June and the early part of July.

Within this period time was found for a few short field excursions, one being through Washington county, another to Dubuque, and a third, in company with Professor Tilton, down the Des Moines river. A short visit was made to Mount Vernon and Ames for the purpose of arranging with Professors Norton and Weems the details of the work on artesian wells.

In July the regular field work of the season was taken up, some time being spent in Woodbury and neighboring counties. New and valuable data were collected and incorporated in the report on Woodbury county. Later the work in Appanoose county, originally taken up in 1893, was completed and the report written out. In September a brief excursion was made in your company for the purpose of studying the drift

deposits of Johnson and Buchanan counties. A day was also spent with Dr. Beyer in tracing the moraine in Story county, another with Professor Leonard in studying the drift of Tama county, and two days with Professor Norton studying the drift near Mount Vernon and in consultation regarding the artesian well report.

In October and November numerous points of interest in Polk county were visited, and it is expected that the report on this county can be completed in the spring. Preliminary to a study of the drift of Polk county visits were made to the Aftonian deposits lying to the southwest and the moraines near Valeria and Cedar Falls to the northeast, as well as to numerous intermediate points.

Since the close of the field season the reports on Washington, Woodbury and Appanoose counties have been given final revision, the illustrations and maps for Volume V and a portion of Volume VI prepared, and the manuscript for the former, as well as a portion of the latter, assembled.

During the year I have continued to make such notes on mining methods as was compatible with other duties. The usual brief communications to geological journals and newspapers have been furnished.

Respectfully,

H. FOSTER BAIN,
Assistant State Geologist.

TO PROF. SAMUEL CALVIN,
State Geologist.

REPORT OF PROF. W. H. NORTON.

CORNELL COLLEGE,
MT. VERNON, Iowa, December 31, 1895.

SIR—I have the honor to make to you the following report of the work done during the year just closing and since my appointment as special assistant in charge of artesian wells.

A correspondence necessarily large, onerous and as yet unfinished was at once opened with well drilling firms, water companies, owners of deep wells, and with all others who might in any way aid the investigation. Several cities were visited personally. The facts thus obtained form the basis of a report now approaching completion. Of each of the 100 or more deep wells in the state, all the obtainable data will be set forth in this report, including the depth, size of bore, tubing, packing, water horizons, and the flow, head and quality of the water from each horizon, together with its availability for the various domestic and communal uses.

Full description will be given also of the strata penetrated by the drill wherever drillings have been preserved, and the geological section of each well will be shown as completely as the facts in hand will permit.

Thus the experience of drillers in all parts of the state and in the various underlying rocks, and the experience of our citizens in the use of different artesian waters, will be made a matter of permanent record.

In order that this mass of data may be as completely intelligible and as widely available as possible, the entire question

of artesian wells and waters will be canvassed with special application to the Iowa fields.

The sources of artesian waters, their chemical composition, and the conditions of their transmission will receive deserved attention. Among other topics considered are the interpretations of water analyses, the adequacy and permanence of artesian supply in Iowa, the sanitary and therapeutic qualities of our artesian waters, and their availability for manufacturing and household purposes, including a resume of recent methods for the improvement of waters naturally unsuited for these uses.

As the question of artesian supply is directly related to other possible sources, the general question of water supply may receive consideration. Statistics have been collected of the waterworks of the state and the various sources of their supply. The purity of our rivers, lakes and shallow wells, their adequacy in times of drouth, the effectiveness and expense of methods of purification now in vogue, are vital questions which must be considered by every community which has the problem of public water supply under consideration. Graphic illustrations are in preparation, such as maps and sections setting forth the structure of artesian basins, the character and attitude of the geological formations, the position of water-bearing rocks, and the hydraulic gradient of artesian waters.

It is hoped that nothing may be omitted from this report germane to its subject and of practical value to the citizens of Iowa.

Very respectfully your obedient servant,

WILLIAM HARMON NORTON,

Special Assistant in charge of Artesian Wells.

TO PROF. SAMUEL CALVIN,

State Geologist.

REPORT OF PROF. A. G. LEONARD.

IOWA GEOLOGICAL SURVEY,
DES MOINES, Iowa, December 30, 1895.

DEAR SIR—I submit herewith a report of the work intrusted to my care during the past year.

The field work upon the lead and zinc deposits of the state was begun in the spring of 1894, and occupied a considerable portion of that year. During the fall and winter, such time as could be spared from other duties was devoted to the preparation of the report. In June last some weeks were spent at Des Moines in preparation of the manuscript, and in November a brief field excursion was made for the purpose of noting such new developments as had taken place within the season just past. Many important items were secured and have been incorporated in my report, which is now complete and has been submitted.

It is a pleasure to state that the outlook for the field is encouraging. The rapid introduction of improved machinery and better mining methods is having an important effect upon the output of the district. The total production for the year 1895 was 750,000 pounds of lead ore and 3,500 tons of zinc, with a total valuation of $42,000.

Respectfully,

A. G. LEONARD,
Special Assistant in charge of Lead and Zinc Deposits.

TO PROF. SAMUEL CALVIN,
State Geologist.