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KENTUCKY GEOLOGICAL SURVEY

AND BUREAU OF IMMIGRATION.

JOHN R. PROCTER, DIRECTOR.

REPORT

ON THE

PROGRESS OF THE SURVEY

FROM JANUARY, 1884, TO JANUARY, 1886,

BY JOHN R. PROCTER.

FRANKFORT, KY.:

CAPITAL OFFICE, JOHN D. WOODS, PUBLIC PRINTER AND BINDER.

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REPORT OF STATE GEOLOGIST.

To His Excellency, J. PROCTOR KNOTT, Governor of the Commonwealth of Kentucky :

SIR: I have the honor to make the following report on the progress of the Geological Survey of the State, and the conduct of the Bureau of Immigration during the two years ending December 31, 1885. The results obtained warrant the assertion that topographical surveys and a study of the geology have been completed over a larger area, during the past two years, than for the same period since the organization of the survey. For the better understanding of the nature of the work, it has been divided as follows :

1. A topographical and geological map of the two coal fields of the State ; obtaining information of the area, thickness, relative position and qualities of the various strata of coals, iron ores, clays, etc. ; studying the relation of same to available transportation routes, and to resources of adjacent States ; also a study of the kinds, quality and distribution of the timbers, the character of the soils, the adaptability of these soils to certain branches of agriculture, and the suitability of the same for immigration ; also to make known the results obtained by carefully prepared and accurate statements of facts, accompanied by accurate maps and explanatory sections.

2. The making of county maps and coloring the geology on the same, with such a study of the geology and analyses

of soils, subsoils, clays, natural fertilizers, as will enable the agriculturist to make practical application of the results obtained, and by a reference to the maps showing character of soil on which his own farm may be located, to profit by experiments made by others on similar soil in various parts of the State. This work I deem to be of paramount importance, affecting, as it does, the well-being of a large majority of the people of this State.

3. In connection with the above, the chemical and laboratory work; analyses of soils, clays, coals, iron ores, mineral waters and other substances collected by the Geological Survey; the practical testing of the coking and other qualities of coals; the testing of fire and pottery clays, etc.

4. In addition to the making of the county maps, giving, from actual survey, the area of each county, and the coloring of the geology on same; the completion of an accurate map of the State.

5. The office work; preparation of reports for publication, drawing maps, preparation of geological sections and illustrations, and the conduct of the large and increasing correspondence of the survey.

6. Work connected with the Bureau of Immigration, placed by law under the direction of the State Geologist.

With the above statement of the plans and objects of the work, I will give briefly the progress during the past two years.

(1.) SURVEY OF THE TWO COAL FIELDS.

Prof. A. R. Crandall has charge of the work in the eastern coal field. In this work he has been assisted during the past two years by Mr. J. M. Hodge and Mr. R. C. Ballard Thruston. Mr. Hodge has worked during that time in the counties of Pike, Floyd, Letcher, Perry, Leslie, Knott, Breathitt and Clay.

He has been engaged mainly in tracing coal beds, making openings in same for purpose of ascertaining thickness and character of coals and sampling same for analyses, and practical tests to ascertain coking properties. He has had two faithful men engaged in digging into coals under his direction, and thus has succeeded in tracing valuable coals over an extended area. Mr. Thruston has been engaged in similar work in Knox, Bell and Harlan counties. His work during the past two years has been somewhat interrupted by time necessarily given to the work for the State's exhibit at the Expositions in Louisville and New Orleans.

Prof. Crandall, in addition to giving a general supervision to the work of Mr. Hodge and Mr. Thruston, with occasional review of it in the field, has completed a report on the Pound Gap region, including portions of Pike, Floyd, Knott and Letcher counties, and also report on Elliott county, and has almost completed a report on the geology of Whitley county. Prof. Crandall's report on the Pound Gap region, and Mr. Hodge's preliminary report on the geology of parts of Letcher, Lesley, Perry and Breathitt counties have been printed. These reports are accompanied by maps, illustrations, numerous sections, showing position and number of coals, and sections drawn to a scale showing thickness of coals at various openings. The report of Mr. Thruston will go to press shortly, together with a report of Mr. Hodge, the result of work during the past season. These reports will be accompanied by maps of the sections treated, and by a map showing the distribution of iron ores of the United States, and their relation to the several coking coal districts of the Appalachian coal field. The following facts will be established by these reports:

1. That the largest known area of coking coal in the United States is in Southeastern Kentucky.

2. That the coal is very thick, of uniform good quality, and as favorably situated for cheap mining as any coal.

3. That it is the nearest coking coal to the center of population of the United States.

4. That it is nearer to extensive deposits of high grade Bessemer steel ores than is any other coking coal.

5. That it is near to extensive deposits of cheap iron ore.

6. That there are other valuable coals in this region, including large deposits of superior cannel coals.

Since the first publication by the Survey regarding the finding of this coking coal, made less than four years ago, the coal has been identified and traced over a wide area, and many tests have been made, proving its superior quality as a coking coal.

The finding of this coal has attracted wide-spread attention, and several railways are projected from the north, and at least three from the southeast, to reach this valuable field. Considering the very great difficulties encountered in this work, owing to the dense timber and undergrowth, the sparse population, and the fact that, in this region, there was for a time an epidemic believed by many to be contagious, great praise is due to Prof. Crandall and his assistants, Messrs. Hodgè and Thruston, and his aid, Mr. T. H. Morgan, for the energy and faithfulness with which the work has been prosecuted, and for the substantial results already obtained.

In June, 1884, Mr. Hugh R. Ayres, in charge of a topographical corps, after surveying parts of Red river and Lulbegrud creek, constituting the south and east boundaries of Clark county, proceeded to Clinton county and completed the mapping of that county, including a survey of roads, creeks, county lines, outlines of Poplar mountain, etc. In August the survey of Wayne county was begun, and completed during the year, with the exception of the survey of the South Fork of the Cumberland

river. This work was platted and maps drawn during the winter of 1884-5. During the past season the geology of Clinton and part of Wayne counties was studied by Dr. R. H. Loughridge, and the geological map of Clinton county is now completed, and it is hoped to be ready for distribution by the time this report is in print.

In the spring of 1885 Mr. Ayres proceeded with his assistants to Western Kentucky, and completed the survey of Crittenden and Caldwell counties, on the western border of the western coal field. He then made a survey of Hopkins county, and so much of the northern part of Christian county as is included in the coal area. Late in the season the work was extended northward into Webster county, and the survey of the larger part of that county completed before the party was compelled by the cold weather to quit the field. Mr. Ayres was assisted in this work by Mr. Fred. F. Bagby and Mr. Charles A. Duncan, during the years 1884-5, and for a part of the year 1885 by Mr. Stuart A. Allen, Mr. Wm. L. Gordon, Jr., Mr. W. W. Ely and Mr. J. F. Gordon.

In the summer of 1884 Mr. J. F. McAdoo, after completing the plattings from notes of previous surveys, was sent to Western Kentucky for the purpose of making surveys in that section. He began work in Warren county, and from there went into Butler county, obtaining data for maps of those counties, with the exception of a small area in Butler, which he completed in the spring of 1885. He was assisted in this work by Mr. M. B. Bowden and Mr. N. Clark. Early in the spring of 1885 Mr. McAdoo made a survey of the county line between Lewis, Carter and Greenup counties, and platted the same, enabling the publication of the completed geological map of those counties. After completing the survey of Butler county, Mr. McAdoo moved his topographical party into Muhlenberg county

and finished a topographical survey of that county; after which he completed a survey of Ohio county, and began work in Daviess, when he was compelled by the winter weather to discontinue field work. He was assisted in this work, at various times, by Mr. J. J. McHenry, Mr. R. C. Todd, Mr. Calvin Duke and Mr. James L. Corbett. It will be seen that, during the past two years, a large area has been surveyed, leaving in the western coal field only the counties of Daviess, Henderson, McLean and parts of Webster, Breckinridge, Grayson, Edmonson and Hart to be completed. It is believed that with the same forces at work, the above-named counties can be finished during the spring, summer and autumn of 1886, thus completing the topography of the entire western coal field. After the completion of these counties the parties can be moved into the subcarboniferous limestone counties surrounding this field. Mr. Ayres, Mr. McAdoo and Mr. Bagby are now engaged in reducing the notes of field work, and preparing maps of the various counties surveyed, for the engravers. The large area surveyed during the past two years by these gentlemen, and the accurate character of the work, is a sufficient evidence of their diligent and faithful performance of duties, often under the most trying circumstances. It has been found a great advantage to complete a topographical survey so that the Geologist may have a map when studying the geology of a district. It is intended to follow the topographic with geological work, as rapidly as the means placed at the disposition of the Survey will admit.

(2.) GEOLOGICAL SURVEY OF THE AGRICULTURAL DISTRICTS.

In my last biennial report I mentioned the fact that it was necessary to first complete the geology of the counties around the rim of the blue-grass region, before a geological map of the State could be completed. This work has been carried forward

by Mr. W. M. Linney, during the past two years, and the geology colored on the maps of Clarke, Montgomery, Bath, Fleming and Mason counties. After the completion of these counties work was begun on the interior counties, and carried over Oldham and a part of Trimble counties. This work can be prosecuted more rapidly over the central counties, because of the fewer geological divisions present. For instance, there are in Madison county eleven distinct geological divisions* requiring to be traced, as many different soils to be studied and analyzed, while in some of the central counties remaining to be studied there are but three geological divisions. Among the discoveries made during the prosecution of this work during the past two years, especial mention should be made of the discovery of a limestone rich in phosphate of lime, occurring in the eastern part of Clark county. Reference to this will be found on page 30, "Geology of Clark and Montgomery Counties," and on page 279, "Chemical Analyses A, part 2."

It is believed that this series of reports and maps, in connection with the analyses of soils, marls, limestones, etc., will form a correct basis for scientific agriculture, and will become more valuable to the intelligent agriculturists as the work progresses. The recent development in the uses of natural gas, and the almost accepted theory that the most productive wells are found along the axes of well defined anti-clinals, has induced me to have all anti-clinals indicated on the maps, and in the reports to be hereafter published.

Dr. R. H. Loughridge was assigned to work up the geology west of the Tennessee river, known as the "Jackson Purchase."

* The following divisions have been placed on the Madison county map: *Lower Carboniferous*, *Upper Subcarboniferous* (including Chester and St. Louis groups), *Lower Subcarboniferous* (Waverly), *Devonian* (Black Shale and Corniferous), *Upper Silurian*, *Upper Hudson*, *Middle Hudson*, *Lower Hudson*, *Trenton*, *Birdseye*, *Chazy*.

The topographical map of this region had been engraved in 1883, but many corrections and additions were made by Dr. Loughridge during his careful work in that region. Dr. Loughridge was peculiarly fitted for this work, having received a thorough training both as a geologist and agricultural chemist, and having made a study and report as special expert, for the tenth census, on cotton production, on the States of Georgia, Louisiana, Texas, and prepared agricultural maps of those States. This work, in the Purchase counties, occupying about eighteen months for its completion, embraced the counties of McCracken, Marshall, Calloway, Graves, Ballard, Hickman and Fulton. This region differs from other parts of Kentucky in topographical, geographical and agricultural features. It is, geologically, the newest portion of Kentucky. Isolated as this region is, in its general features, from the rest of the State, it has been thought best that the "Report on the Jackson Purchase," now in course of preparation, should be made for the entire region as a whole, followed by a brief description of each of its counties, all combined in one volume. The following is an outline of the subject-matter to be embraced in this report:

1. Topographical features, embracing surface contours, elevations and drainage systems.
2. Geological formations, in the order of succession, preceded by a brief review of the adjacent region or ancient shore line in Missouri on the west, Illinois on the north, and the country east of the Tennessee river. This division will include the following formations: *Lower Subcarboniferous*, represented by cherty limestones, forming a narrow belt on the west side of the Tennessee river valley. *Cretaceous*, represented by micaceous sands and thinly laminated clays, in a belt bordering the subcarboniferous, and extending from the Tennessee State line to the Ohio river, at Paducah. *Tertiary*, represented only by the lower eocene

division, with its Hickman group of drab clays, and overlying silicious claystone and lignitic or black joint clays, dark sandy clays, and their overlying beds of lignite, bordering the cretaceous formation on the east, and the Mississippi river on the west. Over the lignite are the Lagrange groups of sand and pipe clays, forming a transition to the next formation. *Quaternary*, covering almost all of the Purchase region, and represented by the following groups: Stratified drift or gravel bed, the succeeding Port Hudson along the larger streams, the Loess capping the river bluffs, the brown loam forming the superficial deposit over all of the upland formations, and the alluvium or recent river bottom deposits.

3. Economic geology, embracing the following: Clays, their important localities and occurrence, varieties, uses and results of tests, including practical tests of twenty-seven samples sent to the Rookwood pottery in Cincinnati; the occurrence, character, analyses and uses of lignite or brown coal, the *gravel* deposits, *polishing material*, *ochres* and *iron ores*.

4. Agricultural features, embracing a description of the soils of the several agricultural regions, both upland and bottom lands, together with the results of chemical analyses of the same, the timber growth, agricultural products, etc.

5. Antiquities, with descriptions of the various ancient earthworks and group of mounds.

6. Description of each county in the Purchase, with topographical, geological and agricultural features.

This report will be accompanied by a large geological map, already published, and by smaller ones, showing agricultural features or divisions, the *hypsothetic* contours, and the *gravel* deposits. It is confidently believed that the reports and maps of this region will be equal in detail and accuracy to those of

any other region in America. The great wealth of fire and pottery clays in this region, together with the remarkable transportation facilities, will doubtless lead to the establishment of industries, so soon as the facts may be made known.*

(3.) CHEMICAL WORK.

The chemical and laboratory work under the direction of Dr. Robert Peter, assisted by Mr. A. M. Peter, has been fruitful of good results. The volume of chemical analyses ("A, part 2") just issued, contains analyses of 182 soils and subsoils, 40 clays and marly shales, 20 mineral waters, 21 iron ores, 35 limestones, 226 coals and 31 cokes. This will prove one of the most valuable reports ever published by the State, containing, as it does, analyses of the purest coals yet discovered, accompanied with valuable practical suggestions upon fertilizers and other kindred subjects, with a valuable report on the comparative analyses of soils. On page 160-1, Dr. Peter gives the peculiar uses of soil analyses, and cites the successful practical application made by Mr. John Prout on his experimental farm in Hartford county, England.

Dr. Peter is now engaged in working up the material collected by the Survey during the past season, and preparing a report on same for publication.

(4.) TOPOGRAPHICAL WORK.

Reference has already been made to the topographical surveys of various counties. In addition to the maps, drawn on a scale of two miles to the inch, the work of the Survey has been directed to the making of a large map of the State, on a scale

* In the Purchase, clays suited to the manufacture of the following articles are found in abundance: Fine pressed brick, roofing tile, encaustic and ornamental tile, terra cotta, flue linings, drain pipes, fire bricks, gas retorts, retorts for zinc works and other metallurgical purposes, glass pots, stove and furnace linings, chemists' and assayers' utensils, stoneware, ornamental earthenware, graniteware, whiteware, ornamental pottery, flower pots, telegraph insulators, water filters and coolers, etc.

of 1-300,000. This work has been carried on by Mr. J. B. Hoeing, chief topographer of the Survey, whose excellent training in one of the best engineering schools of the country, and long connection with the State Survey, renders him particularly fitted for the work he has in hand. Much of the work on the State map has already been engraved, and the proof-sheets are to be seen in the office of the Geological Survey. During the past year the boundary line of the State was completed, enabling for the first time an accurate calculation to be made of the area of the State. Hitherto the area of the State has been variously estimated at from 37,000 to 40,000 square miles. It is now computed by Mr. Hoeing, from actual measurement, to be 41,283 square miles. Mr. Hoeing has also computed the area of a number of counties, and furnished the same to the Auditor, and will from time to time, as the maps are completed, determine the correct area of the counties. The United States Geological Survey has co-operated with the State Survey, and rendered most valuable assistance in mapping the eastern coal field, thus enabling the State Survey to concentrate work in Western Kentucky. During the past two years that portion of the State situated south of lat. 38°, and east of long. 83°, and south of lat. 37°, and east of long. 84°, was mapped, and it is hoped that during the coming season all the region not already mapped between lat. 37° and 38°, and long. 83° and 84°, will be completed, thus leaving but a small area of the eastern coal field to complete in 1887. In addition to the work on the State map, Mr. Hoeing has been engaged in drawing county maps for the engraver, and coloring the geology on same, under the direction of the geologists of the Survey. These maps are beautiful specimens of cartographic art, and have received high praise from various State and government Surveys.

(5.) OFFICE WORK.

As the work of the Survey becomes more widely known the office work and the correspondence greatly increase. During the past year, notwithstanding the constant and efficient work of the Secretary of the Bureau of Immigration, Mr. E. A. Fellmer, it has been found necessary from time to time to engage a stenographer to keep pace with the increasing demands for information from persons beyond the State, and from citizens of our own State, a gratifying evidence of the interest of the people of this State in its development. In addition to the office in the Capitol building, it has been found necessary to rent an office in Lexington for the accommodation of the chief topographer and the gentlemen at work in the eastern coal field.

In addition to the correspondence of the Survey and the methods devised for bringing a knowledge of the resources of the State into favorable notice, much time is necessarily devoted to the preparation of the reports, maps, geological sections, illustrations, etc. All of the reports are stereotyped and the maps engraved on stone, the plates remaining the property of the State, so that at any time new editions may be printed if desired. In addition to the county reports, which will be published as fast as they can be prepared, it is the intention of the Survey to publish a volume in which shall be condensed the results of the survey, giving a description of the entire State, its topography, geology, agricultural features, resources, etc.

Data are being collected and classified for this final report, and it, with the geological map of the State, will be pushed to completion as rapidly as is consistent with accuracy. The needs of such a book are very great. It is to be hoped that it will not only serve as a valuable book of reference to those seeking information respecting the State, but that it will be of

value in making known to our own people, particularly the young, the great resources and unlimited possibilities of Kentucky.

During the past two years, important additions have been made to the geological cabinet, mainly of fossil remains, coals, and a remarkable collection of fire and pottery clays from the Purchase counties, together with samples of tests made from these clays. Valuable reports, pamphlets, etc., have also been added to the geological library.

Before concluding this brief statement respecting the work of the Survey, I desire to express my gratitude to my co-workers on the Survey for the zealous and intelligent manner in which they have discharged their duties. The large amount of work accomplished by the Survey during the past two years is due to the devotion of these men to their professional duties, and to their zeal to advance the best interests of Kentucky.

(6.) BUREAU OF IMMIGRATION.

By act of the Legislature, the State Geologist was made *ex officio* Commissioner of Immigration, and was required by the law to "collect, compile, publish and circulate in such manner, and by such agencies, and in such places as he may deem proper and advisable, in the United States and in foreign countries, pamphlets and other publications descriptive of the resources and advantages of this State, and such other facts and information as will have a tendency to attract and promote immigration, and the bringing of skilled labor and capital into the State." In striving to carry out the provisions of this law, I have been careful to secure mainly thrifty and intelligent tillers of the soil; men who would move upon the unimproved and therefore unproductive lands of the State. I believe that no State has received a better or more intelligent class of immigrants than those brought to Kentucky through the instrumen-

tality of this Bureau during the past few years. The people in the several prosperous colonies located in the State represent but a fraction of the immigration. Many well-to-do farmers from States north of the Ohio river and from Europe have found homes in this State. The manner in which the colonies continue to grow from small beginnings is an evidence of the prosperity of the people comprising them.

The first colony, Bernstadt, Laurel county, composed mainly of Swiss, from the Canton Berne, numbered about 200 souls in January, 1882. In January, 1884, it had grown to 440 persons, and it now (January, 1886) numbers over 800, notwithstanding many have gone from that colony and located upon farms in various parts of the State, and several new colonies, offshoots from Bernstadt, have been established in Laurel county. An astonishing amount of work has been done by these industrious Swiss since they settled. Forests felled, land cleared, comfortable houses and stables built, orchards and vineyards planted, comfortable school-houses and churches erected, roads improved; and, where a few years since was nothing but forests or neglected and worn out "clearings," are to be seen comfortable and attractive homes occupied by contented and industrious people laboriously striving to add to the wealth and prosperity of the State. The same may be said of the other colonies, as I know from a recent visit of inspection among them.

East Bernstadt: From a small beginning three years since, has grown steadily, and at last report numbered 118 persons, twenty-four families—fourteen families from Europe and ten from Northern States—mainly Swiss.

Strassburg: Near London, Laurel county, composed of agriculturists and grape growers, mainly from Alsace and Switzerland, numbering, at last reports, ninety-one persons, with prospects of substantial additions during the coming spring.

Langnau: A little colony recently located south-east from London, now numbering thirty persons, with prospects for rapid growth in the near future.

Saaner Colony: Located in Lincoln county by intelligent farmers and cattle growers from the Saaner valley, in Switzerland. This colony numbered about fifty persons in January, 1883, and 131 persons in December, 1885. I understand that arrangements have been perfected to begin the manufacture of Swiss cheese in this colony during the coming spring.

Lutherheim and Highland Colonies: In the autumn of 1883 I induced Mr. J. Ottenheimer, who had much experience in colonizing in the West, to visit Kentucky; after a careful inspection he purchased a large body of land in Lincoln county, and in the spring of 1884 located the above-named colonies. The growth of these colonies has been phenomenal; the colonists brought to them since the spring of 1884 aggregate over 800, and accessions of skillful agriculturists from Europe and the north-western States are constantly being made. During a recent visit I conversed with many who had come from Illinois, Wisconsin, Minnesota and other northern States, and I failed to find one who regretted coming to Kentucky. I was told by well-informed citizens of Lincoln county, and I have recently seen the same statement made in the county paper, that, through the instrumentality of the company above referred to, over \$225,000 have been brought into Lincoln county during the past two years. The wealth represented by the industry and intelligence brought into the county is much greater.

New Austria: Located in the southern part of Boyle county, numbered, at last report, 105 persons, mainly from Austria.

Templar Springs: A temperance colony, located in Edmonson county, north of Green river. Mr. Thunstrom, the director, reports 100 persons in the colony, and an equal number in the sur-

rounding neighborhood, mostly from Sweden. Nearly 100 Swedes have also settled near Leitchfield, in Grayson county.

In Christian county several small settlements of Germans and Scandinavians have been located during the past few years, mainly from the north-western States. These aggregated at last report 149 persons, and new-comers are expected.

A location has been selected recently for a colony in Lyon county, and a few colonists have arrived. It is hoped that a prosperous colony will be built up in that county. Other locations have been made in various parts of the State by individuals who hope in time to induce others to join with them in establishing colonies. It is impossible to estimate the number of farmers who have come into the State from northern and western States during the past few years, but the number is considerable, judging from the number of publications sent out in answer to applications for information about Kentucky, and from the large correspondence with persons who have arrived in the State. My thanks are due Mr. E. A. Fellmer for his faithful labor as Secretary of the Bureau of Immigration. He has endeared himself to hundreds of immigrants by the care he has taken in replying to all letters of inquiry. His perfect knowledge of the German, French and English languages and his untiring zeal have made his services peculiarly valuable to the State, and to the many who have, during the past few years, found homes in Kentucky.

At the request of the Commissioner of Agriculture, I prepared for his last report* an article on "Immigration and its effect on the agriculture and general welfare of Kentucky," in which I attempted to give emphasis to the following facts:

That the fears of over population are groundless; the State of

*Report of the Bureau of Agriculture, 1885, page 332.

Texas could contain the entire present population of the United States, and the population of Texas would then be no more dense than the population of those countries in Europe (France, Belgium and Holland) where there is more universal prosperity among the masses, and not so dense as is the population of the State of Massachusetts, where there is the largest amount of wealth *per capita* of any State in the Union. That even in Great Britain, with an increase of population, there has been a large increase of wealth and a decrease in the percentage of pauperism and crime. That unjust land laws and the burdens entailed by wars and standing armies account for most of the poverty of Europe. That emigration is less from those countries having the densest agricultural population. That the percentage of illiteracy and crime is greatest in those European countries where there are sparse agricultural populations. That a dense agricultural population adds to the value of life by making accessible, even to the poorest, schools, churches, libraries, museums, good roads and other blessings of a high civilization not attainable even by the rich in sparsely populated regions. That agriculture can be made profitable in all parts of Kentucky by the adoption of crops suited to the peculiarities of the various soils. That our people in portions of the State have acquired, because of the abundance of unoccupied lands, certain land-destroying tendencies, whilst the intelligent immigrants now coming to this country are conservators of land, and have an inherited thrift and care for land. That the agricultural methods practiced by the immigrants—the planting of fruit trees and vineyards; the introduction of new seeds, the careful saving and application of manures, the successful introduction of grasses in portions of the State where grasses have not hitherto entered into the rotation of crops, the neatness of tillage, the introduction of cheese-making and other like industries connected with agriculture—

are already having a most beneficial influence, and will add greatly to the wealth and prosperity of Kentucky.

In conclusion, I desire to thank you, sir, for the interest you have manifested in the work under my direction, and for the kind encouragement given during its progress.

Respectfully yours,

JOHN R. PROCTER,

State Geologist.