GEOLOGICAL SURVEY OF KENTUCKY.

N. S. SHALER, DIRECTOR.

REPORTS OF PROGRESS.

VOLUME V. NEW SERIES.

STEREOTYPED FOR THE SURVEY
BY MAJOR, JOHNSTON & BARRETT.
YEOMAN PRESS, FRANKFORT, KENTUCKY.
1880.

This page in the original text is blank.

INTRODUCTION.

This, the fifth volume of economic reports of the second Geological Survey of Kentucky, contains matter concerning the researches of the Survey which has been published in the form of detached reports from the years 1878 to 1880, inclusive. This volume, together with the Bulletin of the Survey, of which several numbers have been issued, contain all the statements of economic importance concerning the field explorations that have been conducted during these years, as far as they can yet be made sufficiently certain to warrant their publication. The more general scientific results of the Survey will be found in the second volume of Memoirs, which is now going through the press. A great deal of the work done by the parties and individual workers of the Survey will necessarily remain unpublished until the final reports are prepared.

The first of the reports in this volume accompanies the map of the reconnoissance triangulation prepared by Assistant W. B. Page, who, for some years, carried on the geodetic work undertaken by the United States Coast Survey. This work is designed to furnish the basis for the final map of the Commonwealth, and will make it possible to frame this map on a much more accurate basis than could otherwise be secured. If this system is carried out, as we may hope it will be, the topographical work done by the Geological Survey will be final in its nature, and will not require the subsequent repetition which is inseparable from map work done without a system of triangulation of the most exact kind. It is to be regretted that Mr. Page has resigned his connection with the Survey and sought employment in other and more profitable fields. The Commonwealth has never had a more faithful or efficient servant. The larger part of his work is embodied in the published and unpublished maps prepared in his work as a topographer of the Survey; but in the several topographical

reports that accompany these published maps, he has given the best descriptions of surface characters that have yet been furnished for any of the Southern States. The further prosecution of this work has been intrusted to Assistant Schenk, who brings to his task a skill and diligence that has been marked in all of his numerous labors in connection with this Survey.

The second report of this series gives a record of Mr. Schenk's labor in the extension of the topography of the eastern district during the year 1874. A part of this work will necessarily remain for the present unpublished. As it has been found too expensive to prepare contour maps to illustrate the topography of the State, descriptions of the surface, such as are given by Mr. Schenk, have a decided value to the persons who desire a more detailed statement concerning its surface than the plain maps themselves will give. This seems to me a warrant for reports of this nature.

The third report is also from the pen of Mr. Schenk. It concerns the use of the telemeter or topographical maps. At the outset of the present Geological Survey I determined to substitute for the surveyor's chain the telemeter, the special advantages of which had been made plain to me during my experience as an employé of the United States Coast Survey. I knew of no simple and accessible essay on the use of this instrument, and as the methods to be followed in making surveys with it are not generally familiar to our surveyors, who rarely know much of this instrument, it seemed desirable to have some treatise on the subject from the hands of a master in its use. I believe Mr. Schenk's paper will serve this purpose, and I hope it may contribute to the more extended use of an instrument that may fairly be regarded as the greatest modern contribution to the surveyor's art. I am not aware that the telemeter has been much used in any other field for the work of rapid map-making. Our experience with it in Kentucky has shown that facility in its use is speedily acquired, and that the results are as accurate and far less costly than those attained by the old methods.

The fourth report is from Assistant DeFriese. It contains a valuable account of the economic timbers in the valley of the Tradewater river. Besides the information of industrial value, his account of the distribution and succession of the various forest trees, adds another chapter to the important general results that have been attained by the Survey. It is of great importance that these matters connected with the history of our forests should be ascertained as rapidly as possible. Already their original character is well nigh lost by the changes that the axe brings about.

The fifth report in this volume contains another of the series of memoirs on the nature and distribution of the timber trees of Kentucky, by Mr. L. H. DeFriese. Besides No. 4 of this volume, Mr. DeFriese has already contributed several reports on this class of subjects to the preceding volumes of this series—the whole constituting an extended and valuable synopsis of his studies upon this class of questions. Besides the large amount of special economic information this report contains, it includes a brief discussion of some problems of general interest to all who are interested in the present history of our forests. As I have remarked in previous discussions of these questions, the forests of this Commonwealth afford the best possible field for certain inquiries. The problems presented by our prairies have great light thrown upon them by the facts that can be gathered here. Mr. DeFriese has clearly shown in this report that the extension of the treeless areas was in some cases due to the burning of the grass by the early settlers, a process that was adopted from the aborigines, and which served to destroy the younger trees, and so in time to give prairie surfaces to wide regions that were previously wooded. The observations in this report have a special interest, inasmuch as they show the continuance of this work of extending the prairie limits down to a very recent day. I regret that it seems at present unlikely that the Survey will be able to secure any further studies of this description from Mr. DeFriese. It would be very desirable to have this class of

observations extended over the whole surface of the Commonwealth. I trust, however, that the important features adopted in these timber reports given us by Mr. DeFriese, and the other officers of the Survey who have taken part in these forest studies, may be secured in the reports of those who continue the work on the lines laid down by the published reports. In this way we should secure a study of our forests more complete and valuable than has been made in any other area of its size in this country.

In the Chemical Report, the sixth of this volume, we have the third of the valuable contributions that Dr. Peter has made to the new series of the Survey, and the seventh since the beginning of the study of the resources of the Commonwealth; four other reports having been published during the years in which Dr. Owen had charge of this department.

In this report Dr. Peter continues his studies in the composition of our coals, soils, clays, &c., &c. These analyses are accompanied by various comments serving to show their relation to previous work or the economic results that may be derived from them. Those concerning the soils are a continuation of the many hundred previously made by Dr. Peter and published in former reports. This series of analyses now affords a nearly complete basis on which to construct a soil map of the Commonwealth, which shall show the distribution of its various soils, the crops for which they are severally fitted, and the fertilizers that can be most advantageously employed upon them. The work done upon the mineral waters nearly completes the examination of our medicinal springs. There now only remains about half a dozen of the mineral waters of this State that have not received some study from the Survey. In this connection it is worthy of note that some of our underground waters, such as are found by borings in the limestone beneath the Blue Grass district, are shown by Dr. Peter to be fit for steam purposes. As we must abandon all hope of procuring waters for the supply of our towns by means of artesian wells, it is a great satisfac-

tion to know that we may, under some circumstances, find them fit for use in steam boilers.

The analyses of the Hungarian grass and German millet are valuable contributions to the economic chemistry of two of the most useful forage plants. The high price of lands in the central district of Kentucky makes it desirable for us to use the forage plants of the largest yield. The relation of these plants to our soils is therefore a matter of great interest.

In preceding reports Dr. Peter has given similar studies upon the greater part of our important agricultural products. When the final reports of the Geological Survey come to be prepared, it will be desirable to have these general reports on the chemical survey of the Commonwealth worked over, so as to bring the related matters together. At present a large part of their important contents is so scattered as not to be available to the student. Four of these reports are in the old series of publications, which have long been out of print, and are mostly inaccessible to our people.

The report of Assistant Caldwell on the iron ores of the Cumberland district is the third of his memoirs on the iron resources of Eastern Kentucky. These, with the reports of Mr. P. N. Moore, who preceded Mr. Caldwell as metallurgical assistant of the Survey, give a reasonably full account of the prospects of this industry in Kentucky. To a large training in the metallurgical schools of Europe, Mr. Caldwell has added an extensive experience in the practice of working iron in this country; so his results are worthy of the fullest confidence.

I deem it of particular importance that Mr. Caldwell considers the iron ores of the Cumberland district as fit for steel-making purposes. There are very few ores of this class in the valley of the Mississippi, and at no other point are they found in such close juxtaposition with fuel of a cheap sort. Although the United States abounds in iron ores, the greater part of its resources of this nature are not conveniently placed with reference to transportation, and are rather remote from cheap coal. It is a peculiar advantage of our Kentucky ores,

which those of Northern Kentucky prove in an eminent degree, that they are all near to good coking coals and not remote from water transportation. The ores of the Green River district and of the Cumberland and Tennessee districts are easily accessible by rail or water transportation.

The next report in this volume is also from the pen of Mr. Caldwell. It is intended as a summary of the modern advances in the metallurgy of iron. Many of the important discoveries in this art are inaccessible to its practical workers. No modern art has profited more by intelligent experiment conducted with scientific methods than this. It has seemed to me well to recognize the fact that this Survey was intended to diffuse such knowledge among our people. So far as my knowledge goes, this is the best brief presentation of the matter that has yet been given to the public.

The remarks in this report concerning the modern advances in the removal of phosphorus from iron are of especial importance to our Kentucky iron interests, as a large part of our iron ores are rather phosphatic, and it has hitherto been announced that they were unfit for the making of steel, which is now so extensively taking the place of ordinary iron. It seems clear, however, that we may now disregard this impurity, for the most recent advances in the process of manufacture show us means of effecting its removal at an inconsiderable expense.

The tenth report in this volume is from the pen of Mr. L. H. DeFriese, who has written two other reports in this volume. The special aim of this report was to furnish a continuous section across the State from east to west, showing the changes of the trees in passing from the banks of the Mississippi to the mountain district along the Virginia border of the Commonwealth. Besides the practical details introduced in his report, there are several suggestions of great theoretical interest. As before remarked, the forests of Kentucky abound in problems. The order of succession of the various trees, the laws that determine their appearance and disappearance in the various districts, the curious way in which certain spe-

cies, unhappily including the precious white oak, are fading out from the want of young trees in the undergrowth, are all matters of great scientific as well as economic importance. Mr. DeFriese has laid the foundations for very important inquiries into many of these matters, and in some cases he has been able to make important conclusions concerning them.

The report of Mr. W. M. Linney stands in natural relation to that of Mr. DeFriese. It is, in fact, a detailed study of the district comprised within the counties of Boyle and Mercer, which has been touched upon in the last report of Mr. DeFriese. Mr. Linney, during a long residence in this district, has paid especial attention to the history of its once well-wooded lands. He tells a painful story of the successive advances in the destruction of the noble forests that have had to give way before the highly developed agriculture that its admirable soil invites. I know of no other region of equal extent, in this country or Europe, where the land is so completely deprived of its natural forests as this central district of Kentucky. In the central parts of England, the most thickly settled portion of that over-peopled isle, there are here and there considerable tracts of forest, which, with their undergrowth and spongy bed of decaying vegetation, serve to restrain the movement of the rain-water towards the streams. But the value of grazing lands in Central Kentucky is so great that all the woods are deprived of their undergrowth, and set with a close sod, so that the water goes off its surface with almost the same ease that it flows from the roofs and streets of a city. There are two very regretable results arising from this utter neglect of the forests in this district—first, the destruction of the streams, which are no longer as of old constant channels of water, but torrents in the seasons of rain and dry ways in the times of drought; and second, the gradual destruction of the value of the pasture lands of the district from the action of drought and the want of shade. It is a well recognized fact that the high bred and sensitive animals of our breeding farms are considerably affected by the heat of the summer sun. It is

because they afford shade to animals while they are feeding that the wood pastures of our blue grass country are peculiarly prized by stock-growers. At present no provision is made for the renewal of the trees of these wood pastures. They are generally waxing old, and a few more decades will bring about their destruction. Although we cannot expect to see any great part of these lands replanted in forests, we may at least hope that this special need may receive immediate attention.

The twelfth report on this series is from Professor A. R. Crandall, of the State Agricultural School, on the Chinn's Branch Cannel Coal District. There are only two considerable areas of cannel coal near to the line of the Ohio river within the Commonwealth—this, which is the subject of Mr. Crandall's report, and that known as the Breckinridge Cannel Coal in Hancock county. Although there are large areas of this peculiar variety of coal in the region adjacent to the head waters of the Licking and Kentucky rivers, these coals along the Ohio will always have a certain advantage from their proximity to water navigation. In the large markets of the West they always have a value of at least one dollar a ton above the ordinary bituminous varieties, on account of their peculiar fitness for the production of gas and their suitability for domestic uses. These coals lie in a very favorable position for production, and invite the attention of capitalists more than almost any other of our resources. There can never be much competition with the products of these basins, for the other localities must convey their coals over routes of greater length and cost.

The last report in this volume is from Dr. Robert Peter, chemist of the Survey.

This report is introduced by some interesting general statements concerning the soils of Kentucky, of which specimens from seven hundred and seventy-two localities have been subjected to analysis. It appears from this account that there are twenty-nine counties not represented in these studies, and the work is, as a whole, rather irregularly distrib-

uted, though it represents the most important agricultural regions of the State with tolerable completeness. This brief synopsis shows us clearly how important it is to have this disconnected information brought into the compass of a single volume, and so displayed as to make its teachings have their full value.

Following this matter is a brief discussion of the chemical history of hydraulic cements. The lower lying formations of the Commonwealth abound in rocks fitted for use as hydraulic cements, and as the use of this substance is constantly increasing, a special report on the matter should soon be prepared. In this research the chemical study should take the first place. The inquiry may demand several hundred careful analyses, but its results will justify at least a year of labor by Dr. Peter and his assistant.

This report also gives the results of several analyses of marly clays from the so-called lower Silurian limestone series of rocks. These deposits sometimes show very considerable amounts of potash, and if found of sufficient thickness may prove valuable for fertilizing purposes, especially upon tobacco lands. So far the study of the marls and other fertilizers of the State has only been made in the way of reconnoissance. It was best that the institution of a plan for this inquiry should be left until the chance work of the Survey should show the general direction in which it should be turned. It now seems clear that every bed of shale in our rocks, from the lowest part of the section to the top of the Subcarboniferous, should be subjected to a searching inquiry, to show the amounts of potash, soda, and phosphates they may contain. In this way I feel sure that we shall find out some valuable resources which will aid us in preserving and increasing the fertility of our soils.

A good part of the soil analyses given in this report of Dr. Peter was made upon specimens collected during the Survey of Dr. D. D. Owen, by Mr. Joseph Lesley, jr., to whom we are indebted for much of the valuable work done during that

Survey. These samples have long awaited the time when the pressure of other work would permit their study.

A word of personal explanation is now due to the reader. The pressure of other engagements has made it necessary for me to resign my position as Director of the Survey of the Commonwealth. For some years the necessity of this action had been apparent, and was only delayed in order that I might feel sure that the succession would fall into the hands of one well qualified to continue the work to its completion. I now feel sure that all the incomplete work of the Survey will be in better charge than I could give to it. By the kindness of my successor I have been permitted to retain charge of the unpublished work done during my incumbency. Of this there yet remains the sixth volume of Reports, the second of Memoirs, one or two volumes of photographs with text, and the general index to one volume, which is to give the key to all the work reported in the first and second series of reports and in the other publications of the Survey. This index volume is nearly ready for the press, awaiting only the completion of the sixth volume of Reports and the second of Memoirs.

As this introduction leaves my hands I learn of the sudden death of Mr. W. B. Caldwell, jr., long metallurgical assistant of the Survey. I cannot forbear to note my sense of the magnitude of this loss to our people. Every circumstance seemed to lend itself to make a bright future for this young man. Excellent capabilities, well developed by a thorough training in his chosen work, a charming person, an eagerness and joy in the activities of the world which the certainty of a great inheritance seemed not to dampen, helped to make his friends hopeful that his career was to be full of happiness and honor. I looked to him for the prosecution of many researches that we had often discussed together.

N. S. SHALER.

OFFICERS OF KENTUCKY GEOLOGICAL SURVEY

DURING THE TIME OF PREPARATION OF THE REPORTS CONTAINED IN THIS VOLUME, IN THE ORDER OF THEIR APPOINTMENTS.

NATHANIEL SOUTHGATE SHALER, *Director and Principal Geologist.*
ROBERT PETER, *Principal Chemist.*
ALBERT ROGERS CRANDALL, *First Assistant in Geology.*
PHILIP NORTH MOORE, *Assistant in Geology.*
CHARLES SCHENK, *Assistant in Topography.*
CHARLES JOSEPH NORWOOD, *Assistant in Geology.*
WILLIAM BYRD PAGE, *First Assistant in Topography.*
LUCIAN CARR, *Assistant in Ethnology.*
JOHN HOLLIDAY TALBUTT, *Assistant in Chemistry.*
JOHN ROBERT PROCTER, *Assistant in Geology.*
CHARLES WICKLIFFE BECKHAM, *Assistant in Topography.*
EUGENE UNDERWOOD, JR., *Assistant in Topography.*
JOSEPH BERNARD HOEING, *Assistant in Topography.*
LAFAYETTE HOYT DEFRIESE, *Assistant in Botany.*
WILLIAM B. CALDWELL, JR., *Assistant in Mineralogy.*
WILLIAM M. LINNEY, *Assistant in Geology.*

This page in the original text is blank.

TABLE OF CONTENTS.

The reference is to the *bottom* paging in this table.

VOLUME V.

GEOLOGICAL SURVEY OF KENTUCKY.

N. S. SHALER, DIRECTOR.

DESCRIPTION OF THE TOPOGRAPHY

OF THE AREA INCLUDED WITHIN THE

RECONNOISSANCE TRIANGULATION

OF THE

UNITED STATES COAST SURVEY IN KENTUCKY

DURING THE

SEASONS OF 1875 AND 1876,

BY WILLIAM BYRD PAGE.

PART I. VOL. V. SECOND SERIES.

STEREOTYPED FOR THE SURVEY BY MAJOR, JOHNSTON & BARRETT, YEOMAN PRESS, FRANKFORT, KY.

This page in the original text is blank.

INTRODUCTORY LETTER.

OFFICE KENTUCKY GEOLOGICAL SURVEY,
FRANKFORT, KY., March 1st, 1877.

Professor N. S. SHALER, *Director Kentucky Geological Survey:*

DEAR SIR: Herewith submitted you will find a description of the topography of the area included within the reconnoissance triangulation of the United States Coast Survey in the State during the seasons of 1875 and 1876.

The subject is treated with reference to its importance in connection with the topographical work of the Geological Survey. The sketch accompanying the report was drawn by Mr. Joseph B. Hoeing, who aided in the original reconnoissance last season.

The sketch shows the result of the reconnoissance, barometric heights, the topography with reference to the stations, the proposed base lines and connections, and the principal stations on the scale of the preliminary map of the State.

Very respectfully,

WM. BYRD PAGE.

This page in the original text is blank.

DESCRIPTION OF THE TOPOGRAPHY OF THE AREA INCLUDED WITHIN THE RECONNOISSANCE TRIANGULATION OF THE UNITED STATES COAST SURVEY IN KENTUCKY DURING THE SEASONS OF 1875 AND 1876.

The reconnoissance triangulation for the United States Geodetic Survey in Kentucky, under the direction of the United States Coast Survey, has been prosecuted during the working seasons of 1875 and 1876. The general instructions in this work were to commence in the southeastern portion of the State, and to proceed in a northwest direction toward the Ohio river; to establish such primary stations as would be found suitable, and such intermediate or secondary stations as would aid in the determination and delineation of the topography; to ascertain the relative heights of stations, and to make such other observations as would assist in the work of the Geological Survey.

The sketch of the reconnoissance is not to be considered as a determined and approved scheme, but rather as the result of the preliminary work performed, from which a scheme may be selected for final triangulation.

It is from work of this character that the State must obtain an accurate basis for a final and complete topographical map. The detailed surveys of portions of the State already completed, and those now progressing under the direction of the Geological Survey, although complete and accurate within their limits, will be dependent for their proper relative positions upon the triangulation, and it is with this view the topography is carried forward.

From the above considerations the results of the reconnoissance may be of interest to the citizens of the Common-

wealth. The topographical features of the area included in this reconnoissance will be discussed with especial reference to the size and general location of the quadrilaterals and triangles of the scheme.

The area of the work is wholly within the water-shed or valley of the Ohio river. Commencing at the Cumberland Mountains near Cumberland Gap, where is the intersection of the boundary lines of the States of Kentucky, Virginia, and Tennessee, the direction of the work was toward the Ohio river, across the State at right angles to the greatest length. In the direction of that river a continued contraction in the order of triangulation was to be expected. The order, or size, of the triangulation will vary most in this direction. The schemes of the same order will probably extend northeasterly and southwesterly, the topographical features in these directions being more nearly alike.

The possibilities for extensions in other directions were ascertained as thoroughly as practicable as the reconnoissance progressed toward the Ohio river. From the eastern limit of the work, the Cumberland Mountains, the outlook to the eastward and southeastward was very distant, extending far toward the summits of the Appalachian range. When the atmosphere was sufficiently clear distant peaks, probably the Smoky or Unaka Mountains of North Carolina, were observed.

The feasibility of extension in either the northwest or southeast directions is at least equal to that in the direction pursued. To the west the outlook is certainly favorable. The sketch includes about two thirds of the distance from the State line to the Ohio river. The first quadrilateral includes about thirty miles of the Cumberland Mountains; the direction of the chain is about northeast and southwest. The range, being a folded or uplifted mountain, has a decided crest, and is without spurs of size. Five points on the range have been located, and are shown on the sketch. Cumberland Gap is the lowest point in this length of the range; its height above sea-level is one thousand six hundred and

seventy-five feet. The height of the mountain varies from one thousand to two thousand feet above the valley on the Virginia and Tennessee side. The valley of Yellow creek, on the Kentucky side, is one hundred and sixty feet lower than the valley on the Tennessee side. The heights of the several points are given on the sketch. The "White Rocks" station is the highest point included within the scheme or yet measured in the State. Powell's river, on the east side of the mountain, is parallel to it, forming an open valley of considerable width.

On the Kentucky side are numerous small streams, the head waters of the Cumberland river draining from the mountain to the northwest. Between these streams and their branches are the Brush and Log mountains, both intricate in construction, and in height equal to or greater than the Cumberland, which lies opposite them.

They limit the horizon of the Cumberland to the northwest at many points. The Brush Mountains attain a height of three thousand two hundred feet, are level for several miles, and form their junction with the Cumberland Mountain with but little drop in height. West from the "White Rocks" their height has diminished, and they do not intercept any view in that direction. The Log Mountains have many and irregular spurs extending in all directions; they extend between the Cumberland and Pine Mountains, and about double this length in a transverse direction. These mountains are limited on the east and west by Yellow creek and Clear Fork. The peaks are of various heights. The summit known as "Bryson" attains a height of three thousand two hundred feet. This point overlooks the Cumberland Mountains to the eastward, and from it the mountains of North Carolina were observed. The view to the westward is limited by a range of the same mountains, distant about five miles. For this reason this point was not found available as a primary station of the proposed scheme.

To the northward of this point, in the vicinity of Canada Mountain, the overlook into Kentucky, from the north to the west, is very extensive. These mountains as a range,

no known peak being distinguishable, were observed from Green River Knob, distant nearly seventy miles. Parallel to, and about ten miles distant from, the Cumberland range, is the Pine Mountain. Unlike the Cumberland, it is a fault mountain; it is straight and even in height. The position of one point of the range just above Pineville was determined.*

At this point is the water-gap through which the Cumberland river, draining the area above referred to, passes to the northwestern side of the range.

From this point the river makes a decided bend to the northward and westward, and thence somewhat toward the Pine Mountain again. Between the river and Pine Mountain are the Brush Creek hills, resembling in topographical features the Log Mountains. At a few of the summits these hills nearly equal the Pine Mountains in height.

To the north of the Cumberland river to "Paint Gap" Station, on the divide between the Cumberland and Kentucky, are innumerable peaks similar in shape and about equal in height. This rendered it impossible to recognize or locate intermediate points without more detailed work. The area described is included within the first quadrilateral of the proposed scheme. Its area is about seven hundred square miles, and the heights have fallen from three thousand four hundred and sixty and two thousand nine hundred and five feet on the Cumberland Mountain, to two thousand and forty and one thousand eight hundred and sixty feet at the stations "Paint Gap" and "King Knob." King Knob is the summit of a considerable area, the drainage flowing in nearly every direction to the Cumberland river. Raccoon Mountain is the next point reached; it is the summit from which flow the Laurel rivers, Rockcastle, and Raccoon creek, one of its branches. This area is drained principally by the Laurel rivers, and is nearly altogether within the drainage of the Cumberland

*A fuller account of the structure and topography of this region will be found in the third volume of these reports, 1877, and also in the Memoirs of the Survey. In the American Naturalist for July, 1877, there will be found a diagram and description which will convey a more extended idea of the geology and geography of this district.

N. S. S.

river. The line from "Paint Gap" to "Raccoon" has about the direction of the ridge dividing the Cumberland and Kentucky rivers. The features of the country have changed decidedly; the general surface has become much more level, the heights of Raccoon only appearing on the divides. Much of this area will average the height of London, Laurel county, one thousand one hundred and sixty feet, which is about three hundred and fifty feet above Rockcastle river, at Livingston. The sandstones of the coal measures are the surface rocks determining the character of this area.

The quadrilateral—King Knob, Raccoon, Brushy, Green River Knob—together with the triangle to Bear Knob, include within their area the width of the northern water-shed of the Cumberland river; the line King to Green River Knobs following the general direction of the river, and the line from Raccoon to Bear Knobs the ridge dividing the Cumberland and Kentucky rivers. Within this area are the lower portion of Laurel river, the Rockcastle and its various branches, and several lesser streams of the Cumberland. This river, at the crossing of the Cincinnati Southern Railroad, is five hundred and seventy-five feet above sea-level. The highest point within the area, with the exception of King Knob, is Green River Knob.

The outline of the coal fields are crossed in this quadrilateral, and Green River Knob, with several others in the same locality, show the characteristics of the Sub-carboniferous topography. Green River Knob is capped by the sandstones of the Chester Group.

The bases of these knobs, extending, in some cases, their entire height, are of Sub-carboniferous limestone. The slopes are gentle, and often permit of cultivation to the summit.

The higher knobs are capped with sandstone, from which, when exposed, they take the name of sand knobs.

The Green River Knob is two hundred and thirty feet above the next highest knob in the vicinity; it is on the divide between the Cumberland and Green rivers, and is six hundred and eight hundred feet above the creeks at its base on either

side. The triangle Green River Knob, Brushy, and Sand Knob includes the head waters of Green river.

Sand Knob is the summit from which flow the Salt, Green, and the branches of the Kentucky. The area extending north from that already described, as far as included in the sketch, is the water-shed of the Kentucky river.

From the stations Pine, Carter, Bald, Collier, and Bear, known as knobs, the country is cut down with steep slopes through the Carboniferous, Waverly, and Devonian formations to the Silurian. This fall or drop-off varies from two hundred and fifty feet at Pine Knob to over seven hundred feet at Bear, and affords an extensive overlook into the Silurian area to the northward. Twelve miles to the northwest of Green River Knob, the streams cut down to the Cincinnati Group. The points noted in the area north of the knobs are nearly on the same level.

The knobs have been seen from points north of the Kentucky river within ten miles of Lexington. In further progress the triangulation will naturally follow around the edge of the Blue Grass or Silurian area, extending over it from the superior points as above shown. The sketch accompanying this description shows the position of the stations, their heights, and their relation to the topography.

The topography is not from actual survey, but is simply represented to illustrate the relation between the triangulation and topographical map.

Points have been located in sixteen counties of the State.

If from any of these stations a survey in detailed topography should be made, the map could be placed in its proper position, and in this manner a complete and accurate topographical delineation would result.

This, with the additional work of latitude and longitude determinations, would furnish such a delineation of the State as would be alike useful in the location of a farm plat or a railroad line, or in the proper representation of an ore or coal outcrop, or of general geological information.