

FOURTH

REPORT OF PROGRESS

OF THE

GEOLOGICAL SURVEY

OF

MISSOURI.

BY

G. C. SWALLOW.

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1859.

GEOLOGICAL ROOMS, STATE UNIVERSITY,
Columbia, Mo., Dec. 22, 1858.

To Hon. B. F. MASSEY, *Secretary of State*:—

SIR: In compliance with the law providing for the Geological Survey of the State, I herewith submit my Fourth Report of the progress and condition of that Survey.

Very Respectfully,
Your Ob'd't Serv't,
G. C. SWALLOW,
State Geologist.

REPORT OF PROGRESS.

Since my Third Report of Progress, in Dec. 1856, the labors of the Geological Survey have been pushed forward toward completion with all the energy and skill at our disposal; and, although some unforeseen difficulties and casualties have occurred to retard the progress of the work during the present year, and although we have not accomplished all we had anticipated, still the results of our labors in developing the mineral and agricultural resources of our State, are very satisfactory.

WORK DONE IN 1857.

During this year, Messrs. G. C. BROADHEAD and HENRY ENGELMANN were appointed Assistant Geologists; the former was attached to my corps, and the latter to the company of Dr. SHUMARD.

In the spring of this year, I was requested to make surveys along the lines of the South-West Branch and the Iron Mountain Railroad, in accordance with a law passed at the last session of the General Assembly. In compliance with this request, I proceeded to make a careful Survey of the country on the South-Western Branch of the Pacific Railroad, comprising the counties of St. Louis, Jefferson, Franklin, Gasconade, Crawford, Phelps, Maries, Pulaski, LaClede, Webster, Greene, Lawrence, Newton, and a part of Jasper, McDonald, Polk, Stone, Barry, Taney, Dallas, Washington and Wright, an area of more than 13,000 square miles.

A preliminary report of this Survey was made to the President of the Pacific Railroad Company in the autumn of this year. This Report was published by the Company, and widely circulated in the periodicals of the country.

During the succeeding winter and spring, a more extended report was prepared, and has since been published by the Pacific Railroad Company.

After completing this Survey arrangements were made to make a similar Survey along the line of the Iron Mountain Railroad, but the financial difficulties which occurred at that time prevented the completion of the work.

My own company then entered upon the Survey of Cole County, which was completed by Messrs. PRICE and BROADHEAD, as the other duties of the Survey demanded my attention. In October the Survey of Callaway county was commenced; but we were compelled by the snow and ice to suspend the out-door operations early in November, before that county was finished.

During this year Dr. SHUMARD, assisted by Mr. ENGELMANN, made the Surveys of LaCledé, Pulaski, Crawford and Phelps. In the following winter he made out the reports upon LaCledé, Pulaski, Crawford and Phelps, and assisted in identifying and labelling the fossils collected, and in describing the new organic remains of the coal measures, so necessary to the progress and accuracy of our Survey of this important formation.

Mr. PRICE, in addition to the labors of his department, assisted me in the Survey of the South-Western Branch of the Pacific Railroad, and in conjunction with Mr. BROADHEAD, made the Surveys of Osage and Cole counties, and made out the report of Cole.

Mr. BROADHEAD, besides assisting me while in the field, made the Survey of Maries county, assisted Mr. PRICE in the Survey of Cole and Osage, and in making out Sections and Maps. He also made the Reports of Maries and Osage counties.

Dr. LITTON devoted the whole of this year to the labors of the laboratory, making the analyses of Minerals, Soils and Mineral Waters.

It will thus be observed that the field operations of the Survey were prosecuted with energy and great success, notwithstanding the derangement of our plans of operations by the circumstances above

named, and the brevity of the season suited to out-door work ; which was limited by bad weather to less than six months, or from the last of May to the middle of November. The amount of office-work done, in preparing Maps, Sections and Reports, and in examining collections, in determining Rocks, Minerals, and Fossils, and in describing and labelling the same, and in conducting the correspondence and keeping the accounts of the Survey and in analyses of Minerals, Soils and Mineral Waters, was very great.

THE WORK DONE IN 1858.

During the present year the Survey has undergone many important changes, and been retarded by several events which were beyond my control.

Early in the spring Mr. PRICE resigned, leaving a vacancy in the Survey which has not been filled. In the resignation of Mr. PRICE the Survey has lost an accomplished Draughtsman, and a skillful, energetic and faithful Geologist, whose place it will be difficult to fill.

In the summer following, Dr. SHUMARD resigned to enter upon the Geological Survey of Texas. In him the Survey has lost a most skillful Palæontologist and an experienced Geologist. His place has not yet been filled.

But the Survey has been singularly fortunate in obtaining the services of Dr. J. G. NORWOOD, who stands first among Western Geologists. His great experience and skill will very essentially increase the public confidence in the success and results of the Survey. Mr. EDWIN HARRISON, a man of science and great energy, has also been attached to the Geological corps.

The loss of a member of a Geological Survey, who has become thoroughly acquainted with the operations and progress of the work, and the Geological structure of the country to be surveyed, is a much greater misfortune than such a loss would be in any other department of the public service.

Besides the resignation of two assistants, the Survey has been retarded during the present year by the sickness, more or less protracted, of nearly every member of the corps. Exposure in camp-

life to the unusual rainy seasons of the present year, has resulted in much more sickness than has ever before been experienced by those attached to the Survey. In addition to these causes of delay, the season has been so shortened by protracted rains and floods of the spring and early summer, and the rains and snows of autumn and early winter, that not more than five months could be devoted to the out-door labors; whereas, we have usually been able to continue in the field much longer.

Notwithstanding these difficulties, the labors of the Survey have been pushed forward with all possible dispatch.

Dr. LITTON has devoted his time exclusively to the labors of the Laboratory.

Dr. SHUMARD, assisted by Mr. EDWIN HARRISON, completed the survey of Ste. Genevieve and Washington counties, and in conjunction with Dr. NORWOOD, made a re-examination of some of the formations on the Mississippi below St. Louis, for the more accurate determination of their stratigraphical position.

Dr. NORWOOD, besides the work above named, made a careful survey of Madison county and a portion of Iron. In this labor he was assisted by Messrs. G. C. BROADHEAD, DANIEL CROSBY, and P. C. SWALLOW. He has also made, with the assistance of Mr. HARRISON, Surveys of Lafayette and Johnson counties.

Mr. BROADHEAD, besides assisting me in the examinations of Callaway and Montgomery, and Dr. NORWOOD in Madison and Iron, has made the survey of Warren county.

A large portion of my own time was occupied in preparing and superintending the publication of the Report on the South-West Branch of the Pacific Railroad, and in examining mineral deposits in various parts of the State, to determine the true character and value of our lead veins.

Besides these labors, and the general superintendence of the Survey, I have given my personal attention to the survey of Callaway and Montgomery counties.

From this statement it will be seen that the amount of surveying

done during the past season is much less than that accomplished in any one of the preceding years, although we have had a larger force in the field. But still several very important results have been brought out. Two of these will have a vast influence upon the future growth and prosperity of the State. I refer to the adaptation of the climate and the poorer soils of our southern table lands and ridges to the culture of the grape, and the true character of our lead veins, as shown in my report to the Pacific Railroad Company.

In addition to the labors above named, a large amount of office-work has been done. The rocks, minerals, and fossils have been examined, and many of them determined and labelled. The superintendence of the operations of the Survey, the care of the vast collection of specimens, maps, charts, and sections, the keeping of the accounts with the State and with each of the members of the Survey, and the conducting of the voluminous correspondence connected with it, has demanded a large portion of my time. These office duties alone, if carefully performed, would demand more of my time than government officers usually devote to the public service. The correspondence connected with the Survey is very onerous. During the past year some fifteen hundred letters have been received and answered, nearly all of them asking for such information as the people seem to have a right to demand at my hands. Some of them can be answered in a few lines; while others require elaborate and detailed replies, and such as can not be safely given without a careful examination of all the facts and attendant circumstances; as the establishment of extensive operations in mining, manufactures or agriculture, often depends upon the nature of the information given. From these hints it will be perceived that the labor and responsibility of such a correspondence is very great. Since my last Report in 1856, a large amount of matter, showing the mineral resources of our State, has been published and widely circulated, without expense to the State. Several papers on the Geology of Missouri, illustrating its mineral and agricultural resources, have been published in the proceedings of our Scientific Associations and in many of the leading periodicals of the country. A Geological Map of the State has been prepared and will be incorporated with a very important map of the United States about to be published in Europe.

In the early part of the present year, I joined DR. SHUMARD in preparing descriptions of the new Organic Remains found in our Coa Measures, which were published in the Transactions of the St. Louis

Academy of Natural Sciences, and also in pamphlet form. I also joined Maj. HAWN in preparing an article on the Rocks of Kansas, showing the position of the gypsum beds of that Territory and our own. The intimate relations between the Geology of Kansas and the importance of those gypsum beds, made it very desirable for us to know the character of these rocks and their relations to our own.

An article on the Culture of the Grape in our own State, and the adaptation of the climate and the poor flinty soils of our Southern high-lands, was prepared with great care for the Report upon the South-West Branch of the Pacific Railroad. By permission of the President of that Company, it was incorporated in the United States Patent Office Report, and read before the American Association, and widely circulated in the periodicals of this country and Europe.

These papers, and the Report to the Pacific Railroad Company, contain a large amount of facts showing our vast mineral and agricultural wealth. The facts stated in the Report on the South-Western Branch clearly prove the peculiar adaptation of the poorest flint ridges (heretofore deemed worthless) to the culture of the grape; that they are even better for vineyards than any other soils in the State, and that we have at least 5,000,000* acres as well suited to the culture of the grape as any of the soils of Europe; and that this land in vineyards would be worth \$1,500,000,000, that these vineyards, if as profitable as those now in the State, would yield an annual income of more than \$1,000,000,000; and a net profit of \$500,000,000, and give employment to 2,000,000 people. This Report also shows the existence, in the counties on that Road, of 90 localities of Iron ore and two furnaces; 216 localities of Lead and 34 furnaces; and 25 deposits of Copper and one furnace, besides many of Zinc and Coal. These mineral deposits alone would be sufficient to render any State famous for its mineral wealth.

It will thus appear that we have published Geological matter enough to make over 200 full octavo pages, or a volume half as large as that of our Reports published in 1855; and all has appeared in the proceedings of one Scientific Association and the public journals, and been widely circulated in the United States and Europe, without any expense to the State.

No one can doubt that our former reports and these publications have

* France has about 5,000,000 acres in vineyards. They yield about 925,000,000 gallons of wine, besides the 95,000,000 gallons distilled into brandy, and give profitable employment to 2,000,000 of people, mostly women and children

fully established the fact that our State possesses an amount of natural resources, equal or superior to those of any other State in the Union; and that this fact is now to a great extent controlling the sentiment of the country, and directing a large amount of capital to our State. This conviction has had an important influence in securing the very rapid sale of the public domain within our borders, especially in the coal field of the Northern, North-Western and Western counties, and the poorer broken portions of the Southern high-lands. It has also materially appreciated the value of all landed property, particularly in newer portions of the State which have been surveyed.

For these and other reasons, it is very evident that the Geological Survey has very materially aided in securing the rapid progress of our State, the increase of her revenues, and the appreciation of our State bonds.

Were it necessary, it would be easy to prove that the Survey, by its influence on the sale of the public lands alone, annually places more money in the State Treasury than it extracts therefrom.

The question is often asked when the Survey will be completed.

In 1855 it was supposed that the Survey could be completed in six years if the biennial appropriations were increased to \$25,000. But it was found during the years 1855 and 1856 that the current expenses of the Survey were nearly doubled by the increased prices of horses, forage, provisions, and in short nearly all the articles used in the Survey; and that it would be difficult to get the work well done so soon. Still, in 1857, hopes were entertained that the work could be carried through in that time. But since the bad weather of the two past seasons, and the circumstances above named, have so retarded the progress of the work, there is no hope that it can be completed under four years, if the plan thus far pursued of making accurate and minute surveys and maps for each of the 111 counties, be continued.

Much more than half, and by far the most difficult part of the work, is done.

The following table exhibits in a compact form the present condition of the Survey.

TABLE

Showing the condition of the Missouri Geological Survey up
to December, 1858.

NAMES OF COUNTIES.	Survey Completed.	Survey Half done.	Survey Commenced	Maps Made.	Maps Engraved.	Maps Printed.	Maps Colored.	Reports Made.	Sections of Strata made	Schedule of Sections.	Reports Published.
Barry			*								
Benton			*								
Bollinger	*										
Boone			*								
Butler	*										
Callaway		*									
Cape Girardeau	*			*							
Clark	*			*	*		*				
Cole	*							*	*		
Cooper	*			*	*	*	*	*	*		*
Crawford	*			*				*			
Dallas			*								
Dent		*						*	*		
Dunklin		*						*	*		*
Franklin	*			*	*	*	*	*	*		*
Greene	*			*	*	*	*	*	*		*
Howard	*			*	*	*	*	*	*		*
Iron		*						*	*		*
Jasper			*					*	*		*
Jefferson	*			*	*	*	*	*	*		*
Johnson			*					*	*		*
Laclede	*			*	*	*	*	*	*		*
Lafayette	*			*	*	*	*	*	*		*
Lawrence	*			*	*	*	*	*	*		*
Lewis	*			*	*	*	*	*	*		*
Madison	*			*	*	*	*	*	*		*
Maries	*			*	*	*	*	*	*	*	*
Miller	*			*	*	*	*	*	*		*
Mississippi	*			*	*	*	*	*	*		*
Marion	*			*	*	*	*	*	*		*
Montgomery		*						*	*		*
Moniteau	*			*	*	*	*	*	*		*
Morgan	*			*	*	*	*	*	*		*
Newton	*			*	*	*	*	*	*		*
New Madrid								*	*		*
Osage	*			*	*	*	*	*	*	*	*
Oark	*			*	*	*	*	*	*		*
Pemi-scot	*			*	*	*	*	*	*		*
Perry	*			*	*	*	*	*	*		*
Pearce	*			*	*	*	*	*	*		*
Polk			*					*	*		*

NAMES OF COUNTIES.	Survey Completed.	Survey Half done.	Survey Commenced.	Maps Made.	Maps Engraved.	Maps Printed.	Maps Colored.	Reports Made.	Sections of Strata made	Schedule of Sections	Reports Published.
Pulaski.....	*			*				*	*		
Putnam.....	*			*							
Reynolds.....	*										
Ripley.....	*										
Saline.....	*			*							
Scotland.....		*		*					*		
Schuyler.....	*			*							
Scott.....	*										
Stone.....		*									
Soudard.....	*										
Ste. Genevieve.....	*										
St. Francois.....			*								
St. Louis.....	*			*	*	*	*	*	*		*
Taney.....			*								
Washington.....	*										
Wayne.....	*										
Warren.....	*			*						*	
Webster.....		*						*			*
Wright.....	*			*	*			*	*		
In All.....	44	7	9	29	12	10	9	14	17	4	5

From this table, it will appear that the surveys of 44 counties have been completed, 7 are half done, 9 have been commenced, and the preliminary surveys have been made in many others. The maps of 29 counties have been carefully made out. Of these 12 have been engraved and ten printed and colored, (7000 copies of each). The reports upon 14 counties have been made out, and a large amount of work done on the reports of other counties.

In October of 1857 I was invited by the Curators of the State University to give the lectures in the department of the Natural Sciences, during the remainder of that session. After some consultation I accepted the place on condition that I should lecture only during the time when my duties would require me to be at the Geological Rooms in the University.

At the last annual meeting of the Curators they again elected me to that chair, which I accepted on the same conditions as before, that I should not neglect the duties of the Survey.

While engaged in the Geological Rooms in the University I have lectured once each day; but these lectures have taken but little of my time from the regular labors of the Survey; as those labors and investigations are the best possible preparations for practical and useful lectures in that department. At all events, I have not failed to devote about fifteen hours daily to my duties in the Survey. And besides, the money received for my services in the University has been devoted to the use of the Survey. By it the valuable services of Dr. NORWOOD have been secured during the past season.

It will thus be seen that this arrangement has greatly facilitated the operations of the Survey, for by it I have not only performed my full quota of labor, but have also secured the services of another Geologist.

It has been supposed by some that certain portions of the State have been improperly neglected in the prosecution of the Survey. But in all cases I have followed my instructions as closely as possible. And I am satisfied those instructions were the very best that could have been given under the circumstances.

I have received commissions from Governors PRICE, POLK and STEWART, and each of them gave the same instructions; in substance that — “*I should conduct the Survey according to my own best judgment.*” These instructions I have faithfully followed, guided by my own judgment and the advice of those appointed to assist me, and several other Geologists of great experience and well known fidelity.

A plan of operations is as necessary in the prosecution of a Geological Survey as the construction of a Railroad; and this plan will

depend, in the main, upon the Geological character of the country to be examined. It is as necessary that certain portions of the work be done first, as it is that some parts of a railroad be first completed.

The carpenter who would commence his house at the roof and build down, rather than at the foundation, would labor at about the same disadvantage as we, had the Survey been commenced in the middle of our great coal field before we had examined the counties along its borders.

Our plan of operations was fully set forth in the Second Annual Report, and no one has attempted to show its errors. That plan, modified by facts developed in the progress of the work, has been carefully followed out. If any part of the State has been neglected which ought to have been surveyed before the portions already examined, it must have resulted from one of two causes; either our plan of operations was not a good one, or we have failed to accomplish as much as we should have done.

In this connection it may be proper to say that our plan is the best we could devise; and it has secured the unqualified commendation of many eminent Geologists. As to the amount of work done, I can only say that all in my power has been done to push the work toward an early and successful completion. For nearly six years I have devoted all the energies of my nature to the great work. Private business and social duties, all have been neglected, and private means freely expended to obtain the facilities needed to secure its complete success. It has been my ambition, above all things else, to make the Survey of Missouri the most systematic, the most accurate and the most useful, and at the same time the cheapest of all the Surveys of our country. To accomplish this, not less than sixteen hours of each day have been devoted to your service.

With what success these efforts have thus far been crowned, the best judges have declared; but its future progress and completion is left to the wisdom of our legislators.

It would thus seem improbable that any one would complain, when all the facts are known. It is true we have expressed the expectation of finishing certain parts of the State not yet completed, but the bad

weather and the other causes of delay heretofore mentioned, have prevented.

In conclusion I may be permitted again to express my gratitude for the means and facilities afforded me in the prosecution of this great work. Ours, perhaps, is the only Survey on record, in which all the facilities asked by those prosecuting the work, have been granted by the Legislature and the Executive. Nor can we forget that we have everywhere been the recipients of the warm hospitalities and liberal assistance of the people, nearly all of whom have appeared deeply interested in the progress and success of the work.