

# KENTUCKY GEOLOGICAL SURVEY

Charles J. Norwood, Director.

---

## REPORT

ON THE

# Progress of the Survey,

FOR THE YEARS 1904 AND 1905,

By CHARLES J. NORWOOD.

---

Lexington, Ky.

---

PRINTED BY THE GEO. G. FETTER COMPANY, LOUISVILLE, KY.  
1905



IOWA GEOLOGICAL SURVEY,  
DES MOINES, IOWA.

# KENTUCKY GEOLOGICAL SURVEY

Charles J. Norwood, Director.

---

## REPORT

ON THE

# Progress of the Survey,

FOR THE YEARS 1904 AND 1905,

By CHARLES J. NORWOOD.

---

Lexington, Ky.

---

PRINTED BY THE GEO. G. FETTER COMPANY, LOUISVILLE, KY.  
1905



## LETTER OF TRANSMITTAL.

---

*To His Excellency, J. C. W. BECKHAM*

*Governor of Kentucky.*

*Sir:*—I have the honor to submit the following report on the progress of the Geological Survey of the State since the revival of the work in March, 1904, up to date.

Very respectfully,

CHARLES J. NORWOOD,

*Director, Kentucky Geological Survey.*

LEXINGTON KY. December 1, 1905.



## REPORT OF PROGRESS.

---

It will be remembered that the field work of the Survey was suspended in 1892, and the affairs of the office placed in the hands of the State Inspector of Mines as Curator. I believe it is now very generally recognized that the long suspension of the work has proven most unfortunate for the State, hence it is not deemed necessary to enter into the particulars of wherein Kentucky has, during most momentous years of industrial movements, been at a disadvantage in comparison with her sister States that have maintained their Surveys during all the years and have continuously issued bulletins relating to their economic resources. In the years preceding the suspension, as is known by those conversant with the facts, the Survey achieved great results in forwarding the development of the State. Equally as good results will follow the revival, if the latter be not too brief; indeed, in consequence of the formation of commercial clubs and similar organizations, throughout the State, now going on more generally than ever before, with which the Survey may co-operate, we may expect speedier and more effective results from the Survey's work than was possible hitherto.

A history of the operations of the Survey under the administrations of Prof. N. S. Shaler and Mr. J. R. Procter, with summaries of results, will be found in another report now in course of preparation. A detailed discussion of the work accomplished by the present organization is also reserved for that report.

The law which governs the present Survey provides for the study of our resources first by subjects, instead of by regions as hitherto. This plan, which is essentially the same as one which Prof. N. S. Shaler had in mind at about the time he retired from the directorship of the Survey, in 1880, will prove most satisfactory to those seeking information on some particular subject, and it will, of course, carry the Survey the more speedily into all the counties as the investigation of each subject proceeds. It may be well to here quote the two sections of the law relating to this matter. They are as follows:



"Section 5. It shall be the duty of the Director of the Survey and his assistants to examine, study and report upon the economic geology of the State especially, giving particular attention to such mineral resources as coal, iron, lead, zinc, barite, fluorite, clays, shales, building stones, asphalt rock, road and paving materials, salt, cement materials, natural fertilizers, petroleum, natural gas, pigment earths, abrasives, marbles, lithographic stones, and other minerals; determining their location and extent, which shall be shown on appropriate diagrams and maps, their relations to transportation routes, actual and possible, and their chemical and physical qualities to such extent as may be necessary in each case; and such investigations shall be conducted along such lines as will prove of practical value in ascertaining and exhibiting the fitness for commercial uses of the various substances reported upon, and shall include such standard and practical tests as are necessary and usual in determining the commercial values of the various materials under investigation. The occurrence of mineral springs shall also be noted and the waters analyzed when necessary, and the water powers of the State shall be investigated. The soils of the State shall also be studied, with reference to their fitness for various classes of crops, with a view to determining the proper fertilizers for impoverished ground, and such results as are appropriate shall be embodied in a soil map. The character and distribution of the timbers of the State shall also be determined.

"Sec. 6. In furtherance of the object sought to be attained by this act, and in order that the results of the Survey may be presented in most convenient form, the reports of the Survey shall be divided into three classes, namely (1) Subject Reports, (2) County Reports, (3) General or Index Report. (1) The subject reports shall consist of a series of special economic reports issued as bulletins, each report dealing with some particular mineral occurrence, or particular subject, such as enumerated in section 5, and treating it in an exhaustive way, with reference to its occurrence throughout the State as a whole; but in cases where the occurrence of any one mineral is limited in amount or extent, or where two or more mineral occurrences may more appropriately be treated together, then a bulletin may be issued including more than one subject. To carry out the

provisions of this section, therefore, there shall be issued a special report on the coals of the State, which may be divided into two parts, one on the coals of the Eastern Field, and one on those of the Western Field; a similar report on the clays, shales, and cement materials of the State; one on the building stones and marbles; one on the lead and zinc ores, and the barite and fluorite deposits; one on petroleum and natural gas; one on asphalt rock and road materials, and so on, appropriate bulletins being issued with reference to the various subjects of investigation coming within the province of the Survey, the results of the soil survey being published in the form of an agricultural bulletin. Said reports shall be accompanied by all diagrams and illustrations necessary to render them full and complete. In order that the results of the Survey may be given to the public as expeditiously as possible, the bulletins herein provided for shall be the form of publications to be issued first, and in cases of urgency the director may issue preliminary parts of a bulletin, covering the special work so far as it has progressed, in advance of the completion of the entire bulletin. (2) The county reports shall consist of full and complete reports on the mineral, agricultural, and other natural resources of the county, accompanied by maps and diagrams showing the geological formations of the county, with their dips and flexures, and such items of topography as the resources of the survey will permit. (3) The general report shall relate to the distribution of the geological formations and mineral resources of the State as a whole, its purpose being to present a general view of the natural resources of the State, and to serve as an index to the occurrences of the mineral deposits and distribution of timbers by citations to the special bulletins and county reports wherein extended descriptions of the same may be found."



## PERSONNEL OF THE SURVEY.

The following persons are now, or have been, employed on the Survey, named in the order of their appointment under each class:

*Director.*—Charles J. Norwood.

*Assistants in Geology.*—Joseph B. Hoeing, Arthur M. Miller, Aug. F. Foerste, W. F. Pate, Albert R. Crandall, James H. Gardner, Samuel A. Denny, F. Julius Fohs, John M. Nickles (temporary).

*Miscellaneous.*—Alfred M. Peter, chemist; John E. Wright, mining assistant (term of service expired); Moritz Fischer, geologic assistant (temporary); Robert H. Barclay, mining aid (term of service expired); George V. Triplett, Jr., aid (resigned); Curtis L. Jones, secretary (resigned); W. U. Grider, assistant in charge of building stones (resigned).

*Topographic.*—Joseph G. Lewis, topographic assistant (resigned); Joseph S. Shaw, topographic assistant; R. E. Mooreman, draftsman (temporary). Temporary Aids: Oscar R. Kroell, Hargis Hill, Charles G. Montgomery, Boyd M. Sims, Kay K. Kevil, William W. Shelby, Jr.

*Temporary Aids in Geology.*—Charles R. Gilmore, W. C. Payne, John Goff.

Field work began in April, 1904, shortly after the Survey act became a law, and has been pushed vigorously. Two reports, with maps, have been printed, six are now in the hands of the printer, and several are in course of preparation. A list of all reports is given on a succeeding page.

## OIL AND GAS.

A bulletin on the oil and gas sands of the State, prepared by Mr. J. B. Hoeing, has been printed. The report sheds light on a number of things that hitherto have not been understood in Kentucky. It has been learned, for instance, that, contrary to views held hitherto, we have important oil horizons in the "Trenton" (so-called), which gives to that formation, where deep-seated, with favorable structural conditions, a value in Kentucky not heretofore recognized; also, that there are promising gas horizons in the deep-lying Calciferous, which thus gives to a large territory a possible value (justifying prospecting) not hitherto suspected. The large number of well records given in the report will prove of service to drillers when prospecting for oil or gas. Following is a list of the oil and gas horizons, given in their vertical order, reading downward, as defined in the report:

## 1. In the Conglomerate Series of the Coal Measures:

Beaver,	} of	Wages,	} Knox
Horton,		Jones,	
Pike,		Epperson,	
Salt,			
		Floyd, Pike,	
		Knott, etc.	
			County.

## 2. In the St. Louis Group:

In Pike and Martin Counties.

## 3. In the Waverly and Keokuk-Waverly:

	Big Injun Group.
	Cloverport Gas.
Stray.....	Amber of Barren.
Mt. Pisgah	} of Wayne.....
Beaver, Otter, Cooper, Slickford,	
	Berea Grit.

## 4. In the Devonian:

a. Black Shale.....	Gas Sand of Meade.
b. Corniferous.....	{ Ragland Oil, Irvine Oil,
	{ Menefee Gas.



## 5. In the Upper Silurian:

- a. Niagara.....Boyd's Creek of Barren.
- b. Clinton.....Clinton of Barren, Wolfe, Morgan, etc.

## 6. In the Cincinnati (Hudson of Linney):

- "Upper Hudson".....{ Caney of Morgan.  
Upper Sunny Brook.
- "Lower Hudson".....{ Barren County.  
Cumberland County.

## 7. In the Mohawkian (Trenton of Linney):

- Trenton (Lexington) Limestones.....Lower Sunnybrook.
- Highbridge (including "Birdseye" and  
"Chazy" of Linney).....{ Barren, Wayne,  
Clinton and Cumberland  
Lower Sands.
- Knox Dolomite.....Deep Sand of Wayne.

## 8. In the Calcareous:

- Saltwater Sand at Top.
- Gas Sand in Estill County.

It should be said that the systematic study of our oil possibilities is no more than fairly well begun. The project for the further prosecution of the work includes an underground survey of the oil horizons, and the charting of the dips of the rocks throughout the State. This will reduce the uncertainties of wild-cattling. In view of the growing disposition to use natural gas and oil for fuel in this State, and of the value that stores of such fuels have in determining the establishment of manufacturing industries, the importance of continuing this line of investigation in a thorough way is manifest. It is hoped that as the work progresses, tests under intelligent supervision may be made in the Jackson's Purchase region. The finding of fuel gas in that great clay region would prove of incalculable benefit to the district. It may be remarked here, in connection with the reference to supervision of the drilling of wells for gas and oil, that in a number of instances the Survey has been called upon to furnish a man to watch the drilling of wells and keep accurate records of the strata pierced. Since, as is well known by those familiar with the work, it is most difficult to obtain

accurate records and samples of the drillings from the "practical" driller who has immediate charge of the machine, the requests would have been complied with gladly had it been feasible to do so, but the limitations on the expenditures of the Survey in consequence of the comparatively small fund at command rendered it impossible.

## CENTRAL KENTUCKY LEAD, ZINC AND SPAR DEPOSITS.

I think it beyond question that the mineral veins of this district afford the basis upon which may be established important commercial enterprises. The veins, of which there is a remarkable number, very many of them of easily workable width, fall into three classes as regards composition, namely, those consisting of barite with variable amounts of galena and some sphalerite (zinc sulphide); those in which the filling is fluorite, either essentially in whole or in larger part; and those composed of calcite, in some places carrying considerable percentages of sphalerite (as on Twin creek, Owen county), and in others quite free from metalliferous content so far as at present known, as in the case of the great calcite vein of Mercer county.\*

A thorough examination of these hitherto little known and practically neglected sources of industrial wealth was, therefore, deemed one of the most useful lines of investigation to which the early attention of the Survey might be given, and a bulletin on the lead and zinc-bearing rocks of Central Kentucky, by Prof. A. M. Miller, has been printed.

Though the chief purpose of the report is to describe the strata in which the veins occur, a proper classification of the rocks be-

\*It may be, however, that these distinctions are seeming rather than real; that the differences in mineral content are a matter of vertical distribution; and that whether a vein shall show barite, or calcite, or fluorite as the filling matter depends upon whether the outcrop represents a higher, or intermediate, or lower section of the vein. This is one of the problems concerning which sufficient data have not been gathered, but it is a determined fact that barite prevails in veins as they pass through the Lexington, from the Winchester beds down to the Tyrone ("Birdseye") of the Highbridge; that as they pass from the Lexington into the Tyrone calcite and fluorite begin to predominate; and that from near the top of the Tyrone down into the Camp Nelson ("Chazy") as far as the latter has been penetrated, fluorite and calcite prevail.



ing necessary for an intelligent study of the mineral deposits, the bulletin will prove very useful to prospectors. The report shows, among other facts, that the Central Kentucky veins are continuous from the top of what is usually known in Kentucky as the Trenton (now defined as Lexington) far down in the lowest rock that is exposed in the State; and that within the Bluegrass area are large deposits of the finest of fluorspar, whereas not even the mere existence of that mineral was known there a few years ago.

There is warrant for the expectation that the barite deposits of this district will of themselves prove the basis for important industrial establishments, the chief object of which will be the production of ground barite and of barium salts. Already the Mutual Mining Company, of Stamping Ground, Scott county, is engaged in the manufacture of refined (precipitated) barium sulphate, lead fume, and various by-products, and the Monitor (formerly Chinn) Mineral Company, of Mercer county, is preparing to mine and prepare for market its extensive barite, calcite, and fluorite deposits upon a large scale. Mines are in operation in Henry and Owen counties, in the galena-bearing barite veins there. In these counties hitherto only galena has been produced for market, but it is understood that the barite will hereafter be an important product.

In order that the development of these Central Kentucky deposits may be undertaken in an intelligent way, however, it is necessary that a careful study of the veins themselves shall be made throughout the district, so that guiding facts of general application may be determined. With that end in view, Mr. J. E. Wright, mining assistant, was assigned to work in the district in April, 1905, the field assignment continuing until August 1st. In this work the Director has borne a part and has in hand the preparation of a report which will be completed when sufficient additional data shall have been gathered. Another season will be required to complete the work, since the deposits have proved to be more numerous and of more importance, and to be distributed over a larger number of counties than was supposed to be the case.\* Mr. Wright has presented

\*In addition to the counties forming what is known as Central Kentucky, certain counties on the east and Cumberland county to the south are yet to be examined.

a short statement of his observations, which will be printed in the report of the Inspector of Mines for 1905, the briefness of the report rendering it somewhat impracticable to issue it as a separate bulletin. Some important facts hitherto not known to be generally applicable to the district—such as the almost, if not quite universal, relation of the veins to faults—and which make for the greater economic importance of the deposits, have been discovered. Specimens of zinc carbonate of high quality, hitherto unknown in this district, were found by Mr. Wright, in Bourbon county, suggesting a chance that deposits of commercial value may be discovered.\* Zinc carbonate (altered sphalerite) has also been found by the writer in Woodford and Jessamine counties.

The deepest shaft, geologically, in the State is that of the "Twin Chimneys" mine of the Monitor (formerly Chinn) Mineral Company, in Mercer county. There a banded fluorite vein, 4 to 5 feet in width, has been followed down to a depth of 245 feet in the Campnelson ("Chazy"), with no indications of any tendency of the fissure to close. When visited recently, in November, water prevented an examination of the bottom of the shaft, but at a point about 20 feet above the bottom measurements were made showing 53 to 63 inches of vein matter. It was claimed by men working in the shaft that at the bottom the vein showed 4 feet of clean fluorspar. The developments in these lower rocks in Mercer county are instructive to those mining or who may undertake mining in other parts of the Central region, where the "Chazy" is deeply covered. They afford encouragement to those mining in the vicinity of Lockport, Henry county, and Gratz, Owen county, for instance. At Gratz the vein has been followed down to and into the Tyrone ("Birdseye") formation, and because of some eccentricities exhibited by the fissure in the Tyrone questions were raised as to the continuation of the vein downward. There seems to be no good reason to doubt that the vein continues downward, if geologic

\*It seems well to here correct an error that appears in Dana's Mineralogy, and is quoted in Merrill's "Nonmetallic Minerals," namely, the reported occurrence of witherite (carbonate of barium) "near Lexington, Kentucky." Although searched for through many years, ever since the first appearance of the note in the Mineralogy, no witherite has been found in this region.



conditions affecting the Campnelson are similar to those farther up the river, though there may be a change in the vein-stuff.

#### WESTERN KENTUCKY LEAD, ZINC AND SPAR DEPOSITS.

Mr. F. Julius Fohs spent the season of 1905 in the study of the lead, zinc, and spar regions of Western Kentucky. With him was a mapping party\* to accurately locate all mines, prospects, faults, and veins. In 1902 the U. S. Geological Survey, acting in co-operation with the Curator of the Kentucky Geological Department, in whose hands a small sum for the purpose had been placed by citizens of the district, made an examination of the region and the report was issued in August of the present year. With propriety, the claim may be made in behalf of the Kentucky Survey under the administration of the late John R. Procter for a large share in the work upon which the report is based, since the larger part of the field work of Mr. Ulrich, who had charge of the examinations made by the Federal organization in 1902, was done in 1889 and 1890, when that gentleman was a member of the State Survey. Had the report been issued earlier, it would have been of advantage to us in the prosecution of our investigations. That there was need for the State Survey work, and that without conflicting with what had been done by the Federal organization, will appear when our reports are issued.

In addition to a report on the district as a whole, Mr. Fohs will present one on the mineral veins and other resources of Livingston county; the latter will be ready for the printer at an early day.

It was originally intended that the Livingston report should be only a revision (bringing it to date) of the manuscript report made by Dr. R. H. Loughridge—one of the four manuscript reports left in the archives of the Survey when appropriations ceased in 1892, to which reference is made on a succeeding page, the publication of which was authorized by the present Survey law. The discovery of new facts, etc., during the progress of the field work in revision, however, rendered so many additions and modifications necessary that Mr. Fohs will present a practically new report.

\*Headed by Mr. J. S. Shaw.

According to the observations of Mr. Fohs, the Livingston county deposits have the same general character as those of Crittenden; they have the same possibilities so far as regards intrinsic values, the difference between the two regions with respect to possibilities of development being chiefly one of transportation. Some faults hitherto unknown were discovered in the progress of the field work, the probabilities being that at least a number of them are ore-bearing near the surface, and that all of them are so at depth—below the sandy horizons. The report, which is nearing completion, contains descriptions of all the mines and "prospects" (about 60) in the county, and of the mills. Methods of mining, ore-dressing, etc., are described, and the geology and veins are laid down on maps.

The general report will include the following counties:

*Livingston.*—All details of geology, mines, prospects, etc.

*Crittenden.*—All details of geology, mines, prospects, mills, etc. In this county there are 120 mines and prospects.

*Caldwell.*—Practically all mines and prospects are described, together with considerable of the geology. Part of another season of field work will be required for the completion of the geology.

*Lyon.*—Some notes on the geology will be given. There are chances for the occurrence of lead, zinc and spar deposits in this county, but there was not sufficient time at command in which to make a thorough examination with respect to them. Another season of work and close search will be required to develop the facts.

*Trigg.*—Notes on all the mining prospects. There are a great number of shear zones in this county, and the chances for finding ores and spar are good. So far, the prospecting in the county has not been conducted on the best lines.

*Christian.*—Some notes on this county.

It seems well to here briefly present some facts in regard to the district as developed by the work of the Survey.\* It has been noted:

1. That large calcite bands, 3 to 12 feet wide, appear on the

\*Statistics of production for 1903 and 1904 will be found in the report of the State Inspector of Mines for 1904.



walls of some of the larger (more valuable) veins. Since a growing market for calcite has developed, this fact is of commercial as well as of scientific interest. Some shipments of that spar have been made from the district.

2. The barite in the district is associated less with the fluorspar in the large faults than with that in the smaller veins that show little or no faulting and have one or both walls of limestone. The value of this "pointer" will be recognized by mining men.

3. There is little change in the character of the fluorspar deposits with depth other than that which is to be expected in unweathered mineral, and except such as goes, *pari passu*, with the changes of wall rock.

4. The chances for the discovery of new and large bodies of zinc carbonate (as a reconcentration) along large faults where St. Louis limestone forms one wall, if the prospecting be done on the St. Louis side of the fault, are good. Further prospecting for zinc carbonate is encouraged.

5. The character of the fluorspar largely depends on the enclosing rock and manner of formation (genesis) of the spar. This is illustrated by the following examples: "No. 1 fluorspar" (the highest grade) has either Princeton (Ste. Genevieve of Ulrich) or Tribune limestone for one or both walls, largely, when filling fissures. Coarse, dark or brown fluorspar is in large measure associated with bituminous shale walls, and at times it carries a large amount of coarse, crystalline sphalerite. Finer grained, dark colored fluorspar is usually associated with jasperoid, and occurs as a replacement either of Princeton or St. Louis limestones, principally the former; and it is largely associated with fine-grained zinc and small cubical or granular galena. Purple fluorspar, though it occurs more or less in surface deposits, is largely to be found in the St. Louis limestone and in gravel deposits. Gravel fluorspar is in nearly all cases practically in place, and the solid deposits are to be found by sinking on them.

6. The coarser lead ore (galena) is largely associated with white fluorite, while the small cubical and granular varieties are replacement deposits. A body of almost solid galena, 3 feet in width, has recently been found at the Mary Belle mine, on the Columbia tract, at a depth of 40 feet.

7. The largest ore bodies constitute replacements of wide sheeted zones, while the narrower ones are fillings of fissures.

8. The chances for finding zinc deposits are better in sheeted zones parallel with the veins than in the fluorspar deposits, the latter generally occurring nearer the fault plane. On this account, the small amount of cross-cutting that has been done from the veins has prevented the discovery of many zinc deposits. There is reason to believe that the disposition of fluorspar prospectors to cover up the discovery of zinc, and do little searching for it, on account of its undesirability in association with fluorspar, has greatly retarded the opening of probably a large number of deposits of this character. Zinc deposits in the sheeted zones, while carrying some fluorspar, have not as much of that mineral as have those directly at the fault or in the veins.

9. The chances for the discovery of new fluorspar and lead deposits along undeveloped, or partially developed, fault zones are good.

10. A number of clay deposits of the "Stevens Tunnels" type—rather a firesand than a fireclay, of which large quantities are shipped from Stevens Tunnels—were found, with chances for more. This product has naturally the same constituents as Dinas brick, and so is a first-class material.

The quantity of fluorspar in this district is enormous. But few of the opened veins are worked out for as much as even 100 feet below water level, and below that depth the products appear to be the same. The popular idea as to the small amount of zinc in the district appears to be erroneous. A new custom concentrating plant, for the separation of the zinc and lead, is being erected, but its precise character (the method to be followed) is not known.

#### FAULTS SOUTH OF THE WESTERN COALFIELD, ETC.

An examination of the faults and fractures lying south of the known lead, zinc, and spar region in Western Kentucky, and south of the Western Coalfield, to ascertain whether any of them carry ores or fluorspar, was undertaken in 1904. The work



was placed in the hands of Mr. J. E. Wright, the present writer also rendering aid in the investigation. Mr. Wright presented a brief, but interesting, report of his work, the conclusive parts of which will be included in the detailed report on the region traversed. It was determined that most of the fractures do not carry ores or fluorspar within easy reach from the surface, but that possibly some of them do. What may be found at depth on some of the strongest faults can be determined only by deep prospecting. Unfortunately, some of the most important prospecting that has been done along the faults has not been done in the true fault planes, or by systematic cross-cuts at depth, but in the bed planes of dipping rocks.

#### CHEMICAL WORK.

A bulletin of chemical analyses is in the hands of the printer. This bulletin includes all the unpublished analyses that had been made for the Kentucky Survey by the late Dr. Robert Peter, worked out and properly arranged by his son, Dr. Alfred M. Peter, present Chemist of the Survey, together with many additional ones. Analyses of many samples of clay, coal, stone, etc., collected by the present organization, have been made by Dr. Alfred M. Peter, and a few analyses of clay were, in an emergency, made by other chemists. These analyses, not sufficient in number to warrant the publication of another chemical bulletin, have been used in reports now ready or in course of preparation.

#### CLAY DEPOSITS.

My confidence in the future of Kentucky as a clay-producing State grows as more is learned about our deposits, but we must meet the requirements of clay-workers by proving the worth of the clays by technical tests before we can hope to make much progress with them. The means at the command of the Survey have not been sufficient to undertake such work. Among others, there are two reasons why every possible effort should be made to promote the development of our clay resources—one

sociological, and the other purely commercial; they are, first, the well-settled fact that clay-working communities are among the most stable of those that are made up most largely of "laboring" classes, with the further fact that since a large part of the "labor" used need have only simple skill, readily acquired, clay-working plants would give employment to a numerically important element of our population, including women, youths and girls, whose lives now hold but little in the way of a hopeful future; and, second, clay-working industries will call for a greater development of our coalfields.

The most the Survey has been able to do within the time that has been at our disposal, and with the comparatively small sum that could be allotted for the work, has been to gather data for a preliminary bulletin, which should show the locations, thicknesses and general qualities of some of our clay deposits, and give us a better standing with the clay industries than we now have, until technical work may be taken up hereafter. Such a bulletin has been prepared and is in the hands of the printer.

The report is in three parts. Part I., by Mr. J. H. Gardner, includes the kaolins and plastic clays adjacent to the eastern rim of the Western Coalfield, embraced in the counties of Hart, Hardin, Edmonson, Grayson, Taylor and Larue; clays in the Red river valley; and clays of the Jackson's Purchase region. Also a statement by Mr. F. J. Fohs concerning the clays in the region between the Cumberland and Tradewater rivers. Part II., by Prof. A. F. Foerste, is an extract from another report by him, and is a discussion of the clays and limestones of the Silurian, Devonian, Waverly and Irvine formations of East-Central Kentucky. Part III. includes a compilation by Mr. J. H. Gardner of all available analyses of clays that have been collected from various counties of the State. It is believed that this bulletin, although it may be regarded as only a beginning of the study of our clays, will prove of much service to those interested in clay-working and cement-making industries. One of the direct results of the work of the Survey in the Red River Valley is the assurance that a large Portland cement plant will be established there. While in the newspaper accounts of the proposed enterprise the Survey's part in promoting it is not mentioned, it is nevertheless the fact that the movement to es-



establish the plant is due to discoveries and advice and suggestions first made by the Survey.\*

\*Since the foregoing was written, a letter has been received from Mr. J. C. Patrick, who has been most active in securing the establishment of the plant (representing perhaps \$100,000), in which due credit is given the Survey. The letter is as follows:

"STANTON, KY., December 15, 1905.

"Mr. C. J. Norwood, Director of Kentucky Geological Survey,  
Lexington, Ky.:

"DEAR SIR—Recent editions of Lexington and Louisville papers, purporting to give interviews with me, have given out the impression to the public that the major share of the credit of finding and developing the cement material in this region is due to Ohio talent. I therefore feel it my duty to acknowledge to you my indebtedness to the Kentucky Geological Survey, and make known the part they had in the discovery and development of these deposits. The existence of clay and limestone at this place suitable for the manufacture of Portland cement was discovered by Assistant Geologist Gardner. This discovery was made in the course of his routine work in this valley. Afterwards, Mr. Gardner and I went over the ground more thoroughly, and he pointed out the clay and stone to me, and gave me instructions as to how to proceed in testing and developing same.

"Mr. Gardner suggested that since the Kentucky Survey was unable to test these materials, on account of lack of the proper apparatus and laboratories, the clay and stone should be sent to the Ohio Geological Survey for testing. With this end in view, he opened correspondence with the Ohio Survey, with the result that I was enabled to send my material there for testing. The results of these tests are pretty well known now, but I herewith send you a copy of the report on same, in the hope it may be of some value to you in your work.

"I wish to especially thank you and Mr. Gardner for your assistance in this undertaking, because its success is to a very large extent due to your valuable aid and suggestions; and in order that every one concerned may be informed of the true history of the matter, I give you leave to use this communication as you may see proper. With kindest regards, I am,

"Very truly yours,

"J. C. PATRICK."

The report of Mr. C. G. Holmes, City Cement Inspector of Columbus, Ohio, in whose hands, at the suggestion of Professor Orton, Director of the Ohio Survey, the testing of the materials was placed, will be given in full in another report now in course of preparation. His report gives analyses of the materials and physical tests of cement actually made from them, and concludes as follows:

"1. The chemical analysis shows that the raw materials are susceptible of proper combination for Portland cement manufacture.

"2. The cement produced by the combination of these materials gave satisfactory tests in every respect."

Prof. A. F. Foerste has prepared a report which includes an extended discussion of the economic values of the clays and limestones of the Silurian, Devonian, and Irvine formations. It will be issued as a separate bulletin because of the necessity for detailed descriptions and classifications of the formations involved. This bulletin is in the hands of the printer.

## BUILDING STONES.

The study of the building stones of the State was placed in the competent hands of Mr. W. U. Grider, who spent a portion of the season of 1905 in gathering data and making collections, in the course of which work he visited Bullitt, Hart, Warren, Washington, Todd, Logan, Christian, Trigg, Lyon, Simpson, Marion, Nelson, and other counties. Unfortunately and unexpectedly, however, he found it necessary to withdraw from the Survey within three months after taking up the work. At the time, it was hoped he would be able to return before the end of the season, but circumstances have prevented his doing so. Mr. Grider has presented a partial report in which is contained a large amount of valuable and practical information, including descriptions of beds suitable for quarrying for various purposes, methods of quarrying at various points, analyses and physical tests of a number of stones, photographs of exposures, etc. He also has data relating to many other counties than those named, needing but little more field work to enable him to complete descriptions of the stone resources of those counties. It is to be hoped that the work may yet be carried to completion by him.

## THE COALFIELDS.

*The Big Sandy Valley.*—A report by Prof. A. R. Crandall on the coals of the Big Sandy Valley, south of Louisa and Warfield, including the headwaters of the North Fork of the Kentucky river, is in the hands of the printer. It contains many maps and graphic sections. The report covers about 2,000 square miles, and includes Johnson, Martin, Floyd, and Pike counties, part of Letcher, part of Knott, and the larger part of Lawrence county. The presentation of such a report at this



time was rendered possible by the fact that Prof. Crandall had spent several years at work in the Eastern Field as a member of the old Survey. He completed his study of the region during the season of 1904 and the early part of 1905. Many applications for this report, from prospective investors and from parties contemplating the acquirement of mining leases (in which way a large part of the actual development of the Eastern Field must necessarily be done), have already been received. A report on the northern part of the Valley was published some years ago.

*Coals of the Licking Valley.*—During the season of 1905 Prof. Crandall began work on the coals of the Licking Valley and headwaters of the Red river, including Morgan, Magoffin, Menefee, and Wolfe counties, but he could not complete all the field work necessary for a report before the end of the season. He has the report in course of preparation, but some weeks more of field work will be required before it can be completed.

*The Pine Mountain-Cumberland Region.*—During the summer of 1904, Messrs. Shaw and Montgomery were at work determining the precise levels and locations of the various coal-beds north of Pine Mountain in Bell and Knox counties, preparatory for the completion of a report on that region by Mr. G. M. Sullivan, the expectation being that Mr. Sullivan would be in position to take up the work early in 1905. In this the Survey has been disappointed. Since Mr. Sullivan had nearly completed all the field work necessary for a report on a large area in that district, extending into Clay and Leslie counties, and including all of Bell and Knox counties, and a part of Harlan, it was desirable from every point of view that the work on the coals there should be placed in his hands. It is to be hoped that this may yet be done.

*Mining Thin Seams.*—A report on the methods that have proven successful in mining thin coal seams in the Southeastern Coalfield, by Mr. R. H. Barclay, is ready for the printer. It is deemed appropriate for this report to be printed in the report of the Inspector of Mines for 1905, and without objection this will be done.

*The Western Coalfield.*—Work on the higher and lower coals of the Western Coalfield, which was begun in 1904, was continued during the season of 1905. This work is in the hands of the Director, assisted by Mr. S. A. Denny. We are discovering facts in regard to the upper coals of this difficult field, as revealed in the work in Ohio, Muhlenberg, McLean, Hopkins, Webster and Union counties, together with data from Henderson county, which will necessitate a sharp revision of opinions hitherto held in regard to the distribution and order of the coal-beds.

Among the most important facts definitely determined is the occurrence of a large number of coal-beds above the one hitherto accepted as the highest workable seam ("No. 12"), including at least three, possibly more, beds that are workable in places. These upper coals, which in some instances hitherto have been mistaken for No. 11, or No. 12, or No. 9, as the case was, are variable in quality and thickness. Quite apart from their local values, however, the recognition and tracing of these coals as distinct beds, occupying horizons high above the position of No. 12 in the scale, is of much importance in the development of various parts of the field. A report is in preparation, presenting the results of the work so far, but the field is quite difficult, much complicated by faults and unconformities, and it will not be possible to issue a satisfactory report on the coals without having another season of field work.

*The Rough Creek Anticline.*—Prof. W. F. Pate began work along the Rough Creek anticline, in Western Kentucky, during the summer of 1905. This anticline is part of a very important disturbance which apparently extends quite across the State, in an approximately east and west direction, from Shawneetown, Ill., to near Warfield, Martin county. It is important to know what relation this uplift bears to the coals of the Western Field, especially in Ohio, McLean, Webster, Henderson, and Union counties, and its study is also of value in the prospecting for petroleum and gas. The results of the season's work are of much economic interest, but it will require at least another full season of field work, possibly more, to gain a satisfactory understanding of the disturbance.

In addition to his work on the anticline, Prof. Pate examined



the coals in the region adjacent to the Fordsville branch of the Louisville, Henderson & St. Louis railroad, and obtained data for the revision of the Meade county report, referred to beyond.

### OLD REPORTS.

At the time the Survey was suspended, in 1892, there were four reports ready for the printer, namely, one on Breckenridge county, by J. B. Hoeing; one on Meade county and one on Livingston county, by R. H. Loughridge, and one on Warren county, by M. H. Crump. The Breckenridge and Meade reports have been revised and brought to date, and will be printed, as is provided for by the present Survey law. Col. Crump is expected to revise and bring to date his report on Warren county. As stated elsewhere, Mr. Fohs is now preparing what is in effect a new report based on Dr. Loughridge's Livingston report.

### CLASSIFICATION OF FORMATIONS.

Prof. A. F. Foerste has in hand the preparation of a report on the Cincinnati (formerly known in Kentucky reports as the Hudson) series. It is expected that it will be ready for the printer at an early date. It will include twenty-one plates of typical fossils, which will render it of exceeding value to those who find it necessary to identify the rock beds in the areas covered by this formation. It should prove especially useful to persons engaged in boring for gas (seeking the gas horizons in the deep-lying rocks) where the Cincinnati forms the surface, and it should prove useful in the schools of the State.

Prof. J. M. Nickles, to whom was confided the work of discriminating certain of the divisions of the Cincinnati, concerning which there was much uncertainty, has prepared his report, which includes three plates of fossils, and it is in the hands of the printer.

Prof. A. M. Miller continued his study of the Mohawkian during the past summer, and has prepared a revision of the table given in his published report on the lead and zinc-bearing rocks of Central Kentucky. His table, including classifications of the Cincinnati by Foerste and Nickles, together with remarks thereon, will appear in another report.

This work of classification has been taken up because it is absolutely necessary for an adequate study of the economic

values (including petroleum and gas) of the Lower Silurian rocks that we shall have a proper classification of the latter. The practical value of a correct classification of the rocks is illustrated in the bulletin on oil and gas, where the Ragland and Estill oil sands are identified as Corniferous rather than Clinton, to which they have usually been assigned. As a consequence of this, a larger region becomes of interest as regards the possible finding of petroleum than if the Clinton were the important oil rock, since the Corniferous has an even distribution than the Clinton. It also affords a more intelligent basis from which to work in the western counties. Another illustration of the practical value of such work is this: In the progress of his work on classification during the past season, Prof. Miller discovered the exact representatives of the rock phosphate beds of Mt. Pleasant, Tenn., some examples running as high as 72 per cent. phosphate, and having definitely differentiated them, he was able to trace them over considerable areas.

A bulletin giving a revised classification of the formations of the State, together with a new edition of the State geological map, is projected. Work upon both bulletin and map is in progress.

### ROCK PHOSPHATE.

As indicated in the preceding section, noteworthy deposits of rock phosphate were found within the Lower Silurian (Ordovician) area during the past season, and the possibility of establishing a commercial enterprise upon them seems worth considering. While it may be that it will not prove practicable to undertake the mining of high-grade phosphate for disposal to fertilizer works, it does seem feasible to establish a custom grinding mill for the production of "agricultural lime," for which this phosphate rock is eminently suitable since it may be spread where needed without further preparation. Even in the Bluegrass there are now many acres of land that need lime. These phosphate layers, even those lowest in phosphoric acid, gathered and ground, would yield high values. As indicated above, they may be used in the natural state and meet all requirements. The rock, in the form of thin, rather porous-looking, yellowish brown plates, where weathered, comes in at the



top of the Lexington Limestone ("Trenton"). In a memorandum on the subject, Prof. Miller says: "There is hardly a locality where the top of this formation has been exposed in upland situations as the result of slow denudation of the overlying beds, where thin plates of this phosphate can not be found, and recently samples were collected from a locality in Woodford county that indicated a deposit there of phosphate of a very promising character. They ran as high as 33 per cent. phosphoric acid (72 per cent. calcium phosphate). The samples first collected consisted of plates of leached limestone from half an inch to an inch and a half in thickness, and weighing from one to three pounds. These lay scattered very thickly over the surface of a roadside slope, and on digging down were found disseminated through the soil nearly to the bed-rock—here from 1 to 2 feet below the surface. In the light of all that is known at present, the most favorable district for prospecting is in that comparatively level and very fertile belt of country extending northward from Versailles to Midway, and again beginning on the other side of South Elkhorn, in Scott, and extending in the same direction to where the land begins to fall off to the level of North Elkhorn. Fayette county also offers a promising field. The soil at the phosphate horizon is a very deep red, and is characterized by the presence of a 'honey-comb' coral of the genus *Columnaria*." Samples of the rock may be seen in the State Geological Museum, Lexington.

#### CO-OPERATION IN TOPOGRAPHY.

The State Survey has issued many maps which are quite good enough to use in showing the location of mineral outcrops, mines, quarries, etc., but they are not of the sort necessary to use in laying down details of geology, in tracing the extension of coal beds and other deposits, in determining in advance of actual field examination the probable routes for transportation lines, etc. For such purposes maps must show the surface of the country by means of contour lines. Such character of mapping is very costly, and on that account it was deemed advisable to seek co-operation with the U. S. Geological Survey, the expense of the field work to be equally divided between the State and Federal organizations. In the appropriation section

of the Survey law enacted by the last Legislature, therefore, the sum of \$5,000 out of the total annual appropriation of \$15,000 was allotted for co-operation in topography with the U. S. Geological Survey. An agreement with the Director of the U. S. Geological Survey was entered into in March, 1904. In the agreement it was provided that the Federal Survey should expend an amount equal to that allotted by the State Survey; that the work should be carried on under the supervision of the Director of the U. S. Geological Survey, subject to proper inspection and criticism by the Director of the State Survey; that the cost of publication should be borne by the U. S. Survey; and that when desired, the State Survey should be furnished with transfers, at cost of printing, from the copper plates of the topographic sheets, for use in printing editions of said maps. In designating the portions of the State in which work should be done, it was thought proper that those parts in which the U. S. Survey had done no work should first receive attention. That Survey had covered the Eastern Coalfield in preceding years; hence, although it was known to be desirable that much of the ground be resurveyed, it was thought just that it should await until some of the wholly unsurveyed regions should be gone over, and until a more nearly adequate appropriation should be made. For the season of 1904, the areas selected were the Sutherland quadrangle south of Owensboro, the Sebree and Morganfield sheets, in Western Kentucky, and the thirty-minute quadrangle in which Frankfort is situated. For the season of 1905 the Louisville quadrangle was added, together with certain adjacent areas. The Louisville quadrangle was selected because of the great necessity there was for an accurate, contoured map to use in working out sewerage plans for that populous city. The following work has been accomplished, as set forth in statements for each year received from the Director of the U. S. Geological Survey:

*Results for 1904.*—"During the season a complete and accurate map, on a scale of 1.62,500, with a contour interval of 20 feet, of 517 square miles of area of the State was surveyed. The results will be published on parts of the following four atlas sheets, namely, Sebree, Sutherland, Frankfort, and Georgetown, the first two being completed in the field. These sheets cover portions of the counties of Anderson, Daviess, Fayette, Frank-



lin, Henderson, McLean, Ohio, Scott, Shelby, Union, Webster and Woodford. Some additions were also made to the Calhoun, Newburg (Ky.-Ind.), and Owensboro (Ky.-Ind.), and Harrodsburg completed sheets.

"In all, 519 square miles of sketching was done, 1,214 miles of spirit levels were run, with thirty-three permanent bench marks, and 10,116 elevations. There were also run 2,295 miles of road traverse.

"During the season 426 miles of traverse for primary control was extended over portions of the counties of Anderson, Daviess, Fayette, Franklin, Grant, Henry, Jefferson, Ohio, Owen, Scott, Union, Webster, and Woodford."

*Results for 1905.*—"From the expenditure of the funds providing for this co-operation a complete and accurate map has been made on the scale of 1.62,500, with a contour interval of 20 feet, of 235 square miles of the area of the State, represented on the Louisville quadrangle, in Jefferson, Spencer and Bullitt counties, and of 7 square miles represented on the New Haven (Ill.-Ind.-Ky.) quadrangle, in Union county. During the progress of this work the city of Louisville was mapped on the field scale of 1.22,500 for publication on the scale of 2,000 feet to 1 inch, and will be reduced to form parts of the Louisville sheet, and of the uncompleted Prospect, Riverview and New Albany sheets. The area of the city map, including the suburbs, covers 37 square miles of the area of the completed Louisville sheet, and is included in the above statement of its area.

"During this work 533 miles of spirit levels were run, in the course of which 2,958 elevations and twelve permanent bench marks were established. There were run 794 linear miles of road traverse, every bend and every house being accurately located.

"In addition to the above completed sheets there were finally mapped 188 square miles on the Georgetown sheet, in Fayette, Franklin, Scott and Woodford counties, and 117 square miles of the area of Prospect (Ky.-Ind.) quadrangle, in Jefferson and Oldham counties. Considerable secondary control was procured on the Morganfield quadrangle, in Crittenden, Union, and Webster counties, and on Riverview quadrangle (Ky.-Ind.), in Jefferson and Bullitt counties. On this unfinished work 756 miles of spirit levels were run, in the course of which 3,970 elevations

and eight permanent bench marks were established; there were also run 1,834 linear miles of road traverse.

"One party extended primary traverse over the counties of Anderson, Bullitt, Jefferson, Oldham, Shelby, and Spencer, resulting in the occupation of 999 stations, and the running of 86 miles of traverse. This primary traverse is something more and in addition to what had been anticipated and planned at the beginning of the season. It was found that the triangulation about Louisville was not on the United States Standard Geodetic datum, but was a result of some special triangulation extended some years ago in the neighborhood of the city. In order that the resulting maps might conform with the others which we are making in the State, it was deemed desirable to connect this primary control with that in the neighborhood of Frankfort and Georgetown, so that it might be reduced to the standard datum, and be sure that there would be no discrepancies in the work coming from both directions. For that reason a line of primary control was run between these two areas. Inspection of the work done in the previous year on the Calhoun sheet developed the fact that the sketching of the topographer who had mapped that sheet was not up to the standard at which we are aiming, and it was deemed desirable not to publish the results until the field work be gone over and the sketching corrected in such places as it was found to be in error. Accordingly, the final publication of the Calhoun sheet is held up pending such revision as may prove necessary."

It will be observed that within the two years 1,064 square miles have been accurately mapped, while a large amount of work toward completing other large areas was also done. Mr. H. M. Wilson, Geographer of the U. S. Geological Survey, has had general charge of the work.

#### HYDROGRAPHY.

One of the most important duties with which the Survey is charged is the study of our water supply, both above and below ground. We need to know not only the water horizons and the character of the ground waters, but also the varying quantity and quality of the surface streams; the latter we must know in order that as population increases and with it an increasing pollution of the streams, we may act intelligently in adopting



methods for rendering the water supply suitable for domestic use. In such study there are many elements to be considered. A tentative co-operative arrangement, dependent upon the maintenance of the State Survey, has been effected with the Hydrographic Branch of the U. S. Geological Survey, by which this important work may be carried on next season.

#### **TIMBER RESOURCES.**

The Survey law contemplates the study of the timber resources of the State. Realizing the advantage there would be in having this done by trained men from the Forestry Division of the U. S. Department of Agriculture, the question of co-operation was presented to the Chief Forester. A cordial response was received, but the amount (\$1,000) deemed proper for the Survey to allot for the season's work was more than the funds at the command of the Survey would permit; hence it was necessary to defer the work. With the continuation of the Survey, provided with an adequate appropriation, co-operation with the Department of Agriculture in the study of our timbers will again be sought.

#### **CANNELS AND LOWER COALS OF THE EASTERN FIELD.**

A report on the cannels of the Eastern Field is projected. Also one on the coals of the Conglomerate Measures. An adequate study of these subjects will yield valuable returns. Assurances have been received that should the Survey succeed in finding good areas of coal fit for producing iron-making coke in the western outcrop of the Conglomerate series, an iron furnace will be erected to utilize ores in the region to which the coke would be tributary.

#### **SOIL SURVEY.**

An arrangement has been effected with Prof. M. A. Scovell, Director of the State College Agricultural Experiment Station, for co-operation in the study and mapping of the soils of the State. This insures that the work will be carried along accurate and practical lines, such as will prove of real service to the agriculture of the State.

#### **UPPER CUMBERLAND AND KENTUCKY RIVER VALLEYS.**

It is believed that, under favorable conditions, another season will give us a report on the Kentucky River Valley similar to that which is now ready on the Big Sandy region. Otherwise, more time will be required. The Upper Cumberland is a big field, and important because of the great thickness of coal-bearing rocks there. It is believed that with well-organized prospecting, and since much work has already been done there, a report on that region can be made after two more seasons of work.

#### **PROSPECTING CORPS.**

The Survey has always done a great deal of pioneer work in the coalfields, making hundreds of openings in the Eastern Field especially, since it long ago became impracticable to rely on residents of a region to make openings at their own expense. This is costly work and has been a severe tax on the Survey funds. To accomplish the same results more rapidly and at less relative expense, it is contemplated to acquire a small drilling outfit and organize a drilling corps to work not only in both coalfields, but to test the extension of clay deposits, and so on.

#### **CHARTING THE DIPS OF THE ROCKS.**

The proposed charting of the dips of the rocks throughout the State has been mentioned on a preceding page. The mapping of the anticlines and synclines is not only of prime importance to oil and gas development, but it will prove of exceeding value to the coal mining interests. It will enable the prospective operator to determine how to best develop such properties as may be under consideration; he will know how the mines must be laid out to obtain best results with respect to drainage and haulage, also whether in the progress of mining in a certain direction material changes of dip may be expected which would affect the manner of mining, and so on. Mining engineers, especially those who have had experience in the more eastern regions of the Appalachian field, will recognize this as one of the most practical and useful lines of work the Survey can undertake.



## FIRECLAYS AND BALL CLAYS.

Kentucky affords the highest quality of flint fireclays known in this country. Practically all known areas of the famous Carter clay have been taken up by the firebrick companies. It is proposed to continue the search for such clays along the western edge of the Eastern Coalfield. There is an eager demand for first-class ball clays. It is proposed to make especial search for additional deposits of these.

## MISCELLANEOUS MAPS.

A map of the Eastern Coalfield, based on surveys made by the State and Federal Surveys and on data obtained from other authentic sources, on a scale of three miles to the inch, but which in printing will be reduced to four miles to the inch, on which to indicate the outcrop lines of the more important coals of the field, has been prepared.

A similar map for the Western Coalfield was projected, but could not be undertaken because of lack of funds.

A revision of the State geological map is in progress and will be completed in time for publication of the map about June, 1906, should the necessary appropriation for the Survey be made.

In addition, a considerable number of maps is projected, showing the distribution of the various economic resources of the State.

## LIST OF REPORTS.

## Reports Printed, in the Printer's Hands, or in Preparation.

1. Oil and Gas Sands of Kentucky; 3 maps, 10 plates. By J. B. Hoeing. *Printed.*
2. Lead and Zinc Bearing Rocks of Central Kentucky; map and 12 plates. By A. M. Miller. *Printed.*
3. Chemical Report of Clays, Coals, Ores, etc., by Dr. Robert Peter, late Chemist of the Survey; 236 analyses. *In hands of the printer.*
4. Coals of the Big Sandy Valley, covering 2,000 square miles, including Lawrence, Johnson, Martin, Floyd and Pike counties, and parts of Knott and Letcher counties; many maps and illustrations. By A. R. Crandall. *In hands of the printer.*
5. The Upper Ordovician Rocks of Kentucky and their Bryozoa; 2 plates of fossils. By John M. Nickles. *In hands of printer.*
6. Clays in several parts of Kentucky, by J. H. Gardner and A. F. Foerste. *In hands of printer.*
7. Silurian, Devonian, and Irvine Formations of East-Central Kentucky, with an account of their clays and limestones; 18 plates, including map. By A. F. Foerste. *In hands of printer.*
8. Mining Thin Coal Seams of the Southeastern Coal Field; many diagrams and illustrations. By R. H. Barclay. *Ready for printer.*
9. The Upper and Lower Coals of the Western Coalfield; maps and many sections. By C. J. Norwood and S. A. Denny. *In preparation.*
10. Reports on Breckenridge and Meade Counties; Originally prepared in 1891, but revised and brought to date; maps and many plates. By J. B. Hoeing and R. H. Loughridge. *Ready for printer.*
11. The Mineral Veins of Central Kentucky: Lead and Zinc, Barite, Fluorite, and Calcite; maps and plates. By C. J. Norwood and J. E. Wright. *In preparation.*
12. The Coking Coals of Kentucky and the Economic Values of the Cokes Made Therefrom. By C. J. Norwood. *In preparation.*
13. Livingston County: Its Mineral Veins and Other Resources. By F. J. Fohs. *In preparation.*
14. The Iron Ores of Kentucky. By C. J. Norwood. *In preparation.*
15. The Cincinnati Rocks of Kentucky; 21 plates of fossils. By A. F. Foerste. *In preparation.*
16. The Lead, Zinc and Spar Deposits of Western Kentucky; maps and illustrations. By F. J. Fohs. *In preparation.*



## RECOMMENDATIONS

## As to Increasing the Efficiency of the Survey.

For so long has Kentucky been regarded, not only abroad, but at home, as primarily an agricultural State; for so long have our activities been almost wholly along agricultural lines, that it seems no less difficult to persuade our own people that we have a great mineral State as well as a wonderfully fine agricultural one, than it is to convince the investing capital that is flowing past us that such is the case. And yet, that this is so is perhaps not strange; the association of mineral deposits with fertile lands, such as we have, is not common, but quite the reverse, and for years we have been at the disadvantage of having no bureau to work out and offer proof as to the value of our varied mineral resources, while competing States (so to call them) have steadily maintained their Surveys.

According to the closest computations that have been made, the area of the State is about 41,283 square miles. Of that expanse, about 15,680 square miles are covered by coal-bearing formations; a region of about 2,000 square miles in the west is rich in lead, zinc, and fluorspar deposits; in the central part, lead, zinc, barite, calcite, and fluorspar veins, that will unquestionably prove of exceeding value, are found over a region about 4,000 square miles in extent; over the whole of the "Purchase Region," an area of about 2,340 square miles, splendid clays abound, together with excellent sands, valuable silicious earths and other minerals; adjacent to the eastern and southern margins of the Western Coalfield is an area of perhaps 1,000 square miles, in which are to be found most excellent kaolins and plastic clays; in addition to which are the great areas of fine clay and cement-making material on the rim of the "Bluegrass," and on the margin of the Eastern Coalfield, the hundreds of square miles underlaid by iron ores, asphalt rock, building stones of the highest order, oil and gas, and so on. Indeed, it is doubtless within bounds to say that more than two-thirds of the total area of the State, including even the most fertile region in it, is mineral-bearing. That Kentucky is primarily a farming State is because we have made it so; it is because we have em-

phasized the agricultural side, and have either overlooked or neglected the mineral side. It ought to be a great industrial State, and at this time, while there is need for more people to till the soil, there is greater need for an immigration of manufacturing industries to provide more and better markets for the products of the farm, and to provide occupations for our young men.

Industrial capital will come to Kentucky when we are prepared to show in an efficacious way what advantages the State has to offer in raw material, well placed geographically. This can not be accomplished by means of "private" reports, however excellent they may be. There is but one potent way, and that is to maintain an efficient Geological Survey. Under present conditions, \$10,000 per annum (that being the amount hitherto granted for the individual work of the State organization) is too little for the Survey to carry on its work most efficiently. Had the Survey not been so abruptly suspended some years ago, even less than \$10,000 per annum would have served to complete a careful study of the economic geology within a few years; but as matters stand, much that was partially covered years ago, but not reported on, must now all be gone over again. There are regions, in the south-central part of the State especially, about which we know practically nothing. Years ago the search for the various economic materials, locating them and determining their extent, should have been completed, and we ought now to be in position to devote our attention chiefly to the technical questions relating to them. As matters are, the Survey has been unable to go far into technical questions, and yet they must be dealt with if we are to meet present-day requirements. I recommend that the amount for the individual work of the State organization be increased.

As I have already indicated, in order that our geological formations, with their economic values, may be laid down in accurate detail on maps, we must have a higher order of maps than the State can well afford to undertake alone. We must look to the U. S. Geological Survey for co-operation in topography, the policy of that Survey being to expend in such work an amount equal to that allotted by the State. With the allotment hitherto made, a large area has been covered, but with \$5,000 per annum we can not proceed as rapidly in our mapping as the ne-



cessities of the State require. It is doubtful whether there is a State in the Union that stands in greater need of good maps than does Kentucky. As an illustration of this, I present a list of counties showing variations in areas as reported in some of our official documents compared with the areas as determined from the most accurate maps that have been made of the counties. It would be wise to increase the amount allowed for co-operative topography.

### COMPARATIVE LIST OF COUNTY AREAS.

COUNTY.	As given in official documents issued at different times. Square miles.		As computed from maps of the counties. Square miles.
	1	2	
Ballard .....	250	240	235.2
Bath .....	270	253	272.5
Bell .....	350	284	393.625
Boyd .....	130	120	171.5
Boyle .....	180	171	187
Breathitt .....	450	434	485.5
Breckenridge .....	520	472	579
Butler .....	452	397	422.125
Caldwell .....	315	295	345
Calloway .....	434	376	403
Carlisle .....	190	174	191
Carter .....	544	368	411.5
Clark .....	260	245	255.5
Clay .....	580	385	459
Clinton .....	220	152	224
Crittenden .....	340	335	376.25
Elliott .....	270	220	261
Estill .....	250	193	255
Fleming .....	340	332	333
Floyd .....	410	403	409
Fulton .....	190	175	178.6
Garrard .....	225	210	238.5
Graves .....	550	488	540
Greenup .....	352	283	371
Harlan .....	410	667	472.125
Hart .....	410	362	427.25
Henry .....	272	278	306.25
Hickman .....	240	227	229.5
Jackson .....	305	299	363.75
Johnson .....	300	284	271.25
Knott .....	365	370	347.625
Knox .....	350	307	357.5

COUNTY.	As given in official documents issued at different times. Square miles.		As computed from maps of the counties. Square miles.
	1	2	
Laurel .....	450	352	466.5
Lee .....	228	229	203.25
Leslie .....	420	383	341
Letcher .....	310	445	358
Lincoln .....	328	291	325.75
Livingston .....	360	291	370.375
Lyon .....	275	216	243
Madison .....	385	409	378
Magoffin .....	300	312	299.25
Marion .....	336	304	344
Mason .....	225	232	220.625
McCracken .....	250	249	237.3
Meade .....	332	308	323.75
Mercer .....	250	240	263.5
Montgomery .....	200	181	205
Nelson .....	380	400	411.375
Ohio .....	610	538	571.75
Oldham .....	170	182	184.75
Owsley .....	176	178	242
Perry .....	448	371	351.5
Powell .....	144	132	176.5
Rockcastle .....	280	280	305
Shelby .....	405	375	397
Spencer .....	200	180	189.5
Trigg .....	425	348	448
Warren .....	530	512	563
Washington .....	300	278	315
Whitley .....	580	631	600.8
Wayne .....	590	493	570
Wolfe .....	190	244	243.375



## DISBURSEMENTS OF THE APPROPRIATION.

Following is a statement of the disbursements of the appropriation from April 1, 1904, to December 1, 1905. The items are arranged according to the headings under which they are entered in the Survey account book:

## ON ACCOUNT OF GEOLOGY.

1904.		Salary.	Expenses.	Total.
April 14.	J. B. Hoeing.....	\$ 26 00	\$16 30	\$ 42 30
April 26.	J. E. Wright.....	48 00	37 26	85 26
April 30.	C. R. Gilmore.....	.....	3 48	3 48
April 30.	J. H. Gardner.....	.....	6 79	6 79
April 30.	W. C. Payne.....	.....	1 50	1 50
April 30.	S. A. Denny.....	.....	4 52	4 52
April 30.	A. M. Miller.....	.....	7 93	7 93
May 25.	J. B. Hoeing.....	100 00	18 75	118 75
May 26.	J. E. Wright.....	60 00	42 18	102 18
May 16.	S. A. Denny.....	.....	1 42	1 42
May 16.	C. R. Gilmore.....	.....	3 40	3 40
June 30.	J. B. Hoeing.....	104 00	31 51	135 51
June 30.	G. V. Triplett, Jr.....	50 00	.....	50 00
June 30.	John Goff.... (37 days, April 16 to June 1).....	74 00	.....	74 00
July 2.	A. M. Miller.....	44 00	16 25	60 25
July 13.	A. M. Miller.....	32 00	7 25	39 25
July 30.	A. M. Miller.....	44 00	19 72	63 72
July 30.	J. B. Hoeing.....	104 00	38 07	142 07
July 30.	S. A. Denny.....	30 00	22 30	52 30
July 30.	R. H. Barclay.....	45 00	34 67	79 67
July 30.	J. H. Gardner.....	30 00	11 07	41 07
July 30.	M. Fischer.....	60 00	55 57	115 57
July 30.	J. E. Wright.....	36 00	29 20	65 20
July 30.	A. M. Miller, balance of salary, May, June and July..	30 00	.....	30 00
Aug. 19.	M. Fischer.....	.....	28 21	28 21
Aug. 20.	A. F. Foerste.....	.....	58 77	58 77
Aug. 26.	A. M. Miller.....	50 00	32 14	82 14
Aug. 27.	J. E. Wright.....	44 00	38 96	82 96
Aug. 30.	J. B. Hoeing.....	96 00	33 95	129 95
Aug. 30.	R. H. Barclay.....	45 00	52 65	97 65
Aug. 30.	S. A. Denny.....	30 00	26 60	56 60
Aug. 30.	M. Fischer.....	60 00	37 46	97 46
Aug. 30.	J. H. Gardner.....	30 00	24 10	54 10
Aug. 30.	W. F. Pate (for July).....	15 00	6 15	21 15

1904.		Salary.	Expenses.	Total.
Aug. 30.	W. F. Pate (for August)....	13 00	15 95	28 95
Aug. 31.	A. F. Foerste (May, July and August).....	164 00	21 33	185 33
Sept. 30.	Transylvania Co., films, 90 cents; envelopes, 50 cents.	.....	.....	1 40
Sept. 30.	R. H. Barclay.....	45 00	.....	45 00
Sept. 30.	S. A. Denny.....	30 00	44 02	74 02
Sept. 30.	J. H. Gardner.....	26 60	31 53	58 13
Sept. 30.	A. F. Foerste.....	68 00	44 01	112 01
Sept. 30.	J. B. Hoeing.....	104 00	30 94	134 94
Sept. 30.	C. L. Jones (collecting well records) .....	.....	21 69	21 69
Sept. 30.	A. M. Miller.....	50 00	3 00	53 00
Sept. 30.	J. E. Wright.....	88 00	64 85	152 85
Oct. 31.	M. Fischer .....	18 00	40 20	58 20
Oct. 31.	R. H. Barclay.....	45 00	.....	45 00
Oct. 31.	A. R. Crandall.....	187 50	63 65	251 15
Oct. 31.	S. A. Denny.....	30 00	14 85	44 85
Oct. 31.	J. H. Gardner.....	40 00	33 53	73 53
Oct. 31.	J. B. Hoeing.....	104 00	5 60	109 60
Oct. 31.	A. M. Miller.....	50 00	3 40	53 40
Oct. 31.	G. V. Triplett, Jr.....	50 00	1 95	51 95
Oct. 31.	J. E. Wright.....	40 00	25 11	65 11
Oct. 31.	M. G. Clay, making blue prints .....	.....	.....	3 76
Nov. 30.	R. H. Barclay.....	45 00	0 25	45 25
Nov. 30.	S. A. Denny.....	40 00	39 18	79 18
Nov. 30.	J. H. Gardner.....	16 00	18 23	34 23
Nov. 30.	J. B. Hoeing.....	104 00	17 97	121 97
Nov. 30.	A. M. Miller.....	50 00	12 77	62 77
Nov. 30.	G. V. Triplett, Jr.....	50 00	1 95	51 95
Nov. 30.	J. E. Wright.....	24 00	19 64	43 64
Nov. 30.	Jas. Mullen, printing photos .....	.....	.....	3 90
Nov. 30.	Transylvania Co., 1 dozen photo plates.....	.....	.....	50
Dec. 31.	R. H. Barclay.....	45 00	0 25	45 25
Dec. 31.	S. A. Denny.....	40 00	0 25	40 25
Dec. 31.	J. H. Gardner.....	40 00	18 31	58 31
Dec. 31.	J. B. Hoeing.....	88 00	5 70	93 70
Dec. 31.	A. M. Miller.....	50 00	12 64	62 64
Dec. 31.	G. V. Triplett, Jr.....	50 00	.....	50 00
Dec. 31.	J. E. Wright.....	28 00	5 28	33 28
Dec. 31.	A. F. Foerste.....	128 00	14 95	142 95
Dec. 31.	A. G. Spillman, collecting coals .....	.....	.....	100 00
Dec. 31.	Transylvania Co., 1 dozen photo plates.....	.....	.....	35



## KENTUCKY GEOLOGICAL SURVEY.

1905.			Salary.	Expenses.	Total.
Jan. 31.	F. J. Fohs.....		\$16 00	.....	\$ 16 00
Jan. 31.	G. V. Triplett, Jr.....		60 00	\$1 70	61 70
Jan. 31.	J. H. Gardner.....		50 00	25	50 25
Jan. 31.	R. H. Barclay.....		45 00	25	45 25
Jan. 31.	J. B. Hoeing.....		104 00	.....	104 00
Feb. 1.	A. M. Miller.....		50 00	.....	50 00
Feb. 1.	W. F. Pate.....		16 00	1 81	17 81
Feb. 2.	S. A. Denny.....		40 00	.....	40 00
Feb. 20.	Shaffer Art Co., photo prints (December) .....		.....	.....	80
Feb. 28.	G. V. Triplett, Jr.....		60 00	25	60 25
Feb. 28.	S. A. Denny.....		40 00	.....	40 00
Mar. 1.	W. U. Grider.....		107 00	10 30	117 30
Mar. 1.	J. B. Hoeing.....		96 00	11 50	107 50
Mar. 1.	A. M. Miller.....		50 00	.....	50 00
Mar. 1.	J. H. Gardner.....		50 00	25	50 25
Mar. 1.	R. H. Barclay.....		45 00	25	45 25
Mar. 7.	Jas. M. Byrnes, 250 circulars (January) .....		.....	.....	2 50
Mar. 8.	J. E. Wright (January)....		12 00	4 48	16 48
Mar. 9.	A. R. Crandall.....		100 00	.....	100 00
Mar. 10.	A. F. Foerste (Jan., Feb.)..		120 00	14 01	134 01
Mar. 30.	G. V. Triplett, Jr.....		60 00	25	60 25
Mar. 30.	R. H. Barclay.....		45 00	25	45 25
Mar. 31.	A. M. Miller.....		50 00	.....	50 00
April 2.	A. F. Foerste.....		87 97	24 58	112 55
April 1.	F. J. Fohs.....		60 00	24 25	84 25
April 1.	W. U. Grider.....		125 00	55 45	180 45
April 1.	J. B. Hoeing.....		72 00	6 65	78 65
April 1.	A. R. Crandall.....		50 00	.....	50 00
April 6.	M. G. Clay, making blue prints .....		.....	.....	10 45
April 1.	J. H. Gardner.....		50 00	17 01	67 01
April 1.	S. A. Denny.....		40 00	5 04	45 04
April 29.	A. M. Miller.....		50 00	.....	50 00
April 29.	S. A. Denny.....		50 00	12 68	62 68
April 29.	Gross vials, April 15, from Director's account.....		.....	.....	.....
April 29.	J. H. Gardner.....		50 00	34 75	84 75
April 29.	J. E. Wright.....		62 50	33 87	96 37
April 29.	J. B. Hoeing.....		125 00	13 10	138 10
April 29.	F. J. Fohs.....		112 00	66 30	178 30
April 29.	M. G. Clay, blue prints.....		.....	.....	2 05
May 5.	E. M. Denham, drawing maps .....		.....	.....	12 20

## KENTUCKY GEOLOGICAL SURVEY.

1905.			Salary.	Expenses.	Total.
May 8.	W. F. Pate (March, April and May).....		24 00	6 56	30 56
May 8.	G. V. Triplett, Jr.....		42 00	50	42 50
May 8.	W. U. Grider.....		62 50	32 97	95 47
May 19.	E. M. Denham, drawing maps .....		.....	.....	4 00
May 19.	A. F. Foerste (April).....		58 33	.....	58 33
May 31.	S. A. Denny.....		50 00	.....	50 00
May 31.	R. H. Barclay (April, May) .		90 00	.....	90 00
May 31.	J. E. Wright.....		125 00	54 77	179 77
May 31.	J. H. Gardner.....		50 00	60 58	110 58
May 31.	M. G. Clay, 1 blue print....		.....	.....	35
May 31.	A. R. Crandall (April, May)		112 00	.....	112 00
May 31.	F. J. Fohs.....		120 00	68 67	188 67
May 31.	A. M. Miller.....		50 00	2 30	52 30
June 13.	A. F. Foerste (May).....		76 61	13 01	89 62
June 8.	L. M. Prince, 26 blue prints.		.....	.....	7 85
June 24.	O. R. Kroell, drafting.....		.....	.....	36 00
June 28.	L. M. Prince, blue prints...		.....	.....	1 20
June 28.	J. M. Nickles.....		.....	57 72	57 72
June 28.	A. M. Miller.....		50 00	32 74	82 74
June 28.	J. H. Gardner.....		50 00	48 15	98 15
June 28.	A. F. Foerste.....		95 83	38 79	134 62
June 28.	J. E. Wright.....		104 16	46 48	150 64
July 3.	F. J. Fohs (June).....		120 00	66 55	186 55
July 3.	S. A. Denny (June).....		50 00	30 28	80 28
July 9.	J. B. Hoeing (May).....		125 00	42 72	167 72
July 9.	W. F. Pate (June).....		68 00	17 33	85 33
July 24.	J. M. Nickles.....		125 00	44 45	169 45
July 25.	L. M. Prince, blue prints...		.....	.....	1 50
Aug. 1.	A. M. Miller (July).....		50 00	37 50	87 50
Aug. 1.	J. H. Gardner (July).....		50 00	51 70	101 70
Aug. 1.	J. E. Wright (July).....		125 00	38 23	163 23
Aug. 3.	F. J. Fohs (July).....		120 00	50 05	170 05
Aug. 3.	S. A. Denny (July).....		50 00	41 60	91 60
Aug. 3.	W. F. Pate (July).....		68 00	20 65	88 65
Aug. 3.	A. R. Crandall.....		150 00	33 15	183 15
Aug. 17.	R. H. Barclay (June, July) .		45 00	24 86	69 86
Aug. 9.	J. P. Brooks, compiling and drawing 2 large maps, June and July, and \$1 drayage.		.....	.....	201 00
Aug. 31.	W. F. Pate.....		68 00	23 23	91 23
Aug. 31.	S. A. Denny.....		50 00	7 74	57 74
Sept. 1.	A. M. Miller.....		50 00	.....	50 00
Sept. 1.	F. J. Fohs.....		120 00	47 15	167 15
Sept. 1.	J. H. Gardner.....		50 00	67 63	117 63



## KENTUCKY GEOLOGICAL SURVEY.

1905.			
	Salaries.	Expenses.	Total.
Sept. 1. J. E. Wright.....	125 00	.....	125 00
Sept. 6. A. R. Crandall.....	150 00	55 70	205 70
Sept. 29. J. H. Gardner.....	50 00	4 55	54 55
Oct. 3. F. J. Fohs.....	120 00	1 30	121 30
Oct. 3. A. M. Miller.....	50 00	.....	50 00
Oct. 31. J. H. Gardner.....	\$ 50 00	\$1 55	\$ 51 55
Nov. 3. F. J. Fohs (Oct.).....	120 00	35	120 35
Nov. 28. J. H. Gardner (Nov.).....	50 00	.....	50 00
Dec. 6. F. J. Fohs (Nov.).....	120 00	18 35	138 35

Total April 1, 1904, to December 1, 1905.....\$12,168 51

## SHORT STATEMENT OF FOREGOING.

Year.	Salaries.	Expenses.	Total.
1904 .....	\$3,338 10	\$1,391 02	\$4,729 12
1905 .....	5,629 90	1,809 49	7,439 39
Totals .....	\$3,968 00	\$3,200 51	\$12,168 51

## ON ACCOUNT OF MISCELLANEOUS MAPPING, LEVELING AND DRAWING.

1904.			
	Salary.	Expenses.	Total.
April 25. R. E. Mooreman (traveling)	.....	\$ 4 75	\$ 4 75
April 30. R. E. Mooreman (drafting 6 days' salary).....	12 00	.....	12 00
May 10. R. E. Mooreman (drafting, 8 days' salary) .....	16 00	.....	16 00
May 18. O. R. Kroell (copying maps, 9 days) .....	.....	.....	9 00
June 30. O. R. Kroell (drafting, 15½ days) .....	.....	.....	31 00
July 31. G. V. Triplett, Jr. (special aid for July).....	50 00	32 00	82 00
July 31. Hargis Hill, rodman.....	20 00	32 30	52 30
July 31. J. G. Lewis, transitman....	45 00	24 71	69 71
July 31. O. R. Kroell (drafting 5 days) .....	.....	.....	10 00
July 31. O. R. Kroell, levelman, salary 24 days .....	19 35	31 65	51 00
July 31. J. S. Shaw, transitman.....	25 00	23 58	48 58
July 31. C. G. Montgomery, levelman	25 00	5 50	30 50

## KENTUCKY GEOLOGICAL SURVEY.

1904.			
	Salary.	Expenses.	Total.
July 31. Items from Director's acct.:			
July 21, broad hatchet ...	.....	.....	1 25
July 22, L. Ayres, axman..	.....	.....	6 40
Aug. 31. G. V. Triplett, Jr.....	50 00	50 40	100 40
Aug. 31. Hargis Hill.....	20 00	25 05	45 05
Aug. 31. J. G. Lewis.....	45 00	56 90	101 90
Aug. 31. O. R. Kroell.....	25 00	12 70	37 70
Aug. 31. J. S. Shaw.....	25 00	60 37	85 37
Aug. 31. C. G. Montgomery.....	25 00	12 28	37 28
Sept. 30. O. R. Kroell.....	4 00	.....	4 00
Sept. 30. J. G. Lewis.....	45 00	26 01	71 01
Sept. 30. Geo. D. Wright, rodman....	12 00	23 00	35 00
Oct. 31. J. G. Lewis.....	45 00	28 36	73 36
Oct. 31. B. M. Sims, rodman.....	20 00	15 19	35 19
Oct. 31. B. M. Sims, September.....	20 00	18 09	38 09
Oct. 31. J. S. Shaw.....	36 16	132 95	169 11
Nov. 30. Transylvania Co., 1 dozen thumb tacks .....	.....	.....	10
Nov. 30. J. G. Lewis.....	45 00	43 54	88 54
Nov. 30. J. S. Shaw.....	38 34	39 11	77 45
Nov. 30. G. V. Triplett, Jr.....	50 00	1 05	51 05
Dec. 24. J. S. Shaw.....	40 00	25	40 25
Dec. 31. J. S. Shaw.....	.....	16 38	16 38
Dec. 31. C. G. Montgomery (Sept.)..	25 00	22 75	47 75
Dec. 31. B. M. Sims (Nov.).....	10 00	11 79	21 79
Dec. 31. J. G. Lewis.....	45 00	22 22	67 22

1905.			
	Salary.	Expenses.	Total.
Jan. 30. J. G. Lewis.....	\$45 00	\$2 00	\$ 47 00

	Salary.	Notary Fee.	Total.
Jan. 31. J. S. Shaw.....	40 00	25	40 25
Feb. 28. J. S. Shaw.....	40 00	25	40 25
Mar. 30. J. S. Shaw.....	60 00	25	60 25

	Salary.	Expenses.	Total.
April 29. J. S. Shaw.....	60 00	57 30	117 30
April 29. Hargis Hill.....	20 00	37 65	57 65
April 29. K. K. Kevil.....	10 00	16 80	26 80
May 31. J. S. Shaw.....	60 00	73 35	133 35
May 31. K. K. Kevil.....	20 00	22 60	42 60
May 31. Hargis Hill.....	20 00	35 95	55 95
June 3. Hargis Hill.....	20 00	29 70	49 70
June 3. K. K. Kevil.....	12 00	17 00	29 00
June 3. W. W. Shelby, Jr.....	8 00	14 60	22 60
June 3. J. S. Shaw.....	60 00	79 95	139 95



## KENTUCKY GEOLOGICAL SURVEY.

1905.		Salary.	Expenses.	Total.
Aug. 3.	O. R. Kroell.....	30 00	24 05	54 05
Aug. 3.	W. W. Shelby, Jr.....	20 00	29 90	49 90
Aug. 3.	J. S. Shaw.....	60 00	71 85	131 85
Aug. 9.	Hargis Hill.....	25 00	38 25	63 25
Aug. 31.	W. W. Shelby, Jr.....	12 30	17 15	29 45
Sept. 4.	J. S. Shaw.....	60 00	120 70	180 70
Sept. 29.	O. R. Kroell.....	5 00	7 03	12 03
Oct. 3.	J. S. Shaw.....	60 00	10 55	70 55
Oct. 31.	J. S. Shaw.....	60 00	.....	60 00
Nov. 28.	J. S. Shaw.....	60 00	.....	60 00
Total, April 1, 1904, to December 1, 1905.....				<u>\$3,242 91</u>

## SHORT STATEMENT OF FOREGOING.

Year.	Salaries.	Expenses.	Totals.
1904 .....	\$887 85	\$780 63	\$1,668 48
1905 .....	867 30	707 13	1,574 43
Totals .....	<u>\$1,755 15</u>	<u>\$1,487 76</u>	<u>\$3,242 91</u>

## OFFICE ACCOUNT.

1904.		
April 30.	M. M. Kelly, stenographer, pay for April.....	\$ 30 00
May 31.	M. M. Kelly, stenographer, pay for May.....	31 00
June 30.	C. L. Jones, Secretary, pay for June.....	66 66
June 30.	C. L. Jones, Secretary, expenses for June.....	6 90
June 30.	Telegram to Foerste, May 12, from Director's account..	25
June 30.	Telegram to Foerste, May 13, from Director's account..	92
June 30.	Telegram to Wright, June 6, from Director's account..	25
June 30.	Glue, June 21, from Director's account.....	10
June 30.	Telephone message to Frankfort June 23, from Director's account .....	25
June 30.	Glue, June 29, from Director's account.....	20
July 31.	C. L. Jones, Secretary, pay for July.....	66 67
July 31.	Telegram July 2, from Director's account.....	29
July 31.	Telegram July 6, from Director's account.....	25
July 31.	Telegram July 21, from Director's account.....	25
Aug. 4.	Postage stamps, \$20, and notary fee, 20 cents, from Director's account .....	20 20
Aug. 31.	C. L. Jones, pay for August.....	66 67
Aug. 31.	Transylvania Co., July 13, 500 shipping tags.....	30
Aug. 31.	Transylvania Co., Aug. 1, box photo films.....	70

## KENTUCKY GEOLOGICAL SURVEY.

1904.		
Aug. 31.	Transylvania Co., flange for camera lens, \$1; front board, 40c; 2 dozen photo plates, \$1; express both ways, 50c.....	2 90
Aug. 31.	Postage stamps, July 26, from Director's account.....	2 00
Aug. 31.	Telegram, Aug. 22, Winchester and Louisville, from Director's account .....	70
Aug. 31.	Telegram, Shaw and Montgomery, Aug. 29, from Director's account .....	50
Sept. 30.	C. L. Jones, pay, \$66.67 and expenses, \$3.20, for September .....	69 87
Sept. 30.	Transylvania Co., 3 bottles drawing ink.....	75
Sept. 30.	Rent of telephone, \$1 and tolls 95c for August, from Director's account .....	1 95
Sept. 30.	Broom, 30c; bucket, 25c; soap, 5c, September 21, from Director's account .....	90
Sept. 30.	Janitor's pay, one-half month, from Director's account.	10 00
Oct. 31.	C. L. Jones, pay for October.....	66 66
Oct. 31.	Jas. Mack, janitor, pay for October.....	20 00
Oct. 31.	Telegram October 5, from Director's account.....	35
Oct. 31.	Telephone rent and tolls for September, from Director's account .....	1 80
Nov. 5.	Telephone rent and tolls for October, from Director's account .....	1 75
Nov. 30.	C. L. Jones, pay, \$66.67, and notary fee, 25c.....	66 92
Nov. 30.	Jas. Mack, janitor, pay, \$20, and notary fee, 25c.....	20 25
Nov. 30.	Stenographer's note books, Transylvania Co., Oct. 10...	10
Dec. 8.	Telephone rent, \$1, and tolls, 85c, for November (Director's account) .....	1 85
Dec. 15.	Brower & Co., flat top desk.....	12 00
Dec. 15.	Brower & Co., Globe-Wernicke file, unit and top.....	11 50
Dec. 24.	C. L. Jones, pay, \$66.66, and notary fee, 25c.....	66 91
Dec. 24.	Jas. Mack, pay, \$20, and notary fee, 25c.....	20 25
Dec. 31.	Transylvania Co., December 14, journal record book....	2 15
Dec. 31.	J. M. Byrnes, one-half dozen invoice files, \$2.20; pamphlet file, 50c.....	2 70

1905.		
Jan. 2.	Telegram to Pate, December 15, from Director's account .....	25
Jan. 2.	Telegram to Foerste, December 23, from Director's account .....	25
Jan. 2.	Rent telephone No. 1012, \$1, and tolls, \$1, for December, from Director's account.....	2 00
Jan. 2.	Rent telephone No. 1540, for quarter ending March 31, from Director's account.....	5 70
Jan. 2.	Telegram, Grider, from Director's account.....	25
Jan. 31.	C. L. Jones, pay, \$66.67, and notary fee, 25c, for January .....	66 92
Jan. 31.	Jas. Mack, janitor, pay for January.....	25 00



1905.

Feb. 1.	Transylvania Co., January 2, duster, 35c; box tacks, 10c; waste basket, 25c. January 7, benzine, 10c; stencil paper, \$2; mineral ink, \$1.20.....	4 00
Feb. 1.	P. O. Box rent, January 6, from Director's account.....	1 00
Feb. 2.	Telephone No. 1012 rent, \$1, and tolls, \$5, for January..	6 00
Feb. 28.	C. L. Jones, pay for February.....	75 00
Feb. 28.	James Mack, janitor, pay, \$25, and notary fee, 25c, for January .....	25 25
Feb. 28.	C. L. Jones, expenses of two trips to Frankfort from Lexington, January 25-27 and February 15, on office business, \$3.90, and notary fee, 25c.....	4 15
Feb. 28.	Postage stamps, February 27, from Director's account..	10 00
Feb. 28.	Rent telephone No. 1012 for February, from Director's account .....	1 00
Mar. 30.	James Mack, janitor, pay for March and notary fee....	25 25
Mar. 30.	C. L. Jones, Secretary, pay for March and notary fee...	75 25
April 22.	C. F. Brower & Co., Globe-Wernicke book cases, 20 units, March 27 and April 7.....	78 00
April 29.	C. L. Jones, pay and notary fee for April.....	75 25
April 29.	Jas. Mack, pay and notary fee for April.....	25 25
April 29.	Items from Director's account as follows:	
	March 3, telegram, Hopkinsville.....	25
	April 1, rent of phone No. 1540 quarter ending June 30	6 00
	April 3, telegram, Marion.....	35
	April 5, P. O. Box rent, quarter ending June 30.....	1 00
	April 20, rent telephone No. 1012, \$1, and tolls, \$2.40 for March .....	3 40
	April 20, telegram, Milton, Wis.....	68
May 1.	Rent telephone No. 1012, \$1, and tolls, \$2.20, for April, from Director's account.....	3 20
May 8.	Transylvania Co., April 8, gummed labels, 25c; April 19, one-half dozen pencils, 50c.....	75
May 9.	F. C. Elkin, postmaster, postage stamps.....	20 00
May 9.	Secretary of State, notary commission.....	2 00
May 16.	J. M. Byrnes, pads of yellow writing paper.....	1 25
May 19.	J. H. Bean, notary seal, \$3; rubber stamp, 50c.....	3 50
May 30.	C. L. Jones, pay for May.....	31 20
May 30.	Jas. Mack, pay for May.....	25 00
June 29.	C. L. Jones, pay for June.....	75 00
June 29.	Jas. Mack, pay for June.....	25 00
July 31.	Transylvania Co.'s account June 30, box pens, \$1; holder, 5c.....	1 05
July 31.	C. L. Jones, pay for July.....	75 00
July 31.	Jas. Mack, pay for July.....	25 00

1905.

July 31.	Items from Director's account as follows:	
	May 20, stenographer 1¾ days.....	1 75
	June 3, telegram to Pate.....	25
	June 12, telegram to Foerste.....	85
	June 23, telegram to Grider.....	35
	June 30, transfer wagon.....	35
	July 1, rent telephone No. 1540 for quarter ending September 30.....	5 70
	July 1, rent telephone No. 1012, \$1, and tolls, \$1.25, for May.....	2 25
Aug. 31.	C. L. Jones, pay for August.....	75 00
Aug. 31.	Jas. Mack, pay for August.....	25 00
Sept. 6.	Roger Harp and Bro., account rendered September:	
	August 1, 3 bars soap, 1 broom, spool of wire, box tacks	75
	August 24, 1 broom.....	35
Sept. 27.	C. L. Jones, pay for September.....	50 00
Sept. 29.	Jas. Mack, pay for September.....	25 00
Oct. 4.	Items from Director's account as follows:	
	July 3, 2 telegrams.....	54
	July 7, P. O. Box rent quarter ending September 30...	1 00
	July 20, map purchased from U. S. Geological Survey.	25
	July 24, Sam Coleman, labor.....	1 00
	August 1, telephone No. 1012 rent, \$2, and tolls, \$1.20, June and July.....	3 20
	October 1, telephone No. 1540 rent, quarter ending December 31.....	6 00
	October 3, P. O. Box rent, quarter ending December 31	1 00
	October 3, postage stamps.....	1 00
Oct. 31.	Jas. Mack, pay for October.....	25 00
Nov. 20.	Transylvania Co., April 18, 500 tags by Jones.....	60
Nov. 28.	Jas. Mack, pay for November.....	25 00
Total, April 1, 1904, to December 1, 1905.....		<u>\$1,734 26</u>

## CHEMICAL ANALYSIS AND TESTING.

1904.

Oct. 1.	A. M. Peter, analyses to date.....	\$130 00
Nov. 30.	A. M. Peter, analyses in November.....	79 00
Dec. 31.	A. M. Peter, analyses in December.....	100 00



## KENTUCKY GEOLOGICAL SURVEY.

1905.			
Feb.	3.	A. M. Peter, analyses in January.....	70 00
April	4.	Anderson and Faig, testing 3 specimens of stone.....	6 00
May	9.	A. M. Peter, preparing Chemical Bulletin.....	100 00
July	14.	A. M. Peter, analyses February 1 to July 2.....	94 50
Aug.	17.	A. M. Peter, analyses in July.....	66 50
Sept.	1.	W. E. Burk, bill rendered for 17 analyses.....	160 00
<hr/>			
Total, April 1, 1904, to December 1, 1905.....			\$806 00

## ACCOUNT OF MUSEUM.

1904.			
April	22.	S. M. Brown, repairing cases.....	\$49 50
May	20.	S. M. Brown, repairing cases.....	37 50
May	20.	S. M. Brown, painting cases, \$2.50; making ladder, \$2.95	5 45
June	9.	H. B. Pope, work in Museum, 3 days.....	3 00
June	30.	R. B. Sadler, work in Museum, 17½ days.....	17 50
July	31.	R. B. Sadler, work in Museum, 25 days.....	25 00
Aug.	31.	R. B. Sadler, work in Museum, 26½ days.....	26 50
Sept.	3.	R. B. Sadler, work in Museum, 3 days.....	3 00
Nov.	10.	A. Mitchell, work in Museum, from Director's account.	50
Dec.	8.	3 jugs, 35c; telegram, 51c, from Director's account.....	86
<hr/>			
1905.			
Feb.	1.	R. Hays & Bro., January 31, bucket, mops, turpentine, 2 bars soap .....	1 45
Feb.	10.	Amount charged by Kentucky World's Fair Commission for shipping part of Kentucky mineral exhibit at close of Fair to State Geological Museum .....	\$100 00
Feb.	10.	Paid by Survey for unloading, hauling, etc. (See Freight, etc.).....	44 80
<hr/>			
		Check sent Commission for balance.....	55 20
Oct.	4.	Thomas Churchill, labor 2½ days, from Director's account .....	2 50
Dec.	6.	Smith, Watkins & Co., wire and tacks.....	50
<hr/>			
Total, April 1, 1904, to December 6, 1905.....			\$228 46

## FREIGHT AND DRAYAGE.

1904.			
June	28.	J. H. Hostetter, freight, 66c; drayage, 75c, from Director's account .....	\$ 1 41
July	12.	Adams Express Co., bill for June.....	2 10
Aug.	1.	Adams Express Co., bill to July 19.....	85

## KENTUCKY GEOLOGICAL SURVEY.

1904.			
Sept.	10.	Adams Express Co., bill to August 10.....	13 64
Oct.	12.	Adams Express Co., bill for September.....	26 55
Nov.	16.	Adams Express Co., bill for October.....	9 05
Dec.	1.	Adams Express Co., bill for November.....	6 31
<hr/>			
1905.			
Jan.	21.	J. H. Hostetter, unloading and placing in Museum mineral specimens, cases, etc., sent from Kentucky mineral exhibit at World's Fair by Kentucky World's Fair Commission, this being part payment of \$100 charged by the Commission for shipping the material to the Museum. (See also Museum account).....	44 80
<hr/>			
Jan.	21.	J. H. Hostetter, freight and drayage as follows:	
		December 8, 1904, drayage on box of stone.	\$0 25
		December 28, 1904, freight, 28c; drayage, 25c on box of stationery.....	53
		January 20, 1905, freight, 96c; drayage, 50c on 2 boxes of pictures from Frankfort.	1 46
<hr/>			
			2 24
Jan.	28.	Adams Express Co., bill November 29, 1904, to January 24, 1905 .....	7 45
Mar.	25.	Adams Express Co., bill for March.....	5 87
April	29.	Adams Express Co., bill for April.....	5 54
May	16.	J. H. Hostetter, drayage on mineral specimens, February 1, to May 16.....	1 75
June	29.	Adams Express Co., bill April 28 to June 29.....	8 50
Aug.	1.	Adams Express Co., bill June 27 to July 17.....	5 25
Sept.	6.	Adams Express Co., bill July 28 to August 19.....	4 48
Sept.	29.	Adams Express Co., expressage on surveying rods from Marion .....	1 50
<hr/>			
Nov.	20.	Farley Transfer and Storage Co., freights and cartage as follows:	
		March 7, freight and cartage on box of stones .....	\$0 25
		April 4, freight and cartage on sack of stones .....	81
		April 5, freight and cartage on sack of stones .....	81
		April 6, freight and cartage on sack of stones .....	78
		August 8, freight and cartage on sack of stones .....	91
<hr/>			
			3 56
Nov.	23.	Adams Express Co., bill October 16 to November 2.....	90
<hr/>			
Total, April 1, 1904, to December 1, 1905.....			\$151 75



## KENTUCKY GEOLOGICAL SURVEY.

## EQUIPMENT, REPAIRS AND SUPPLIES.

1904.

June 6.	Keuffel & Esser Co., "Y" level, \$85; barometer, \$26.64; hand level, \$5.60.....	\$117 24
June 15.	Keuffel & Esser Co., roll profile paper, \$6.30; small "Y" level, \$85; plumb bob, 18 oz., \$1.12.....	92 42
June 30.	A. M. Miller, photo plates, May 13, from Director's account .....	2 25
July 2.	Keuffel & Esser Co., 2 Phila rods.....	20 80
July 11.	McAdams & Morford, 6 gross bottles and corks for well samples .....	14 40
July 16.	Queen & Co., repairing 2 barometers.....	10 25
July 27.	Keuffel & Esser Co., 2 aneroid barometers.....	33 60
July 27.	Keuffel & Esser Co., 2 Harvard compasses in cases, \$7.30; 1 dozen field books, \$3.50; 1 dozen level books, \$3.15..	13 95
Aug. 25.	Keuffel & Esser Co., small transit.....	93 50
Aug. 29.	Keuffel & Esser Co., repairing large transit.....	13 50
Oct. 12.	Keuffel & Esser Co., repairing large transit.....	27 00
Oct. 19.	M. H. Crump, 1 transit, \$110; 1 level, \$90.....	200 00
Oct. 31.	Keuffel & Esser Co., 2 Florida rods.....	16 00
Nov. 30.	Keuffel & Esser Co., roll drawing paper, \$6.20; 10 yards drawing paper, \$2.45; roll tracing cloth, \$10.42; 4 card protractors, 82c.....	19 89

1905.

Feb. 27.	Keuffel & Esser Co., 1 pint Columbia ink, \$2; 1 steel tape, \$8.27; hand level, \$5.60; paper cutter, 24c; "metallic" tape, \$1.51; spring bow pen, \$1; drawing pen, 98c; railroad pen, \$2.63; sponge rubber, 42c; erasing shield, 17c .....	22 82
April 29.	Keuffel & Esser Co., 2 barometers, \$43.44; small steel tape, \$2.25; hand level, \$5.60; set "Key" brand drawing instruments, \$8.47; 1 railroad pen, \$1.67.....	61 43
May 8.	Transylvania Co., Star Primo camera, \$22.50; Zeiss lens, \$52.40; film adapter, \$1; 6 plate holders, \$6; tripod, \$3; film pack, 70c; 1 dozen photo plates, 40c.....	86 00
May 16.	J. M. Byrnes, paper bags for samples.....	45
June 30.	L. M. Prince, drawing paper.....	8 75
June 30.	Transylvania Co., 3 field books.....	1 50

Total, April 1, 1904, to December 1, 1905..... \$855 75

## CONDENSED STATEMENT.

For the year 1904.....	\$674 80
For the year 1905.....	180 95
Total .....	\$855 75

## KENTUCKY GEOLOGICAL SURVEY.

## DIRECTOR'S ACCOUNT.

1904.

May 30.	Railroad fares for April and May.....	\$ 8 20
May 30.	Items paid by Director, but carried to other accounts:	
	April and May telegrams (to Office acct.)..	\$1 17
	May 13, A. M. Miller, for photo plates (to Equip., etc., account).....	2 25
		<u>\$3 42</u>

June 30. Railroad fares for June..... 1 70

June 30.	Items paid by Director, but carried to other accounts:	
	June 6, telegram (to Office account).....	\$0 25
	June 21, glue (to Office account).....	10
	June 23, telephone message (to Office account) .....	25
	June 28, J. H. Hostetter, freights and drayage (to Freight account).....	1 41
	June 29, glue (to Office account).....	20
		<u>\$2 21</u>

Aug. 2. Field expenses, July 2 to August 2..... 61 74

Aug. 2.	Items paid by Director, but carried to other accounts:	
	July 2, telegram (to Office account).....	\$0 29
	July 6, telegram (to Office account).....	25
	July 21, telegram (to Office account).....	25
	July 21, broad hatchet (to Mapping acct.)..	1 25
	July 22, L. Ayres, axman (to Mapping acct.)..	6 40
		<u>\$8 44</u>

Aug. 4. Postage stamps (to Office account)..... \$20 00

Aug. 30.	Notary fee (to Office account).....	20
		<u>\$20 20</u>

Aug. 30. Field expenses for August..... 16 05

Aug. 30.	Items paid by Director, carried to other accounts:	
	July 26, postage stamps (to Office account)..	\$2 60
	Aug. 22, 2 telegrams (to Office account)....	70
	Aug. 29, telegram (to Office account).....	50
		<u>\$3 20</u>

Sept. 30. Field expenses for September..... 26 14



1904.

Sept. 30.	Items paid by Director, carried to other accounts:		
	Sept. 8, telephone rent, \$1, and tolls for August, 95c (to Office account).....	\$1 95	
	Sept. 21, broom, 30c; mop, 30c; bucket, 25c; soap, 5c (to Office account).....	90	
	Sept. 30, janitor, ½ month (to Office acct.)..	10 00	
		<u>\$12 85</u>	
Nov. 5.	Field expenses October 1 to October 31, inclusive.....		10 30
Nov. 5.	Items paid by Director, carried to other accounts:		
	Oct. 5, telegram (to Office account).....	\$0 35	
	October 12, telephone rent, \$1, and tolls, 80c, for September (to Office account).....	1 80	
	Nov. 2, A. Mitchell, work in Museum (to Museum account) .....	50	
	Nov. 5, telephone rent, \$1, and tolls, 75c, for October (to Office account).....	1 75	
		<u>\$4 40</u>	
Dec. 7.	Traveling expenses, November 29 and December 4.....		7 95
Dec. 7.	Items paid by Director, carried to other accounts:		
	Nov. 14, 3 jugs (to Museum account).....	\$0 35	
	Dec. 6, telegram, account mineral exhibit (to Museum account).....	51	
	Dec. 7, telephone rent, \$1, and tolls, 85c for November (to Office account).....	1 85	
		<u>\$2 71</u>	
1905.			
Jan. 2.	Traveling expenses, December 19 to 31.....		9 86
Jan. 2.	Items paid by Director, carried to other accounts:		
	Dec. 15, telegram (to Office account).....	\$0 25	
	Dec. 23, telegram (to Office account).....	25	
	Jan. 2, telephone rent, \$1, and tolls, \$1, for December (to Office account).....	2 00	
	Jan. 2, telephone No. 1540, rent for quarter ending March 31 (to Office account)...	5 70	
	Jan. 2, telegram (to Office account).....	25	
		<u>\$8 45</u>	
Feb. 2.	Traveling expenses for January.....		10 60

1905.

Feb. 2.	Items paid by Director, carried to other accounts:		
	Jan. 6, P. O. Box rent, quarter ending March 31 (to Office account).....	\$1 00	
	Feb. 2, telephone No. 1012 rent, \$1, and tolls, \$5, for January (to Office account)....	6 00	
		<u>\$7 00</u>	
Feb. 28.	Traveling expenses for February.....		2 05
Feb. 28.	Items paid by Director, carried to other accounts:		
	Feb. 27, postage stamps (to Office account) .	\$10 00	
	Feb. 28, telephone No. 1012, rent for February (to Office account).....	1 00	
		<u>\$11 00</u>	
May 2.	Traveling expenses in April.....		4 00
May 2.	Items paid by Director, carried to other accounts:		
	March 3, telegram (to Office account).....	\$0 25	
	April 1, telephone No. 1540, rent for quarter ending June 30 (to Office account).....	6 00	
	April 3, telegram (to Office account).....	35	
	April 5, P. O. Box rent, quarter ending June 30 (to Office account).....	1 00	
	April 15, ½ gross vials for drillings (to Geology account) .....	50	
	April 20, telephone No. 1012 rent, \$1, and tolls, \$2.40, for March (to Office acct.)..	3 40	
	April 20, telegram (to Office account).....	68	
	May 1, telephone No. 1012 rent, \$1, and tolls, \$2.20 for April (to Office account).....	3 20	
		<u>\$15 38</u>	
July 3.	Traveling expenses in May.....		6 20



1905.

## July 3. Items paid by Director, carried to other accounts:

May 20, stenographer, 1¾ days (to Office account) .....	\$1 75
June 3, telegram (to Office account) .....	25
June 12, telegram (to Office account) .....	85
June 22, telegram (to Office account) .....	35
June 30, transfer wagon (to Office acct.) ..	35
July 1, telephone No. 1540, rent quarter ending September 30 (to Office acct.) ..	5 70
July 1, telephone No. 1012, rent, \$1, and tolls, \$1.25, for May (to Office acct.) ..	2 25
	<hr/>
	\$11 50

## Oct. 4. Traveling expenses August and September..... 6 20

## Oct. 4. Items paid by Director, carried to other accounts:

July 3, telegrams (2) (to Office account) ..	\$0 54
July 7, P. O. Box rent, quarter ending September 30 (to Office account) .....	1 00
July 12, T. Churchill, work in Museum (to Museum account) .....	2 50
July 20, U. S. Geological Survey, 1 map (to Office account) .....	25
July 24, Sam Coleman, 10 hours work in office (to Office account) .....	1 06
Aug. 1, telephone No. 1012, rent June and July, \$2, and tolls, \$1.20 (to Office acct.) ..	3 20
Oct. 1, telephone No. 1540, rent quarter ending December 31 (to Office account) ..	6 00
Oct. 3, P. O. Box rent, quarter ending December 31 (to Office account) .....	1 00
Oct. 3, postage stamps (to Office account) ..	1 00
	<hr/>
	\$16 49

Total field expenses, April 1, 1904, to October 4, 1905..... \$170 99

Total items paid and carried to other accounts,

April 1, 1904, to October 4, 1905..... \$127 25

## U. S. GEOLOGICAL SURVEY ACCOUNTS.

## CO-OPERATIVE TOPOGRAPHIC SURVEYING.

	1904.	Totals.
April 30.	J. R. Ellis, pay-roll for April.....	\$ 27 00
April 30.	J. R. Ellis, field expenses for April.....	51 75
April 30.	J. R. Ellis, miscellaneous traveling expenses.....	35 85
May 31.	J. R. Ellis, pay-roll, \$135, and expenses, \$337.51.....	472 51
May 31.	W. L. Miller, pay-roll for May.....	147 10
May 31.	W. L. Miller, expenses for May.....	457 66
June 24.	J. R. Ellis, June pay-roll.....	112 00
June 25.	J. R. Ellis, field expenses for June.....	183 73
June 30.	W. L. Miller, field and miscellaneous traveling expenses for June .....	409 76
June 30.	C. A. Clunet, pay June 16 to 30.....	35 00
July 15.	C. A. Clunet, pay July 1 to 15.....	35 00
Aug. 1.	W. L. Miller, July pay-roll.....	296 00
Aug. 12.	W. L. Miller, traveling and miscellaneous expenses for July .....	36 95
Aug. 15.	R. W. Berry, traveling and miscellaneous expenses for July .....	26 25
Aug. 22.	W. L. Miller, field expenses for July.....	330 43
Sept. 1.	W. L. Miller, August pay-roll.....	430 00
Sept. 1.	W. L. Miller, field and miscellaneous traveling expenses for August .....	304 23
Sept. 1.	R. W. Berry, miscellaneous traveling expenses for Aug. ....	85 30
Oct. 1.	W. L. Miller, September pay-roll.....	435 00
Oct. 15.	R. W. Berry, expenses for October.....	85 14
Nov. 1.	W. L. Miller, October pay-roll.....	196 84
Dec. 22.	W. W. Johnson, care of U. S. Survey animals.....	77 90
Dec. 22.	J. W. Newman, care of U. S. Survey wagons, etc.....	16 94
	1905.	
Jan. 30.	W. A. Cooke, storage, \$10, and loading, \$2.75, U. S. Survey property .....	12 75
Jan. 31.	J. R. Ellis, salary for January.....	100 00
Jan. 31.	W. L. Miller, salary for January.....	133 33
Feb. 28.	W. L. Miller, salary for February.....	133 33
Mar. 31.	W. L. Miller, salary for March.....	133 34
April 25.	W. H. S. Morey, pay April 1 to 24.....	56 00
May 20.	Chas. E. Cooke, expense account for May.....	211 50
June 13.	Chas. E. Cooke, May pay-roll.....	288 98
June 13.	C. H. Bliss, livery bill (for C. E. Cooke and party) May.....	108 75
June 13.	J. S. B. Daingerfield, field expenses for May.....	89 45
June 13.	L. Scott Smith, expense account for May.....	96 20
July 10.	C. H. Bliss, livery bill (C. E. Cooke and party) June.....	98 00
July 10.	Chas. E. Cooke, June pay-roll.....	300 00
July 15.	Chas. E. Cooke, expense account for June.....	445 84



## KENTUCKY GEOLOGICAL SURVEY.

1905.		
July 15.	J. S. B. Daingerfield, expenses for June.....	85 45
Aug. 1.	Chas. E. Cooke, July pay-roll.....	300 00
Aug. 9.	L. Scott Smith, July expenses.....	92 75
Aug. 9.	J. S. B. Daingerfield, July expenses.....	143 09
Aug. 9.	O. B. Ellis, livery bill (for C. E. Cooke and party) July.	60 00
Aug. 17.	Chas. E. Cooke, expenses June 14.....	3 00
Aug. 17.	Chas. E. Cooke, July expenses.....	506 60
Aug. 17.	C. H. Bliss, livery (for C. E. Cooke and party) July)..	30 00
Sept. 6.	C. E. Cooke, August pay-roll.....	310 00
Sept. 6.	O. B. Ellis livery bill (for C. E. Cooke and party) Aug.	61 50
Sept. 14.	C. E. Cooke, August expenses.....	383 19
Sept. 14.	L. B. Daingerfield.....	114 03
Sept. 14.	Matt. Winn, livery bill (for Sallee and others) August.	52 50
Sept. 14.	C. H. Bliss, livery bill (for Daingerfield) August.....	10 00
Sept. 14.	L. S. Smith, August expenses.....	92 05
Oct. 3.	L. S. Smith, September expenses.....	13 74
Oct. 3.	C. B. Kendall, September pay-roll.....	150 50
Oct. 3.	C. E. Cooke, September pay-roll.....	280 00
Oct. 16.	C. B. Kendall, September expenses.....	102 69
Oct. 16.	W. H. Snyder, pay, rodman in September.....	26 00
Oct. 16.	J. H. McKee, livery bill (for C. B. Kendall) September.	31 50
Oct. 16.	J. S. B. Daingerfield, September expenses.....	106 05
Oct. 16.	W. J. Lloyd, September expenses.....	53 85
Oct. 16.	C. E. Cooke, September expenses.....	391 50
Nov. 20.	C. E. Cooke, October expenses.....	41 70
Nov. 20.	W. H. Sallee, pay, 17 days in October.....	34 00

Total, April 1, 1904, to December 1, 1905.....	\$9,971 50
--	------------

## SUMMARY.

Allotment for State organization work, 2 years.....	\$20,000 00
Expended in 1904 and 1905, to December 1.....	19,358 63

Balance to credit State organization work.....	\$641 37
--	----------

Allotment for U. S. Geological Survey co-operation, 2 years.....	\$10,000 00
Expended in 1904 and 1905, to December 1.....	9,971 50

Balance to credit U. S. Geological Survey December 1.....	\$28 50
---	---------