GEOLOGICAL SURVEY

ALONG THE

MACON & BIRMINGHAM RAILWAY

BY J. W. SPENCER

GEOLOGICAL MAP along the MACON & BIRMINGHAM RAILWAY

ECONOMIC

Geological Survey,

—IN—

GEORGIA AND ALABAMA,

THROUGHOUT THE BELT TRAVERSED BY THE

Macon & Birmingham Railway,

EMBRACING A SURVEY OF THE

MINERAL-RESOURCES, BUILDING-MATERIALS, TIMBERS,

WATER-POWERS, SOILS, ETC.

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ILLUSTRATIONS,

INTRODUCTION.

The following report is the result of a geological reconnaissance of the belt of country between Macon, Ga., and Birmingham, Ala.; traversed by the line of the proposed Macon and Birmingham Railway. The collected information of economic importance is given in the following pages. This survey crosses, in part, a rich agricultural country; in part, a mineral belt of wonderful wealth; and in part, a hilly country valuable chiefly for its timber. There are great belts of Iron and Coal, of Granite, Marble, Limestone, Sandstone, White-sand and Brick clays—all in unlimited quantities,—besides extensive deposits of Pyrites and Gold, etc. The Agricultural and timber resources are scarcely less varied. The Water-Powers are numerous, and already the sites of many small mills, supplying local demands partly utilize them. In many cases, these sites will form centres for towns when the country is opened up by railway communication. By glancing over the table of contents, the varied resources are seen at a glance. Attention is also called to the SUMMARY of the freight-producing resources at the end of this report. This report is not only the result of several month's labor in the field, but also of invaluable assistance rendered by my friend, Prof. E. A. Smith, State Geologist of Alabama, and by Prof. Henry McCalley and Mr. Joseph Squires, of the State Survey; by Mr. G. W. Chambers, of Talladega; by Mr. Jasper Williams of Clay County; by Mr. Brainard, chemist, of Birmingham, by Dr. William Taylor, of Talladega, and by several otherg entlemen,

1—GEOLOGICAL AND PHYSICAL FEATURES OF THE BELT EXPLORED.

In order to make intelligible the relationship of the different minerals to the various rock formations, a short outline of the elements of the structural geology will be necessary. Even the effects of the agents, which have been at work in moulding the land surfaces into mountains, plains, and valleys, obliterating valuable minerals in some places, and exposing them in others, depend directly upon the constitution of the rocks, and their arrangement, which may be called geological structure. The relative ages of the different groups of rocks examined varies from those of the highest antiquity to others of extreme youth, consequently the agents which have caused the rocks to decay have produced, in the physical features, results of great variety.

In passing along the line of survey, a glimpse of each of the great geological groups may be seen, and also of many of the systems, although the distance is only 230 miles.

The following table gives, the geological formations found along the line of survey, in descending order:

Group—Era.	System—Period.	Series—Epoch.	
Cenozoic.	Modern.		Alluvial deposits.
	Pleistocene.		Gravels and loam.
	Pliocene.		Wanting alongline
	Miocene.		" "
	Eocene.		" "
Mesozoic.	Cretaceous.	Lower (only).	Sand & white clay.
	Jurassic.		Wanting.

Group—Era.	System—Period.	Series—Epoch.	
	Triassic.		Wanting.
Palæozoic.	Permian.		Wanting.
	Carboniferous.	Coal measures.	Coal beds, shales and sandstone.
		Mill-stone Grit.	Sandstones, conglomerates, etc.
		{ Lower or Sub- } Carboniferous.	Limestones etc.
	Devonian.		Mostly wanting.
	Silurian.	Clinton. Other series wanting.	Red iron ore bed, sandstones, shales.
	Cambro—Silurian	Trenton.	Limestones. Other series not important
	Cambrian.	Calciferous or Knox.	Limestones, shales, brown iron ores.
		Potsdam.	Sandstones and sandy shales.
		Acadian or Ocoee.	Semi-metamorphic slates and conglomerates.
Archæan.	Huronian.		Hydromica schists, gneisses, iron ore.
	Laurentian.		Gneiss and hornblende gneiss and mica schists.
			Granites.

Some of the geological systems are wanting in whole or in part, whilst others are represented by great thicknesses of rocks. The mineral wealth of the country is however more widely divided amongst the different systems than might at first sight be supposed.

THE ARCHÆAN GROUP

The word Archæan, meaning "ancient" is the name given to the oldest known rocks. It is from these rocks decayed that many of the soils along the country traversed have been formed. Some of the rocks have been molten, as the granites, others have been deposited in the state of muds in very ancient seas, hardened into rocks, and subsequently 'metamorphosed' or turned into masses with a crystalline texture. This metamorphism passes through all stages from that of a highly crystalline texture to a structure almost without crystalline appearance. Except along the western margin of the crystalline belt, all such rocks belong to the Archæan group, which extend from near Macon to the western margin of Clay County Alabama.

The lowest rocks of the Archæan group, which I have seen along the line of survey, are represented by several belts of granites, or granitoid gneisses. The difference between the granite and the gneiss is that the latter has an internal bedded structure, whilst the granite has not, or only a slight foliation, in which case it becomes a granitoid gneiss. Both rocks are made up of quartz, feldspar (composed of the elements of clay and of potash), and mica (composed of the elements of clay with iron and potash or magnesia). In many cases the mica of the granite or gneiss is wholy or in part replaced by hornblende (composed of silica, magnesia, lime and iron with alumina), in which case the rock is called hornblendic granite, and is usually of a somewhat dark color, and when decayed becomes red.

The belts of granite crossed have the form of rounded knobs or hummocks, or chains of hummocks, rising through disturbed beds of gneisses, which are deeply decayed. Many of these knobs are of value in that they form good building stones, which is not the case with the overlying gneisses, as these last are too rotten for use. There are

several belts of granite in Georgia, but the most western is just beyond the Tallapoosa River, near Louina. Under the head Granites for building purposes, the localities will be designated. It is sufficient here to say that these granite knobs probably constitute the lower part of the Laurentain system.

Overlying the rocky backbones of the continent, which are only here and there exposed in the granites, there are other rocks which are of a highly crystalline texture. These consists mainly of gneisses and mica schists. This last rock differs from the gneiss in that the mica largely predominates, producing a foliated irregular texture with the omission of the feldspar, which gives the former rock a distinctive character. Many of the gneisses are hornblendic and thus in weathering give red soils. The beds of these rocks generally dip to the south-east, at angles occasionally quite low to the horizon, but in some places they are found resting upon their edges in vertical positions. Again, they are often folded, bent, and even overthrown, showing the tremendeous strains and pressures they have been subjected to. These are the rocks which everywhere overlie the granite masses which here and there peep up through them. The rocks are everywhere deeply decayed and from them the surface soils are derived.

Occasional masses of iron are found, and gold has been reported; the soil often contains iron-sand derived from their decay, still these rocks are of little mineral value. Geologically, they may be considered as the representative of an upper part of the Laurentain system.

The physical features into which these last rocks weather is a succession of low hills and valleys, all with a very much rounded outline, and no bold points. Where the rocks are hornblendic, the decay seems to have gone deeper, and there we find that the streams are liable to cut the land into

deep gulleys. In this country there are many valuable shoals and water-powers.

Beyond the formation just described, as in Clay County, the character of the rocks changes. There,the rocks are of much less crystalline texture, and consists of dull fissile layers or slates which belong to what are called hydromica and chlorite schists. Whether elevated or low, these rocks form a flatter surface than the Laurentian rocks. But rising above these slates, there are numerous narrow ridges, having sometimes a height of 300 or 350 feet. Whilst some of them are composed of hydromica or other schists, other ridges are made up of graphitic gneisses—that is gneisses in which the mica is replaced by graphite or plumbago, in the form of scales. The ridges may also contain iron ores, copper, pyrites or sulphide of iron, and workable deposites of gold. The slates are sometimes fine enough to be worked for domestic purposes.

The rocks dip at angles from almost horizontal to angles approaching the vertical, The direction of the dip varies from north of east to nearly south. The physical features are boulder than in the Laurentian country. The narrow ridges often extend many miles, in a north-east and south-west direction broken only here and there by an occasional stream. Their surfaces are decayed, and are often covered with the iron ore or with quartz blocks,derived from the veins of these materials, upon the decay of the rock masses themselves. Some of these ridges belong to the Huronian system.

In passing over the various rocks of the Archæan group, the general altitude of the country rises from about 500 feet on the hills about Macon, to from 800 to 1,000 feet above the sea, throughout a considerable portion of the belt. However, there are ridges considerable higher, whilst the altitude diminishes to somewhat below 600 feet in crossing the Chattahoochee and Tallapoosa Rivers, the most important

waters flowing through the belt.

THE CAMBRIAN SYSTEM.

In this geological system there are included three great series of rock formations—in descending order; Calciferous or Knox, Potsdam, and Acadian or Ocoee.

THE ACADIAN OR OCOEE SERIES.

On approaching the eastern side of Talladega County, along the line of the survey, the highest hills in this part of Alabama are encountered. These hills form the Blue Mountains, rising 600 or 700 feet above the country and 1,600 feet above the sea. It is through Porter's Gap (Sec. 4; T. 30; R. VI E.), in this ridge, which trends northeastward that the survey is made, crossing it at a little over nine hundred feet above the sea. This ridge forms the southeast portion of a belt of country of six or seven miles in width, consisting of hydromica schists, in the main, together with a conglomerate made up of pebbles of quartz cemented together. This belt extends to the south-eastern side of the valley of Talladega, and the rocks are well exposed along Talladega creek, which emerges into the valley at Craigdale or Taylor's Mills. The slates are often of a dull appearance, but again, where moderately exposed to the weather, they have a shining, greenish or greyish lustre, with a greasy feel. The beds of this series dip towards the southeast, at angles from of 20° to 30° in the region of Porter's Gap, but at only from 7° to 10° at Craigdale, consequently these newer semi-metamoaphic rocks appear to pass under the older Hnronian series to the southeastward. This inverted order is appearant and not real, for in the movement which made the mountains there were some overthrows and gigantic slippings of the earth's crust which overturned some of the older strata and brought together rocks of very different ages. The group of rocks just described has been classed by Prof. E. A. Smith, State Geologist of Ala-

bama, as being the Alabama eqnivalent of the Ocoee (and possibly of the Acadian) series of Geology, although in a semi-metamorphic condition. The ridges composed of these slates are usually covered with scanty soil, as they do not decompose into deep earth. In the region of the conglomerate beds, the surfaces are covered with quartz fragments or blocks.

Whilst these slates usually break with an uneven surface, upon their north-western flank there are several layers which break with a smooth surface into thin plates, fit for roofing and other purposes. Upon the north-western edge of this bed of Acadian rocks there is also a very large development of white and blue marbles. These underlie hydromica slates; but they were probably brought beneath older rocks by a geological overthrow, (see beyond). A portion of this zone of hydromica slates is traversed with quartz veins, which are gold bearing, as well as some of the adjacent slate rock. Upon the southeastern flank of the Blue Ridge, facing the Huronian country, there is a heavy bed of brown iron ore. This bed, trending from the northeast to the southwest, passes close to Porter's Gap. As already indicated the belt of rocks belonging to the Acadian series is one of considerable mineral wealth. Each mineral will be considered in its proper place.

POTSDAM SERIES.

This is the next great series in the geological scale, but the rocks belonging to it do not appear in contact with those of the Acadian group on the southeastern side of the valley of Talladega, but occur upon the northwestern side of the valley, six or seven miles distant. They form a chain of mountains, rising to about 1,000 feet above the valley or 1,600 feet above the sea. Through this interrupted chain, at Renfroe Gap, the railway survey passes. The backbone of this narrow ridge is made up of sandstone, dipping at high an-

gles to the southeast. It is flanked by the formatians of the next, or Knox series, which underlie the more level country on both sides. Upon the flanks of the hills on both sides of the chain there are deposits of brown iron ore.

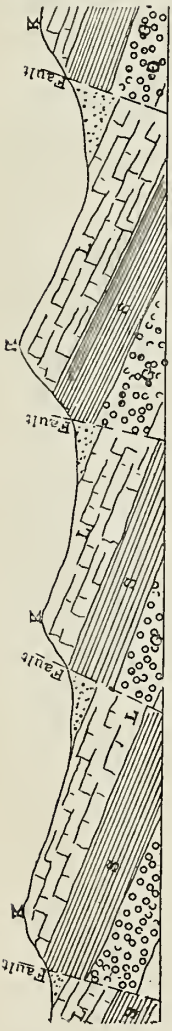
THE KNOX OR CALCIFEROUS SERIES.

Geologically, this series is divided into three formations, in ascending order; sandstones, shales and dolomites. From the mineral stand point, this is one of the most important formations crossed by the survey, as it contains the wonderfully rich and commonly pure brown iron ores. These rocks are named the Knox series in Tennessee, which locality is a part of the great series of geology, known as the Calciferous, whose position is somewhat that of passage beds between the Cambrian and Silurian systems.

Along the line of survey the sandstones form no important feature. The shales constitute the floor on the northwestern side of the Talladega valley. But the dolomite formation, with its surface decomposed, forms the floor of a great part of the valley, and also the surface of the hilly country, extending to the Carboniferous ridges half a dozen miles beyond the Coosa River. Indeed, owing to some remarkable faultings, the survey crosses another strip of the Calciferous series, between the Coosa and the Cahaba coal fields, in the valley of the Little Cahaba River, at Leeds.

The Knox dolomite formation is composed commonly of bluish compact magnesian limestone with some shales. Certain portions of this limestone is filled with great quantities of irregular nodules of chert or flint. This chert was originally in the form of sand or silica, enclosed in the limestone mud, long ago, before it was hardened into rock. Limestones usually contain as impurities a little clay and sand other than that in the form of concretions or nodules. In addition, some of the beds of the limestones of the Knox series, in Alabama, and elsewhere, were richly charged with

iron ores. During the long ages that the rocks of the Knox series have been exposed to the weather, the action of the atmosphere, the rains, and the rivers have washed out much of the lime, leaving irregular beds of brown iron ore—now of great value—an earthy soil derived from the sand and clay impurities with more or less iron, and great sheets of chert nodules, loosely deposited on some of the hills, as these stones are scarcely affected by the weather. This weathering may extend to a depth of sixty or eighty feet o more. Thus we see what is now a great deposit of loose, earthy soil, was once a more or less impure limestone.



SECTION ACROSS THE COUNTRY SHOWING THE REPETITION OF RIDGES OF THE KNOX(K) DOLOMITE, OWING TO THE FAULTING.

The country underlaid by this series of rocks is characterized by a succession of ridges, usually less than 200 feet high, with intervening valleys.

Whilst the valleys are fertile, the ridges are often densely covered with the loose chert, and are only cultivated to a limited extent. Still the chert is usually superficial, although it may form a dense cap. The beds of this series all dip to the southeast, to the extent of sometimes 20° or more, and as the belt of country is wide, the thickness of the formation might be supposed to be very great, but the whole region is faulted, thus the same beds are repeated to form a series of parallel ridges, like the teeth of a saw, separated by

valleys, as in the accompanying diagram.

One of these faults, at Henryellen Coal mines, brings the Knox dolomite and Coal Measures sharpely side by side. and represents a direct slipping of the earth's crust of 9,000 feet. The faults are of great importance in geological examinations. Whilst they may bring to view valuable beds, yet they so dislocate seams or veins as to often render their following difficult or impossible.

The Knox limestones are valuable for building purposes and for lime. There are also some seams of Barite or Heavy Spar south of Leeds.

THE CAMBRO-SILURIAN SYSTEM.

TRENTON SERIES.

Whilst the Cambro-Silurian system is represented elsewhere by a great developement of rocks, which have been grouped in different series, only the Trenton is represented along the survey. This is a limestone, containing fossil shells etc., which has been brought to view, at the base of Red Mountain, six miles east of Birmingham. Here is found a thickness of 700 feet or more of limestone of a high degree of purity, from which a large part of the limestone used in the iron furnaces of the district is supplied. As surface deposits, these limestone form only a narrow belt, being generally covered by rocks of the succeeding system. They would not have been brought to the surface, and made available for use, had it not been for faulting and folding of the earth's crust, in this region.

SILURIAN SYSTEM.

CLINTON SERIES

Like the preceding system, the Silurian rock are represented by only a few score of feet, these belonging to the Clinton series. But this thin layer contains the hematite

or red fossil ore, of Red Mountain. The Clinton series is composed of alternate beds of shales and sandstone, some of which are highly ferruginous. Amongst these rocks there are several beds of the so called "fossil ore." This consists of beds of what were once limestones made of masses of broken shells. This stone was more or less porous, and from it the lime has been dissolved away, to a greater or less extent, and its place taken by iron. Its characteristics will be described under the head of Iron Ores. But it may here be said that this ridge is the greatest source of mineral wealth of the South. The deposit extends not merely across a portion of Alabama, but into Tennessee and thence northward, even to Canada, and is perhaps the most constant of any one geological belt in eastern America. However, it is not everywhere sufficiently rich in iron to be profitably worked for the metal. Indeed, the cheapness of the iron derived from this "fossil ore" depends largely upon its proximity to coal and limestone. Owing to folding, faulting and breaking of the earth's crust, this thin deposit of the Clinton series is brought to view, resting somewhat upon its edge, in several belts, in Alabama, but only the principal one, at Red Gap, approaching the Railway line.

In the Clinton series, beneath the ore beds, there are very fine red sandstones, from which beautiful building stones can be obtained.

DEVONIAN SYSTEM.

Whilst a portion of the Birmingham valley is excavated out of a thin deposit of shales belonging to the Devonian system, yet these rocks are of no importance from the economic standpoint.

CARBONIFEROUS SYSTEM.

From a point about six miles west of the Coosa River,

the line of the Macon and Birmingham Railway crosses a belt of twenty miles or more belonging to the Carboniferous system (including the break in it along the Little Cahaba River, occupied by the Knox dolomite). The system is divided into two great series—the Lower or Sub-Carboniferous and the Coal Measures.

The physical features along the line of the Macon and Birmingham Railway are nowhere so rough as through the country composed of the rocks of the Carboniferous system, especially upon the western sides of the Coosa and Cahaba coal basins. The highest of these ridges rise to 300 or 400 feet above the valleys. This ruggedness is readily understood, for the rocks are all dipping to the southeast, at angles from a few to from 12° to 20° or more, and along the western margin of the Coosa coal basin, just east of Leeds, the dip is over 30°. Here the rocks capping the ridges are very durable sandstones or conglomerates of the Mill Stone Grit. These rocks, either in the form of sheets, or as great massive blocks, defend the ridges from the reducing action of the weather.

LOWER OR SUB-CARBONIFEROUS SERIES.

This series is characterized by a great accumulation of limestones. But besides these rocks there are also beds of sandstone and shale, and in some regions, unimportant beds of coal. In Alabama, there is a great development of rocks belonging to the Lower Carboniferous series; reaching to a thickness of 2,400 feet, according to the measurements of Mr. Joseph Squires, or the Geological Survey.

Owing to some of the beds of limestone containing chert, the effect of the weathering upon ridges composed of such rocks, is to leave an earthy soil covered with a thick layer of unconsolidated cherty gravel. The Lower Carboniferous formation does not form a broad surface feature, as it is

exposed in the form of narrow zones around the margins of the Coal Measures. It is most extensively developed along the northwestern margins of the Coosa (just east of Leeds) and Cahaba (east of Red Mountain) coal fields. East of Red Mountain there is an extensive ridge of white sandstone, some of which is friable, and easily crushed into the finest sand for glass-making or other purposes. Just beyond this ridge, but on the southeastern flank of Red Mountain, there is a very extensive deposit of chert, the residue from the decay of cherty limestones of the Lower Carboniferous system. This is in the form of rough, hard gravel, which is extensively used to macadamize the streets of Birmingham. In some places. the limestones are sufficiently uncovered te be quarried, but not along the line of the survey. Besides the enumerated economic uses of the Lower Carboniferous rocks, there are extensive beds of brown iron ore, be-neath some of the cherty deposits.

UPPER CARBONIFEROUS SERIES.

The lower portion of this formation is composed of sand stones and conglomerates, the latter being made up of small pebbles and grains of quartz cemented into a very hard rock. Along with these rocks, there are beds of shale, and near the top, some thin seams of coal. This lower portion of the Coal Measures series is known as the Millstone Grit. In Alabama it has been found to be 1,700 feet thick. The best exposure of these rocks is on Oak Mountain (just east of Leeds) along the western margin of the Coosa coal basin. The beds dip to the southeast from 30° to 35°. Some of the beds of the sandstone are thin and break into the finest paving stones. and slabs for hearths and furnaces.

COAL MEASURES PROPER.

In Alabama there are three coal basins—the Coosa, the Cahaba (both crossed by the Railway survey) and the War-

rior (beginning just beyond Birmingham, where the Railway terminates). The rocks of the Coal Measures, crossed, are shales and sandstones, together with the occasional seams of coal. The total thickness of the Cahaba Coal basin, above the Millstone Grit, has been measured by Mr. Joseph Squires and found to be 3,800 feet. Through this mass of rock, distributed at irregular intervals, there are over thirty coal seams, above one foot in thickness (or about forty, including those in the Millstone Grit (Squires) with an aggregate thickness of 92 feet of coal.) But of all these beds of coal, along the line where the survey crosses the Cahaba Coal fields, from Henryellen for five or six miles westward, there are only eight or ten seams having a thickness of two feet or more—the maximum being eleven feet. The more eastern of the workable beds of coal dip at about 25° to southeast, but in crossing westward the rocks flatten out, favoring the mining of the coal. Some of the Cahaba coal is amongst the best in the South. The coal mining will be described later.

Returning eastward a few miles to the Coosa coal fields, which have a direct width of seven or eight miles in the regions of the survey, there are no beds seen along the line of the Railway thicker than two feet four inches, although farther north there is one four feet thick. Besides the smaller amount of coal in this field, than in the Cahaba, the beds are more interrupted and broken by the rocks being faulted. Whilst the Railway will carry coal and other freight from beyond Birmingham, yet it is not the province of this report to give an account of the general geology, beyond the limits of the road itself, but attention will be given to the whole coal question in its proper place.

The periods of the great geological changes, which have most laagely brought to view the mineral wealth along the line of the Macon and Birmingham Railway were, first, at the

close of the Archæan era, and subsequently after the muds and coal deposits of the Carboniferous system were laid down, beneath the seas of the Palæozoic era. At the close of this last era the earth's crust was folded, twisted, overturned, bringing to view the mineral wealth, in the form of coal, iron, etc. For all, or most, of the time that has elapsed since the general upheaval of the land above the sea, the rocks have been subjected to the reducing action of the weather, and streams, which have worn away a great portion of the original hills, and carried the mud into the seas, left the rocks decayed often to great depths, obscuring the underlying beds, and rendering the study of the geology more difficult, but at the same time leaving few places without some surface soil that can be cultivated.

MESOZOIC GROUP.

Of this group only a small belt of the Lower Cretaceous clays and sands are seen adjacent to Macon and westward, between decayed Archæan rocks and overlying drift deposits. Some of the sands could be used for building purposes, and the clay for bricks or coarse pottery.

CENOZOIC GROUP.

Of this group, only the Pleistocene or Southern Drift, and the modern river alluvium are represented. The Pleistocene series is represented on the hills about Macon and for a few miles westward, by occasional beds of rounded water worn gravel, varying from perhaps one to ten feet in thickness. This is commonly overlaid by a reddish or other colored sandy loam of only a few feet in thickness. Sometimes the gravel is wanting, and then the loam rests upon the underlying Archæan or Cretaceous rocks. These deposits are also met with on the hills high above the Chattahoochee, Tallapoosa, Talladega and Coosa Rivers, This Southern drift has not been seen at altitudes more than 700

feet above the sea. When not too deeply covered with loam, these gravels are of value for road making and ballast purposes.

Alluvial clays occur along some of the rivers, occupying the position of first or second bottoms. In many cases these clays are suitable for brick-making.

II—MINERAL RESOURCES.

A—IRON ORES.

OCCURRENCE. QUANTITY. QUALITY.

The recent great development of the mineral wealth of Alabama, Tennesse and Georgia has been primarily due to the great deposits of iron; but these would not have been available had not there been sufficient good coal in proximity, wherewith to turn the ores into the metal. As the Macon and Birmingham Railway will be the shortest road to the sea, and as it will pass through the iron and coal belts or touch them, it will not only assist in opening these resources still further, but will make more accessible to the markets the products of most of the furnaces in Alabama. At the same time, the iron products must of necessity supply to the Railway an enormous revenue arising from the heavy transportation.

IRON ORES.

The ordinary ores of iron are:—magnetite, hematite, limonite, and siderite, in one or other of the various forms. Pyrites is used as a source of sulphur and not as one of iron.

Magnetite—This mineral is usually compact or coarse crystalline, hard, and of black color. The powder, when pure. is also black. It it attracted by a magnet, or affects the needle of a compass. When pure it contains 72.4 per cent. of iron. This is the richest ore of iron, but it often contains too much of one or other impurity to permit of its use. It is only found in the metamorphic rocks, and consequently need not be looked for westward of the Blue Mountains of Alabama. Adjacent to the survey, there are several places in Clay and neighboring counties, where magnetite is found. In small quantities, it is found on the property of Mr. Monroe, near Hillabee post office. On Mr. Knowles' farm (sec. 15, T. 20, R. VII E.) there is a bed of magnetite

but it is too rich in silica to be of use. Magnetite in the Birmingham district would be of particular value for puddling processes, in the manufacture of bar iron, but abundance of the silica in the ore would prevent its use. Southwest of Hillabee, there are several ranges of hills which contain so much magnetite that it interferes with the compass needle in making surveys. By the use of the needle, many of the valuable mines of New Jersey and Pennsylvania have been discovered, and so some of these Clay County deposits of magnetite may be found to be of value. On Mr. Cox's farm (Sec. 16, T. 20, R. VII E.) there is a thick bed of ore, consisting of hematite, with some limonite, and seams of magnetite. This remarkable mixture, where opened up, shows a series of beds six or eight feet thick overlying graphitic gneisses. Only a small proportion is magnetic, but the average of the whole is rich in silica, as shown by a partial analysis made by Prof. C. M. Strahn, for the survey. Metalic Iron 44.94 per cent: Silica,31.60 per cent: Phosphorous, 0. 1953 per cent.

There are other various localities where magnetite has been found-

Hematite.—When crystalized, hematite is of a black color, and often shining. I have seen scales of such ore in Alabama, but it is not in this form that it occurs so abundantly. When pure it contains 70 per cent. of iron. The common form, in which the great beds of hematite occur, is that of an earthy-looking bright red rock. This is the "red ore." The structure is generally that of a mass of broken shells cemented together. In reality, the red ore was once a mass of limestone made up of broken shells, and more or less porous. Waters percolating this porous rock have dissolved away the limestone and deposited the iron in its place. As will be seen by analysis all of this red ore, in

Alabama, contains a large quantity of silica. Nearer the surface, it is somewhat porous, and contains but little lime. However, in descending into the beds beneath atmospheric action, the ore becomes more compact and rich in limestone. Such is the general character of the ore which makes the wealth of the Birmingham district, that will be described in detail.

Limonite or Brown Hematite—When pure, limonite occurs in nodular or stalactitic masses, with internally a fiberous structure. Its color may be black, brown, or ochre yellow. In composition, it differs from hematite in that it contains water. Pure limonite contains sixty per cent of metallic iron. By exposure to the air, limonite looses part or all of its water and becomes red or black, passing into the condition of hematite, and yielding a larger per centage of iron. This purer condition of limonite is the exception, for it is more commonly found commingled with clay, through which it is scattered, sometimes in large masses, but more frequently as small particles or lumps. The brown ores are by far the most widely diffused iron deposits of Alabama. Some of the brown ores are of great purity, being of higher quality than the red ores; but the extent of the deposits are somewhat more uncertain. The brown ores sometimes occur in beds, but oftener still in somewhat irregular pockets.

Siderite is the carbonate of iron. Although the limonite and red hematite were originally in the condition of siderite, and certain thin seams associated with the coal, in the form of "clay iron stone" and "black band ore," are siderite, yet along the line of the survey, this mineral does not form a source of ore for iron manufacture.

THE RED HEMATITE OF THE BIRMINGHAM DISTRICT.

Birmingham owes its existence to the belt of red hematite, which passes near it. This has been described in a gen-

eral way under the geology of the Clinton series. Let us now examine the iron from an economic standpoint. In this district, the workable ore is confined to Red Mountain. This ridge trends from about forty miles southwest of Birmingham northeastward, passing that city about six miles to the east, at Gate City. Thence, the iron bearing mountains extends for about twenty-five miles farther, when it swings around the northern end of the Cahaba coal field, in the region of Springville. This may be considered as the extent of the Birmingham district. In the vicinity of Springville, all the rocks are broken and involved in folds, faults, and anticlinals, which bring up the ore beds, in several ridges. The natural outlet of the ore southwest of Birmingham, or of the iron derived therefrom, is to, or by way of, Birmingham. The furnaces of the district could also economically draw ore supplies from beyond the more northernly twenty-five miles. Of this long belt, the Macon and Birmingham Railway is the shortest outlet for the iron carried to eastern Georgia, and to the whole North, by way of the sea. So much can be said for the distribution and length of the ore deposits. The width of the available ore is more limited. The ore beds rise from beneath the ridge and valley to the east of Red Mountain, and generally come to an outcrop upon its surface. This varies from 200 to 300 feet above the drainage levels. The slope or rise of the ore beds at the Sloss mines, near Red Gap is from 12° to 15°, but elsewhere, the slope is less in some places, but in others it is much steeper. At the present time, the workable beds consist of those deposits in the mountain above the natural drainage of the valley. Mines requiring artificial drainage could not compete with those upon the mountain side, where not even hoisting is necessary. Thus the width of the available ore varies from 1,000 to 1,500 feet. In some localities, there are as many as six or seven different ore beds, whilst again they are reduced to three, or, sometimes, to only one

workable bed, for several may be united. As to thickness, even the same bed may vary greatly. At Red Gap, through which the Railway is to pass, there are three workable beds, the lowest averaging four; the next, thirty; and the upper two and a half feet; all of which are locally much thicker. Where this condition obtains, the lowest is that commonly worked. A few miles south of Birmingham, where the iron ore forms the surface rock, it is worked to a depth of even forty feet, in an open quarry. At the present time, many of the Companies work only the softer and richer deposits, yet the time is coming when all the beds will more or less be used. By the softer ores is meant the beds from which the limestone has been washed out, thus leaving it porous and containing a large per centage of the metal. As this condition extends only to moderate depth, the supply of the soft ores is limited. Indeed, the harder ores are now being largely worked.

Whilst in some cases the ore forms the surface of the mountain, yet it is commonly covered with shales or sandstones, although to only a moderate depth. Numerous transverse ravines cross the ore beds, and often cut through them. This is an advantage, as it renders the mining easier.

From what has been written it will be readily seen that the volume of red ore in the Birmingham district is enormous, not considering that which is below the base of the mountain.

As to quality, the ore is variable. That nearer the surface is more likely to be richer in iron and silica than than at a greater depth, which is richer in limestone, often to such a degree as to be self-fluxing. But everywhere the per centage of silica is large, thus requiring larger quantities of limestone for fluxing, and consequently a great expenditure for fuel. The character of the ore is better seen from

the analyses. Of the three beds belonging to Messrs. Sloss at Gate City, above referred to, the following are the avererage analyses, furnished by Mr. Fred Sloss, jr.

	I.	II	III
Metalic Iron	48 per cent	40 per cent	55 per cent.
Alumina	3 "	3 "	3 "
Silica	28 "	42 "	15 "
Phosphorous	0.30 "	0.20 "	0.35 "

No I is analysis of lowest beds. Number II is that of the thick but poorer bed. Number III is the analysis of thinner upper bed, which on descending below atmospheric action decreases in iron and silica with a corresponding increase in lime. Of this, Mr. Sloss gives the following analysis from samples below atmospheric action.

Metalic Iron	45 per cent.
Carbonate of Lime	30 per cent.
Silica	6 per cent.
Phosphorous	0.20 per cent.

About six miles south of Birmingham, the Eureka mines and furnaces are situated at Oxmore. Mr. Mack, the general manager, furnished me with the analyses of the ores there obtained. The beds worked are from twenty to twenty-eight feet thick—the upper portion not being covered with superficial rock. The upper portions of the beds, which consist of soft ore, contain from 49 to 52 per cent of metallic iron; 18 to 23 per cent of silica; 0.34 to 0.40 per cent of phosphorous. In the lower portion of the same beds, still near the surface of the mountain, where the ore is not exposed to atmospheric influences to a great extent, the iron further decreases to from 30 to 40 per cent. the silica is also decreased to from 12 to 18 per cent.: the phosphorous decreases with the iron.

The average per centage of the ores which go into the Birmingham furnaces does not exceed 40 per cent; and

much of the ore used falls below 35 per cent, and even some ore with as low as 25 per cent of iron is found profitable. In the soft ores, the average amount of iron is 50, and of silica 25 per cent, whilst in the hard ore the silica is reduced to 16 per cent. (This information was received from Mr. Alfred F. Brainard, Analytical Chemist of that city.)

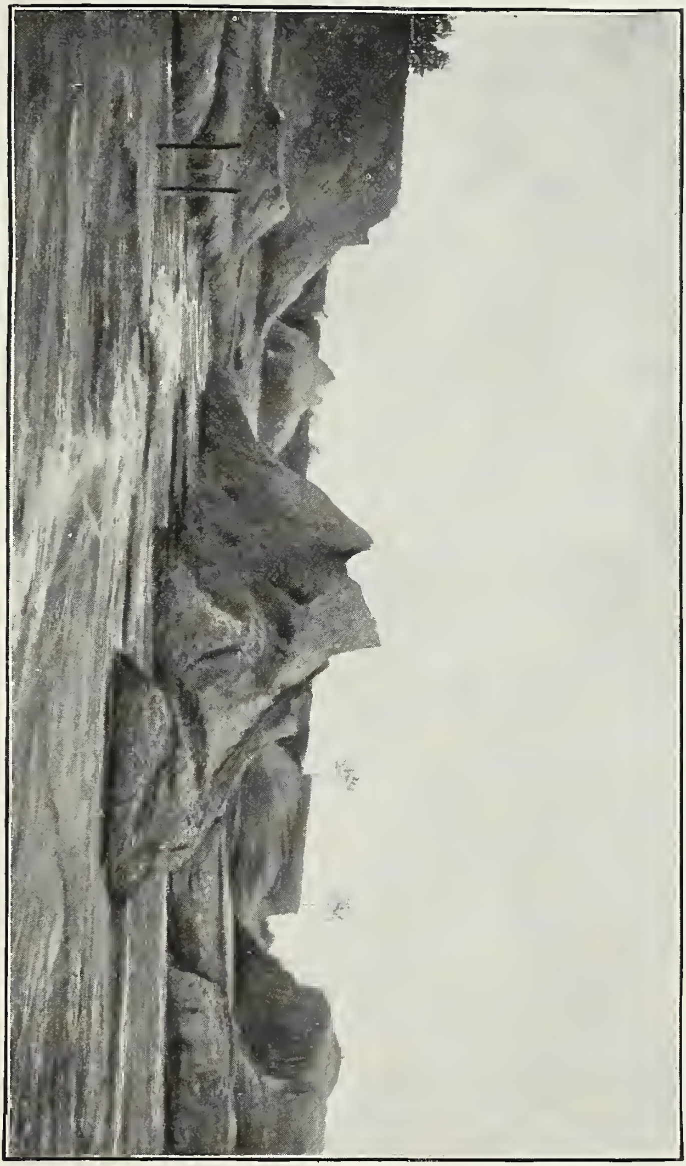
As to the value of the ore and the cost of mining, they will be considered later. Whilst some of the furnaces use red ore alone, most of them prefer to put in the furnaces an admixture of brown ores or limonite. These last are obtained from several regions southward, and also northeastward of Birmingham, but they are more costly. The brown ores are low in silica, often very low in phosphorus, but they are usually somewhat richer in iron than the red ores. Mr. Brainard informs me that the annual yield of those furnaces where the ores are mixed is larger than where only the red ore is used. This question will be referred to again, but it is here mentioned merely to show that there is a great demand for brown ores, which the immediate district does not furnish, but which the route of the Macon and Birmingham Railway crosses, thus at once opening a large traffic for ores to Birmingham, and increasing the importance of that city as a centre for iron production.

BROWN ORES IN THE TALLADEGA VALLEY AND ITS EXTENSIONS.

Subordinate only to the Red Mountain ores are the brown ores, or limonite of the Talladega valley and its extensions. The general valley is only about six miles wide, but this is broken up into a number of subordinate valleys. It trends from the southwest, (near the lower end of which are the Shelby Iron Works) northeastwards towards Tennessee, and the valley of Anniston is only part of the same general depression. As seen under the geological sketch, the brown ores of the valley belong to the Knox series of rock forma-

tions. The ores are derived from beds of limestone, containing layers of the iron ore, deposited, however, in more or less irregular forms or in pockets. During the long continued decay of the rocks, the limestone has been washed out leaving the iron ores associated with clay, beneath a cover of red clay and chert (which has often to a depth of fifteen feet),also the remains of the original impure limestone. The atmospheric erosion has also washed the ridges into more or less irregular hills. It is in these ridges or hills, rising to sometimes a hundred feet above the floor of the valley, or in the foot hills of the margin that the ore is found. Generally speaking, the full depth of the ore beds has not been worked, only a little surface digging having been carried on, adjacent to the line of our survey. However, at Anniston, some twenty-five miles northward, the great pits are fifty or sixty feet deep, and of huge dimensions. One of these mines is shown on the plate opposite this page.

The masses left standing in the picture are in part, pockets of ore, either too poor to work, or of a white clay, pure enough for common, if not for fine porcelain, ware. After passing through the surface loam or clay, which may be only a foot or two thick, or ten or fifteen, dirty yellowish clay containing apparently, to the superficial observer, occasional nodules of brown ore, and here and there large masses, is met with. This unpretentious looking mass is the ore bed, and the first impressions are not always promising. But throughout this clay there are large quantities of small lumps, and occasional large pockets of very fine ore. This iron bearing ore is dug up and passed through screens, (the smallest being of three-fourths of an inch mesh,) thus from a quarter to more than a half of the whole mass sometimes proves to be ore. At Talladega, a man is able to handle from four to five tons a day. The ore, in the form of the earthy looking lumps, will average over fifty per cent of metallic



iron. Sometimes the pockets of the limonite are of considerable size. It is seldom that blasting is required. This method of mining is usually done by contract. Some of the mining companies work the deposits, as at Anniston, Ironaton, etc. In this case, they take most of the earth as it occurs, picking out by hand the large nodules or masses of the ore, and convey the remainder directly in carts to screw washers. This effects great saving, for the fine ore is not lost. This last is usually the purest ore. By washing the quantity of the ore is not only increased, but also there are a few per cent more of iron in the ore thus treated. At the present time, there is a large quantity of the sifted ores carried fifty miles up the valley. Also, similar brown ores are brought long distances from Georgia to Anniston. The furnaces, at Janiper, carry all their supplies from a considerable distance. The deposits in the Talladega valley are widely spread, but owing to the long circuitous routes to Birmingham, and those over two railroads, the ores have not yet extensively found their way there, which will be the case when the Macon and Birmingham Railway is completed. Up to the present time, the ores have been shipped to Anniston, Janiper or Ironaton, to be used in making charcoal iron for car-wheels. Recently, however a furnace has been erected at Talladega, and this will be followed by others.

A considerable list of properties upon which the ore occurs, adjacent to the survey line, could be given, but those visited form only a small number of those reported, as probably containing ores.

Some of these properties have been accumulated, whilst others in smaller tracts are still in the hands of the farmers. Amongst those accumulated, there are some four thousand acres belonging to Mr. George W. Chambers of Talladega. This gentleman originated the present furnace company at Talladega, and acquired for it some two thousand acres of

ore land. These lands were acquired to supply two furnaces. Several of the properties of the remaining four thousand acres (a considerable portion of which has been obtained since the present furnace company was organized), I have seen, and here alone there is room for probably four more furnaces. Indeed, I doubt not that Talladega and the environs is the natural centre of at least eight or ten furnaces. These lands have been obtained in lots of from forty to a few hundred acres, and whilst there are no such otherlarge holdings, yet, there is probably much more land just as rich in iron as that already taken up, and it is now generally held at from $15 to $20 an acre for that which has been explored. Some is held at $50 an acre. The smaller properties are for sale, whilst the larger, as that of Mr. Chambers is held for investment in companies building furnaces. After the successful efforts of Mr, Chambers in opening up the iron industry at Talladega, I cheerfully refer to him any parties interested in investing in the iron industries. He has also a property on which there is a lake suitable for the location of furnaces, which he offers to companies building furnaces at Talladega. He has also good brick yards near the lake.

To obtain a knowledge of the independent properties, Dr. William Taylor is referred to, however he is not interested in the ores, other than a general wish for the development of the valley. Yet, Dr. Taylor's mills, four miles from Talladega, would also be a good locality for a furnace or factory, and the ore would not have to be carried any farther than to Talladega. After the general development of the Birmingham region, the environments of Talladega offers the most favorable opportunities for new enterprises. Even for shipment to Birmingham, the poorer qualities of the ore would be sought after with direct railway communication, such as the M. & B. Ry will afford.

The following is a complete analysis of one of the inferior ores, which is however superior to the Red Mountain ores.

Silica	2.80
Peroxide of iron	81.47
Oxide of Manganese	0.52
Alumina	1.92
Lime	trace.
Phosphoric Acid	0.43
Sulphuric Acid	0.07
Carbonic Acid	None
Combined water	0.80
Moisture	0.69
	88.70

Metalic Iron 57.037

This sample was analysed by Mr. Riley of London. It was evidently a surface specimen, as there is usually a larger per centage of water and a smaller per cent. of iron in the ores.

A better idea of the ores actually used, will be seen from the following analyses for the Talladega Iron and Steel Company, furnished by Mr. J. Lancaster, the superintendent, copied by myself from the records of many samples, as being typical.

	I	II	III	IV	V	VI	VII
Iron	53.93	52.31	51.53	47.04	49.28	50.40	51.52
Silica	4.00	4.30	8.70	11.64	11.90	8.40	7.70
Phosphorus	0.076	0.04	0.041	0.043	0.322	0.688	1.089

All of these are screened ores, none of them are washed.

No. I is the analysis of the ore from Mr. Weisinger's farm, about two miles from the furnace, to which there is

tramway; No. II is from the ore bed at Carlton station, about six miles from Talladega furnace, on the Anniston and Atlantic Railway—it is at present the largest opening that the new furnace has made; No. III is from the Renfroe mine, beyond the mountain, southwest of Talladega; No. IV is from Ogletree mine, also beyond the last ridge referred to; No. V is from Mallory's mines, east of Baker's Mills, on the E. T. V. & G. Railway; No. VI is from Mr. Riser's farm, two or three miles eastward of the last mine. This last contains the largest quantity of phosphorus of any ores analyzed by the Talladega Furnace company. No. VII is from Lawson's Mine, belonging to Mr. G. W. Chambers, in which there is an extensive opening.

The ores about Anniston have practically the same composition as those already given, but when washed the iron amounts to 55 or 56 per cent. There is usually a little maganese in the ore. The quantity of sulphur is not worth considering. Whilst the ores containing the largest per centage of phosphorous are rendered unfit for charcoal iron, of the quality made in this region, yet they could be used to mix with the red ores of Birmingham. Indeed, brown ores have been used there that contain over one per cent of phosphorus.

From what has been said, the quantity of ores in the Talladega valley is seen to be large, and the quality good. There is enough to supply not merely the existing furnaces and those under construction, and other to be built, but to afford a heavy freight to Birmingham. Of this valley, not merely in the region of Talladega, but with the East Tennessee, Virginia, and Georgia, and the Anniston and Atlantic Railways, the natural outlet, of the iron produced, to the sea, both from the southwest, and from beyond Anniston to the northeast, will be by way of the Macon and Birmingham Railway.

OTHER BROWN ORES ADJACENT TO THE SURVEY.

BETWEEN TALLADEGA AND RED MOUNTAIN.

On the western side of the mountains west of Talladega, formed of the Potsdom sandstones, there is a belt of deposits of brown ore, whieh, in several loealities, are very promising, where they have been opened. They belong to tbe same geologieal position as the Talladega ores.

Just east of the Coosa River, near where the survey erosses, I found some seattered ore, of doubtful value.

On the western side of the coosa river there are large deposits of brown ores, having the same geologieal position as those of Talladega. The ridges passing near Easonville post office present excellent surfaee showings, as in some plaees the ground is literally covered with bloeks or ledge of ore. Some of them I visited on section 34, T. 18, R. III E. (Mr. M. C. Frame's); on section 2, T. 18, R. III L.; and on seetion 35, T. 17, R. III E. (Mr. D. W. Waite's). Near Kelley Creek post office, on seetion 5, T. 18, R. III E. (Mr. T. R. Beaver's) there is a rich iron deposit whieh has been dug into. Near the village, there are surface showings of ore. On the ridges in section 29, T. 17, R. III E. (Mr. Goss') and on neighboring sections there are some large deposits of brown ore. The best display of ore is on the farm of Mr. Goss, or on that whieh he sold to Col. Sloss. These ridges are the remains of Knox dolomite, and are commonly eovered with ehert in great quantities. There is also plenty of available limestone at hand.

Southwest of Kelley Creek post office, there are some promising ore beds on section 27, T. 18, R. II E. (Mr. J. M. Duke's). Here I saw one bed that had been dug into for a depth of three feet. It was a true bed and not a pocket. There are also adjaeent properties which are iron bearing.

In Little Cahaba Valley. Eastward of the village of Leeds, upon the northwestern margin of the Coosa coal ba-

sin, there are some brown ores, which, extending from the northeastsrn part of T. 17, R- I E, are said to occur in large quantities. Upon the western side of the valley there are also other deposits. The valley of the Little Cahaba is underlaid by the Knox dolomite. Rising out of this, there is the Oak ridge, on the eastern side of which, about six miles south of Leeds (on section 11, T. 18 R. I W. and adjacent properties), there is one of the heaviest ledges of solid brown ore seen. It is overlaid by chert. This deposit was bought by Col. Sloss, several years ago, and is now owned, I believe, by the Henderson Steel and Iron Company. From the natural position, a branch road should be extended from Leed's past this property to the lower part of the Cahaba coal basin.

Col. Fred. Sloss jr., informs me that all the brown ores about Leeds, with which his family had to do, contained about :

Iron	50 per cent.
Silica	10 per cent.
Phosphorus	0.40 per cent.

Again, between the Cahaba coal field and Red Mountain there are some reported beds of brown ore, but none of these have I visited.

East of Blue Mountain and in Clay County. Upon the eastern side of Blue Mountain, and extending in both directions from Porter's Gap, there is a heavy ridge of brown ore. It extends many miles in length, but of course it is broken and interrupted, yet in places the quantity of the ore is enormous. This ore is associated with the Ocoee slates and conglomerates, which are semi-metamorphic, and are situated on the western border of the Archæan group. This ore bed crosses the survey line (at Porter's gap), eleven miles east of Talladega.

Farther eastward, in Clay County, there are many deposits of brown ore. Upon a chain of ridges extending from

sec. 36, T. 20, R. VI E, diagonally across T. 20, R. VII E. there are some large deposits of brown ore. Mr. Jasper Williams has cut into a bed to a thickness of ten feet or more, dipping steeply to the southeast. The mean analysis of this ore and surface samples from adjacent parts of the mountains is:—iron 56.82 per cent; silica 9.40 per cent; and phosphorous (Mr. Williams' ore) 0.4408 per cent, and of ore from two other localities 0.5412 per cent, and 0.8091 per cent respectively. Upon a parallel ridge, is the ore of Mr. Cox, where there is a thick bed of hematite and limonite, with some seams of magnetite already noticed on page 22. These localities are about five miles northwest of Hillabee post-office. The underlying rock is a graphitic gneiss. Within a half mile of Hillabee, I saw another bed of brown ore, lying in a bed shown me by Mr. A. J. Nelson.

A few miles southwest of Hillabee, there are other large deposits of brown ore on sections 27, 28 and 33, T. 21, R. VI E. Some surface ore from sec. 28 yielded Prof. C. M. Strahn: metallic iron 56.18 per cent; silica 6.00 per cent; phosphorus 1.20 per cent. Some two miles farther southwest there are reported still larger deposits of ore.

On account of the distance from railways, the mineral wealth of Clay County has not been developed, and few of the orebeds have even been opened out. Of the ore beds which I have visited, only some of the most promising have been referred to, but there are many others of good repute within easy access to the survey line.

Summary of the localities of the brown ores.

(a) Enormous quantities of brown ore cover large areas in or adjacent to the Talladega valley; (b) large quantities of brown ore occur on the west side of the Coosa River; (c) there are large deposits of the ore near Leeds; and coming

eastward (d) there are the ores of Clay and adjacent parts of other counties.

As coal and limestone enter into the consideration of the production of irons, and are of as much importance as the ore, it will be better to report upon these before considering the question of iron manufacture.

B—COAL.

THE COOSA COAL.

The Coosa coal fields are about sixty miles long and have an area of 150 square miles. The lower portion is broken into two branches or basins, by an intrusion of Knox dolomite. Our survey crosses the basins (which are nearly united in that locality), between a point, just west of Kelley Creek post office, and Thompson's Gap, two miles or more east of Leeds. As the road crosses the basin obliquely, it is about ten miles miles wide, but the coal is found only in the western portion, from near Bald or Oak Mountain on the western side of the basin to somewhat eastward of Landrum's mills. Only in a few localities have pits been opened up to the extent of obtaining coal for the local blacksmithing. These openings soon cave in and obscure the coal. Again the weathering of outcrops is such that for satisfactory reports upon the extent of the coal beds numerous openings through the earth must be made. The nearest locality to the survey where the Coosa coal has been worked is some twelve miles to the northeast, at Broken Arrow, in the same basin. Prof. Tuomy said that he saw two seams along the creek, each 5 feet 2 inches thick. According to the report of the Geological Survey for 1882, there are said to be three seams of coal respectively of 3, 3½ and 4 feet in thickness. In the northwest portion of sec. 36, T. 17, R. 1 E., there is said to be a bed of coal two feet thick. In the adjacent township to the east there are several places

where the coal is known to exist. Three of them I visited, on the farm of Mr. James Dunlap, on that of Dr. Owen (the latter is on sec. 29, T. 17, R. II E.), and one near Landrum's Mills. At the last locality the coal is 2 feet 4 inches thick.

Farther north the coal is reported to be thicker. As the coal beds are liable to vary in thickness, it is quite possible that seams of greater thickness may be found. The quality of the coal seen near Landrum's Mills was good. The Confederate Government obtained coal from the tributaries of Broken Arrow Creek, and found that the coke made therefrom was superior to any that was obtained elsewhere in Alabama.

The Cahaba Coal The Cahaba Basin is about seventy miles long, and has an area of 250 square miles (Prof. Smith.) The Macon and Birmingham survey crosses the upper and narrow portion of the basin, which is, there, four and a half miles wide, but as the road traverses it obliquely, the distance is somewhat increased. The eastern margin is sharply marked, as at Henryellen, where there is a fault of about 9,000 feet, bringing the rocks of the Upper Cambrian system, (Knox series) in contact with the Coal Measures (see diagram on page 39).

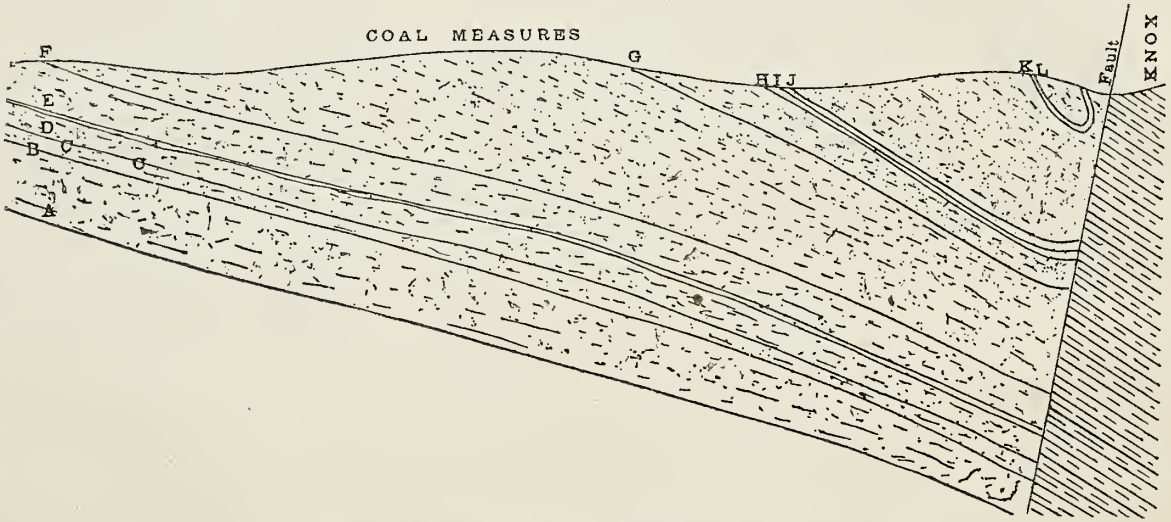
Thus a man can have one foot on rocks of one Series and the other on rocks a mile and a half higher, geologically speaking, which have been brought opposite to each other, by gigantic slippings of the earth's crust. From this line where the coals have been overthrown and broken, the slope of the rocks assumes a dip to the southeast, which at the Henryellen mines is from 25° to 27°, but flattens out to 8° in proceeding westward, thus facilitating the mining in the more western portion of the basin.

The rocks, between the coal beds, are shales and sandstones, the former largely predominating. The volume of the coal is best seen from the following section, extending nearly across the basin, (except that on western side, where only some of the

lower and less important seams occur). This section is in decending order, or proceeding from east to west, and was made by Mr. Hugh Howard, Superintendent of the Henryellen mines.

L—Coal	3 feet.	
Rock.	4 "	
K—Coal	3 "	
Rock	1000 "	
J—Coal	6½ "	interupted with thin shaly partings.
Rock	40 "	
I—Coal	5½ "	this is the lower Henryellen seam.
Rock	30 "	
H—Coal	2½ "	
Rock	250 "	
G—Coal	2 "	
Rock	950 "	
F—Coal	1 foot 3 inches.	
Shale	10 inches.	
Coal	1 foot.	
Rock	200 feet.	
E—Coal	2 feet.	
Rock	8 "	
D—Coal	1 foot.	
Shale	1 foot 3 inches.	
Coal	3 feet 6 "	it contains a half inch of shale
Rock	250 feet.	
C—Coal	3 feet	shale parting near top.
Rock	150 "	
B—Coal	5 feet,	with two shale partings near top.
Rock	400 "	
A—Coal	2 " 5 inches.	

The position of the beds is illustrated in the section on opposite page.



SECTION OF COAL MEASURES FROM HENRYELLEN WESTWARD.

The beds lettered from A to L represent the workable coal seams interbedded amongst shales and sandstones. The beds K and L are overthrown, the others are cut off by a fault, which brings the Knox series in contact with the Coal Measures, and represents a slipping of the earth's crust to the extent of about 9,000 feet.

Thus there are eight seams known, that are three feet or more in thickness, and even thinner could be worked. In the same Cahaba coal basin, in one portion or another, Mr. J. Squires has found more than twenty other thin seams, but these are not worth considering from the economic standpoint. There are in sight over 30 feet of workable coal covering a large area, giving practically an unlimited quantity.

The thickness of the seams (and of the rock between the seams) is vary variable. Thus there may be seen in two shafts at the Henryellen Mines, only a mile apart, the sections differing as follows:

NORTHERN SHAFT,		SOUTHERN SHAFT.	
Coal	6½ feet	Coal	6½ feet.
Shale	11 "	Shale	40 "
Coal	5½ "	Coal	5½ "
Shale	2½ "	Rock	30 " (shale and
Coal	2⅓ "	Coal	2½ " sandstones).

Farther north, the three seams unite to form one, known as the "Mammouth" seam, which reaches a thickness of from 11 to 14 feet. These are the three seams of the general section, lettered H. I. J. Seam I is that worked at present in the Henryellen mines. However, in some cases this mass of coal is represented by only three feet of coal. Other beds become double the thickness given in the section.

The general character of the coals of the Cahaba basin, compared with the coals of Indiana and Ohio, may be seen from the following analyses:

	I	II	III	IV
Specific gravity,	1.26	1.35	1.24	1.26
Moisture,	1.98	2.13	5.20	4.54
Volatile combustable matter,	31.47	27.03	34.80	34.61
Fixed carbon,	63.92	66.22	57.20	58.68
Ash,	2.63	4.62	2.60	2.17

Sulphur, as Sulphide of Iron, and as Sulphates,	1.06	0.502	—	0.87

No. I is the mean of ten analyses from eight seams of the Cahaba basin by Mr. R. P. Rothwell (from the Report of the Alabama Survey for 1875). No. II is the analysis of the Montevallo seam, near the southern part of the Cahaba basin, this being given as it is a favorite domestic fuel. No. III is the mean of fourteen analyses of Indiana coals (Cox). No. IV is the mean of six analyses of Ohio coals (Newberry). There was a remakable degree of similarity amongst the different coal which went to make up the mean analysis of the Cahaba coal basin.

The coals of the Cahaba basin are remarkably dry ,and are further superior to the coal of Indiana and Ohio as to heating power, on account of the larger quantity of fixed carbon. They are also remarkably low in ash. Some of the Cahaba coal burn dry and this is one of the reasons that the Montevallo coal is such a favorite for domestic purposes, together with its freedom from shale, although it contains a larger amount of ash than some of the other coals. Whilst many of the coals are dry burners, to such an extent that some of them would work raw in the furnaces, others make good coke. A portion of the coal at Henryellen, as well as seams at many other places, make a fine quality of coke of hard texture and silvery appearance. The Cahaba coals are generally freer from shale than the coals of the Warrior basin, and consequently the cokes contain a smaller quantity of ash and cinders. The small quantity of sulphur is another feature in the value of the Cahaba coals.

The cost of mining will vary at different mines, and in different seams. At the Henryellen mines, where the seam that is being worked is six feet thick, the miner receives forty-five cents a ton. The cost of coal at the surface is less than fifty cents a ton. To this add the fixed charges (wear of

machinery, interest, etc.) Consequently, the absolute cost of coal on the cars is not over sixty-five or possible seventy cents per ton. At the present time, seams can be worked, if coal can he put on the cars at eighty or eighty-five cents a ton. Railway companies are getting coal from Henryellen mines at $1.10 a ton. Whether these coals sell at any lower figures, I do not know, but farther west, in the Birmingham district, coal can be obtained at one dollar a ton. Adjacent to the Macon and Birmingham Railway, the Henryellen mines are the only works in the Cahaba coal basin, for until the building of the Georgia Pacific Railway there was no outlet. Besides, the basin for about ten miles on either side, belongs to the company. Farther south, there are numerous mines in this basin, including the Montevillo, which has been worked since 1855.

At the Henryellen mines, there are two shafts in operation. The present output is 250 to 300 tons a day. This is entirely used as steam and heating coal, part of which finds its way to Birmingham and part goes eastward to Georgia. But with the construction of iron furnaces in the Talladega valley and elsewhere to the east, using coke, the Cahaba coal will be largely used in the iron manufacture. This will necessitate the opening of new mines, and a branch of the Macon and Birmingham Railway running south-westward would open up the most natural supply market for the coke required in the Talladega valley, and for the coals needed in central and eastern Georgia. The Cahaba coal, being freer from shale bands than the Warrior coal, yields a coke much freer from ash than the more western coals. (See analyses beyond at page 44.) The better class of northern cokes are made from coal yielding from 55 per-cent to 70 per cent. of coke. From analyses of the Cahaba coals, it will be seen that those coals will yield as large a per centage of coke as the better class of the northern coals, and contain but little sulphur and a low per centage of ash.

It may be remarked here that the price of coke at Birmingham is from $2.00 to $2.25 per ton at the furnaces.

The Warrior Coal Basin. As the coals of the Warrior basin are not along the line of the Macon and Birmingham Survey, I have made no special report. But the basin is of importance, on account of the large output of coal, the greater portion of which is consumed in the furnaces and by the railways. Whilst, but a limited portion of the Warrior coal will find its way over the Macon and Birmingham Railway, yet the furnaces to the east of Birmingham, as at Talladega, will not entirely depend upon the Cahaba coals. The Warrior coal is of importance in keeping the Cahaba coal prices within reasonable limits, and also in being the great source of supply of coke to the furnaces which will send their iron over the Railway. The following statements taken from the report of the Geological Survey of Alabama, for 1885 will add interest to the present report.

The Warror coal basin has an area of 7,810 square miles. The maximum thickness of the Coal Measures is estimated at 3,000 feet, and contain nearly fifty seams of coal with an aggregate thickness of nearly 100 feet; There are six beds of four feet and over in thickness. The available bituminous and semi-bituminous coal of Alabama is estimated at three times the amount of that in the State of Pennsylvania.

The composition of the coals is shown in the following analyses:

	Pratt Mines.	New Castle.	Black Creek.	Connellville.
Specific gravity	1.999	1.33	1.36	
Sulphur	1.041	0.64	0.10	0.06
Moisture	1.025	0.50	0.12	1.20
Volatile matter	32.169	28.24	26.11	28.50
Fixed carbon	63.370	59.69	71.64	64.12
Ash	3.342	19.92	2.93	6.12

Connellville is one of the most celebrated coking coals of the North, and its analysis is given for comparison. Whilst the analyses show the chemical composition of the coals they do not show the physical properties upon which their value partly depends. The Pratt mines, six miles from Birmingham, supply about a third of the present demand, there being a daily output, in 1889, of 4,500 tons.

The composition of the coke is seen in the following analyses by Mr. A. F. Brainard, of Birmingham:

	I	II	III	IV	V	VI
Moisture	0.165	0.500	( )	0.075	0.200	0.150
Volatile	1.190	1.700	(1.60)	2.720	1.600	1.120
Fixed carbon	86.744	90.340	83.43	91.355	92.304	91.468
Sulphur	1.501	0.800	0.72	0.700	1.116	0.661
Ash	10.822	6.660	14.25	5.150	4.780	6.000
	100.00	100.000	100.000	100.000	100.000	100.00

No. I is sampled from the stock pile of the Tenn. C. and I. Co., and is coke from the Pratt coal. No. II is sampled from coke ovens of the Sloss Furnace Company, also made from Pratt coal. No. III is from the stock pile of the Alice furnace (1885) and also from the Pratt coal. No. IV is from the Cahaba coal, and is here introduced to show its superior character. No. V. is from washed coal of Watt's mine. No. VI is from Newcastle coal. Mr. Brainard says that the average amount of ash in cokes used at Birmingham is probably from 10 to 12 per cent of the coke (in 1888,) but that a reduction of 3 per cent has been effected in three years, and that with more skilled labor in mining and removing the shale from the coal, a further reduction can be easily accomplished.

The development of the coal trade is an index to the growth of the iron and general carrying trade of the manufacturing district, as over a third of the coal is used at the furnaces. In 1870, the output of coal was only 11,000 tons in 1882,800,000 tons; in 1885,2,225,000 tons; in 1889, the

coal mined reaches over 14,000 tons a day (according to Riccio, Sloan and Vedeler) or approximately four and a half million tons a year. This is the yield of only the twenty-six principal companies. The quantity will be considerably increased in 1890, as there is a large number of new furnaces undergoing construction.

The quantity of coke produced in 1885 was 304,509 tons; the daily product in 1889 is 3643 tons, which will yield nearly a million for the year. This amount will also be increased next year by the use of coke in the new furnaces, including those at Talladega and Anniston. The quantity of the coal is practically inexhaustible. With the continuous and heavy growth in the iron manufactures alone, the construction of the Macon and Birmingham Railway, giving a shorter road to the sea, by which a great proportion of the iron for the north must go, is only a matter of a short time, owing to the successful competition of the southern iron with the northern, even in the northern markets.

C—LIMESTONES.

Under this head the consideration of the marbles will follow that of the limestones. Economically, the value of these rocks is manifold. In point of quantity used, that consumed in the iron furnaces is by far the largest. Then the supply for building materials is unlimited, as well as for road making. But a very large demand, and one which involves long transportation, is that used for lime making.

Limestone adjacent to the Survey near Birmingham. The question of the occurence of limestone is not the only one to the economist, but whether it be sufficiently uncovered in nature, and in sufficient masses to be worked without the expenditure of non-productive labor, in removing the earth covering, etc. Such conditions is best developed in only one place near Birmingham—at Gate City, some six

miles to the northeastward of the great manufacturing centre. Here, on the northern side of Red Gap, the limestone rises to the top of Red Mountain, and for nearly a mile in length, there is a surface exposure of over a quarter of a mile in width. The height of the ridge is about 250 feet above the drainage level of the adjacent valleys. The thickness of the limestone, from a boring, has been found to be over 600 feet. The rocks lie comparatively flat, as, in part, the beds dips at only 7° to the southeast, whilst those nearer Red Gap have been more disturbed by local dislocation. With the present prices of limestone, this is practically the only large source of supply for the Birmingham furnaces within a distance of about twenty-five miles. It may here be said that these quarries, being only six miles from Birmingham, have a considerable advantage over any others in freight rates. They were opened by the Messrs Sloss. These gentlemen have contracts for over a thousand tons of broken limestone a day, with fifteen of the neighboring furnaces, which pay from 60 to 67½ cents a ton, delivered. the freight being 17½ and 25 cents a ton, according to the locality. The cost of quarrying is reduced to a minimum, as there are opened up rock faces of sixty feet or more in height and by the drilling of large holes by steampower,and the use of heavy charges of dynamite, a single set of explosions will often bring down a much as 30,000 tons. The cost of quarrying and loading is reduced to from 22 to 27 cents a ton. The fixed charges increase the cost somewhat. These quarries are unquestionably amongst the most valuable properties in the Birmingham district.

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Limestone in the Talladega Valley, This stone is dolomite or magnesian limetone–that is a double carbonate of lime and magnesia; consisting, when pure, of calcium carbonate 54.35, and magnasium carbonate 45.65 per cent. However, the lime often predominates, and the rock is apt to contain impurities Pure magnesian limestone is as suitable for fluxing iron ores as the simple limestones.

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Carbonate of magnesia	32.60	46.21
Silica	2.40	0.38
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This is a good fluxing stone, as the silica is in small proportions, and the other impurities are not worth considering. There is an abundance of limestone in the valley, and this is the stone used at the Talladega furnace. It is also a good building stone of a bluish color and of fine texture. Except the marbles along the southeastern side of the great valley, of which Talladega is a part, there are no limestones anywhere to the eastward along the Macon and Birmingham Railway.

The Marbles. Upon the southeastern side of the valley, approaching to within about four miles of Talladega, there is a thick deposit of marble lying at the foot of the semimetaphoric rocks of the Ocoee series, before described, By boring, this deposit is known to be over a hundred feet thick. In some places, a considerable portion lies below the drainage level of the valley. The belt of marble extends for long distances on both sides of the survey.

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been the most extensive workings. Here we find some marble of good quality. The surface is everywhere worn into more or less irregular forms. Some of the varieties are only fit for lime. But this is a condition in every marble deposit. The very finest quality, has everywhere to be assorted from great masses. At the Carrara quarries, the celebrated place for the Italian stone, there are only about 500 tons a year of statuary marble obtained out of the product of the labor of 3,000 men, the vast proportion being common marble. Prof. C. H. Hitchcock has identified this Alabama marble as being of the same geological position as the Vermont marble. With the indifferent marble being used in the furnaces as a flux, or in the manufacture of lime, and there is practically no limit to the quantity, and a large marble trade ought to spring up. The composition of the marble at Bowie's quarry, which is being largely used for flux, at Anniston, was given to me by Mr. Lancaster:

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Limes. Exclusive of cements, there are two kinds of lime used—those that are made from pure limestones, and those from magnesian limestones. In either case, the freer from earthy matter the better is the product. That made from limestone swells up upon being slackened to a much greater bulk than that from magnesian limestone, and among masons is called "fat lime" to distinguish it from that containing magnesia which does not swell so much. The magnes-

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portation is to convey the iron to Savannah by rail and thence by sea; and every facility offered to reduce the cost will add to the development of the industry. The freight from the furnaces at the present time is less than $4,00—($3,85) per ton to New York. With the completion of the Macon and Birmingham Railway, which will be the shortest road and the easiest grade, the advantages in transportation will be correspondingly great.

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1 ½ tons of coke at $2.25 " "	$3.37
⅝ ton of limestone at 0.67½ c. "	$0.43
furnace labor and fixed charges "	$1.50
Cost of pig iron "	$7.80

In many cases, the amount of limestone is equal to the weight of metal produced, which will somewhat increase the cost. On the other hand, the cost of coke may fall below the price given. The price of the ore given is that of the best soft red variety delivered at furnaces, which buy their supplies. The price of the harder ores falls to $1.00, or sometimes less, per ton, but they are not so rich in the metal. For those furnaces which own ores, there is a heavy reduction in the price. Further reduction in the cost may be effected in the economic handling at the furnaces. Thus Col. Fred. Sloss, Jr. informs me that under the old management of their furnace, they were able to produce highly graphitic pig iron, with the silicon down to 2 per cent, by the use of 2,800 pounds of coke carrying 15 per cent of ash.

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It is probable that a furnace will be located near Leeds to use the ore described on page 34.

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At Talladega, one furnace capable of yielding about 35,000 tons a year has just gone into blast. The same company propose to erect another furnace, and establishments for the manufacture of their products. This is a coke furnace, bringing its coke from the Birmingham district, which by our Railroad will be much shorter than the by other roads. This

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It is probable that a furnace will be located near Leeds to use the ore described on page 34.

Another furnace may be located just west of the Coosa River to use the ores described on page.

At Talladega, one furnace capable of yielding about 35,000 tons a year has just gone into blast. The same company propose to erect another furnace, and establishments for the manufacture of their products. This is a coke furnace, bringing its coke from the Birmingham district, which by our Railroad will be much shorter than the by other roads. This

will be equal to a carriage of about 50,000 tons of coke alone for one furnace, besides the transportation of the product. The cost of this iron is expected to be:

2 tons of ore at 1.25	$2.50
1¼ tons of coke at $3.15	$3.94
1–5 ton of limestone	$0.10
Fixed charges—if as at Birmingham	$1.50
	$8.04

The smaller quantity of silica in the ore, and consequently the smaller amount of limestone used reduces the amount of coke, when compared with the Red Mountain iron. But as the company owns its own ores, a further reduction of nearly a dollar a ton ought to be effected. This iron is of excellent quality and fit for fine Bessimer steel, containing only 0.062 per cent of phosphorus, and 2.30 per cent of silicon (J. F. Barnett, chemist) in No. 1 grey iron .Whilst the Birmingham irons are good for foundry purposes, and from them good bar or malleable iron is made, they do not make Bessimer steel. However, with the use of the Henderson process for the removal of the phosphorus, good steel rails may yet be made at Birmingham. The theoretical limit of phosphorus in the iron for the manufacture of rails by the Bessimer process is 0.12 per cent although, many rails contain more. The Talladega iron contains phosphorus to only half the limit allowed in Bessimer steel.

From the quantity of ore in the Talladega velley, there is room for several furnaces along the line of the Macon and Birmingham Railway. And there seems no reason why Bessimer rails should not be made at Talladega.

Charcoal Furnaces at Ironaton.

From Talladega northeastward, as far as Anniston, I have examined numerous brown ore beds. At Ironaton, six or eight miles northeast of our survey, there is the

Clifton Furnace. The same company is now erecting another furnace. These are charcoal furnaces. The product of the one, long in operation, amonnts to 12,000 tons a year. The capacity of that in construction is 18,000 tons. The prodnct is entirely nsed for the manufacture of car-wheels. As to the cost of the iron, Mr. Noble sen. is said to have stated that his company produced this iron at $11.00 a ton. It is difficult to arrive at the exact costs from the information obtainable from the company. for their advantages are company secrets. All of the ore is washed, at the company's mines, and this is the cheapest method. But when the ore is delivered by contractor's it is worth $0.80 a ton. The ore is roasted, the cost of which, although cheaply done, I do not know. It is said that it takes 115 bushels of charcoal worth about 6 cents a bushel to make each ton of iron. The limestone is brought from Gadsden, some distance towards the north, and the cost may reach thirty cents for each ton of iron produced. The company stated that the lowest price at which the iron has been sold is $19.00 a ton, for there had been no cut in the prices, as there that had been in those of the coke-iron. Mr. Brainard informed me that the avarage amount of phosporus in the charcoal irons of Alabama should not exceed 0.33 per cent, although sometimes reaching 0.40 per cent.

At Janiper, eight miles farther north, also on the Anniston and Atlantic Railway, there is a charcoal furnace of 8,000 tons capacity per annum, which until recently belonged to same company as that at Ironaton. At Janiper, there is also to be constructed another furnace. All of the ore is brought by rail to Janiper, from other points along the railway, as the amount of phosphorns in the local ores is saidto be too large for charcoal iron.

The product of the furnaces at both Ironaton and Janiper is largely carried south, crossing our survey and going twenty miles farther, and is there transferred to the Colum-

bus and Western for shipment by a longer route to the sea. Besides the freight on the iron export, there is an import freight of over $20,000 a year (according to J. S. Mooring of Ironaton, who kindly furnished me with the above figures).

A little farther north, in the same valley, at Anniston, there have been for a long time in operation the Woodstock furnaces, also making charcoal iron for car wheels. There are two furnaces, with a united capacity of 20,000 tons a year. The Company largely work their own ores, but those from outside are worth $1.20 a ton. There are just completed two other large furnaces, which will have a capacity of 70,000 tons a year. This will require about 450 tons of coke a day which will be brought from the Cahaba basin.

Even at Anniston, with the Anniston and Atlantic Railway a tributary, the Macon and Birmingham Railway will have equal advantage in the carrying of freight, with the Georgia Pacific Railway, to the sea-board. Besides the furnaces, there are now a large pipe-works which will be one of the largest foundries of this kind in the United States. These together with the cotton factory and other manufacturies make the tonnage of Anniston swell up to an enormous traffic.

The most eastern locality for a furnace along the Macon and Birmingham Railway will probably be east of the Blue Mountain or in Clay County, but the iron ore will not likely be found to be pure enough for charcoal iron, yet the coke can be brought from the Cahaba coal fields, and the limestone from the region of Taylor's Mills.

E—MANGANESE.

Closely related to the production of iron, manganese is of importance; namely, in the manufacture of spiegeleisen, which is extensively used in the manufacture of Bessimer steel. It is also used indirectly in the manufacture of

bleaching powder. It is a mineral of high price. In many places from Virginia to Georgia it is profitably mined, and the same rock formations continue into Alabama. It is reported at several places, but I have only seen it, adjacent to the M. and B. R., on the property of Mr. Jasper Williams, about five miles northwest of Hillabee. It occurs associated along with decayed gneissoid rocks, but in hardly sufficient quantities to be worked. It is here a compact dark bluish mineral, and of good quality. Everywhere it occurs in a pocket form, and may yet be found in large quantities, along our road.

F—GOLD.

The great gold belt of Georgia passes in a southwestward direction into Alabama, and in the vacinity of the Macon and Birmingham Railway, it is broken up into three zones, several miles apart, and in different kinds of rocks. Since the first excitement, about 1836, there have been various periods of activity down to the present time. The most eastern of these zones, approached, is that about Goldville, now only a post office, with a few old buildings. During the height of the gold fever, it was a village boasting of seven saloons, and that here upon certain days as many as a thousand men, engaged or enterested in mining, were sometimes congregated. To the south and west of this village there were a number of workings, at some of which, such as at the old Log Cabin mine a considerable quantity of gold, paying handsomely, was obtained. I visited the Hog Mountain mine, which has been worked during the present year. Here, there is an opening on a quartz vein to a depth of twenty or thirty feet. The vein is from four to ten feet wide traversing a very rotten micaceous rock—probably a mica schist. The vein has also been worked underground by means of a adit in the hill-side. If this gold bearing rock is not in the Huronian system of geology, it is near the wes-

tern margin of the Laurentian system, for just northwestward of this locality there are some hydromica schists, typical of what may be provisionally regarded as the Huronian system of the south. In the region of the gold mine, all of the rocks are thoroughly decayed to a great depth. At this mine there are two batteries of modern stamps, and a sufficent quantity of water, for the gold-bearing quartz is crushed in presence of running water, which carries the gold in contact with the analygamating plates.

The second belt crosses the survey a few miles west of Hillabee. One of the mines in this belt is the Harall, (on section 34, T. 20, R. VI E.). There are two mines in operation this year adjacent to Enitachopco post office, That of Mr. Harallson has only recently been re-opened, with use of modern stamps. It is in decayed gneiss, and the vein is also of decayed rock about six feet wide. It contains from three to four dollar worth of gold per ton. It is stamped with water and the gold amalgamated in the usual way. The gold can be extracted at a profit when the rock contains even less than a dollar's worth of the metal in a ton of rock. Mr. Harallson informs me that the whole mass of the decayed rock could probably be worked as a placer mine if the water were at hand, and that with some outlay it could be obtained. With a sufficient amount of capital invested, it appears as if this ought to be a good property, when it is a paying investment upon the small scale.

A mile or two away from the Harallson mine is the Shinker mine. The foreman informed me that it was his duty to weight the gold and that the product ranged from three pounds of gold to over seven per week. The cash receipts had reached over $1400, as the result of the labor of twelve men for eight days each. These mines are situated in or near the borders of the Laurentian and Huronian systems, as in the case of the Goldville mines. It seems

that in this region we have a field of profitable gold mining, if modern methods are adopted. Of the numerous mines which were opened up years ago, no doubt the failure of a portion of them was due to the lack of water and to the older and more primitive methods of working. There were places where men were able to make wages by crushing the rock in mortars and washing out the gold in pans. Another cause of the failure of some of the old workings was the presence of pyrites which prevented the amalgamation of the gold.

The third belt of gold bearing rocks is on the western side of the Blue Mountains, in a belt between Riddle's Mills and Taylor's Mills. The gold occurs in quartz veins traversing the hydromica schists of the Ocoee series, before described, and consequently belonging to rocks of considerably younger period than those deposits in the more eastern belts. There were three principal mines in this belt. The Storry Mines (sec. 17, T. 19, R. VI E.) has yielded $100,000 worth of gold, one company having made a profit of about $16,000. At the Robb mine, (sec. 19. T. 19, R. VI E.) by the pan and mortar process men have made from $2.50 to $5,00 a day. The third mine in this belt was the Riddle, (sec. 16, T. 19, R. VI E.) None of these mines have been worked since 1887. These data were given to me by Dr. Wm. Taylor, of Craigdale.

There seem to be good reasons for believing that the gold mining will revive from the sporadic attempts that have been made, since the crude mining of the earlier days of the gold fever. And whilst the rapid fortunes of gold seekers may not be realized, yet an important industry is likely to be developed at future times, for good profits have been realized in many of the regions worked, not only those adjacent to our survey, but in various localities throughout the whole great gold belt in Alabama and in Georgia.

G—COPPER AND IRON PYRITES.

Copper pyrites is a compound of sulphur, iron and copper, and is of a bronze yellow color. When pure it contains 34 per cent of copper. Iron pyrites is a compound of sulphur and iron, and when pure contains 53 per cent of sulphur. It is of a bright yellow color. These minerals even when tarnished can readily be distingnished apart by their hardness—the copper compound not scratching glass, whilst the iron scratches it easily.

In Clay County Ala., there was a copper fever in the early fifties. Several mines were opened for copper, some of which proved to be iron pyrites. Other mines were opened in iron pyrites with which was mixed some copper pyrites. One of the copper mines—that on the farm of Mr. Wm. McGee (Sec. 3, T. 21, R. VI E.)—I visited. The mineral was mostly pyrites but with some copper. These sulphides are scattered through vesicular quartz of six or eight feet thickness, but that rich in pyrites is about three feet thick. The vein dips at angles from 60° to 75° For copper alone, it is not worth working, but for the sulphur in the pyrites, it may yet be valuable.

On section 30, T. 20, R. VII E., there was another mine opened for copper, but it turned out to be only pyrites. The pyrites occurs also upon the adjacent property of Mr. Jasper Williams (about six miles north west of Hillabee). The vein or bed occurs associated with decayed gneissoid rocks. As the pyrites decomposes so easily, the surface rocks do not show the extent of the deposit. This zone of pyrites extends into Georgia, where the beds are more than fourteen feet thick. At the surface, the pyrites is often converted into brown or red hematite, and it is quite possible that some of the iron ores on the ridges in Clay County will be found to pass into beds of pure pyrites, as they do in some other places when shafts are sunk below the depth of

decayed rock. The value of pyrites arrises from its use in the manufacture of sulphuric acid, which is so largely consumed in the production of super-phosphates. Whilst a few per cent of copper alone would not pay for the extraction, yet when the mineral is used for the manufacture of acid, the residue may be worth something for the contained copper.

At the present time pyrites is not the common source of sulphur in the South, as special furnaces are required. The sulphuric acid is made from imported Sicilian brimstone or sulphur, the price of which is now about $25.00 a ton. At Savannah, Spanish pyrites is imported and used for the acid manufacture. But although not used at present, it is more than probable that our pyrites will come to replace the imported sulphur to a greater or less extent.

H—GRAPHITE.

Graphite, plumbago or black lead is a soft mineral of a dark leaden or blackish color. It occurs in scales with a bright shining lustre, or in masses which are less brilliant. It is a mineral extensively used in the manufacture of crucibles for melting metals in, for polishing iron, in making certain lubricators; it is also used in electrotyping, and is largely consumed in the manufacture of lead pencils. Even the scales are easily recognized by their softness, greasy feel and soiling paper or the fingers as does a lead pencil.

Graphite is abuntantly distributed along the M. & B. Railway. It occurs as bright scales in decayed gneiss, where it takes the place of the mica. Northwest of Hallibee I saw several beds of this graphitic gneiss. On section 20, T. 20, R. VII E., a graphite mine has been recently opened. The bed is over 20 feet thick, and dips at an angle between 60° and 75° to the southeast. The rock is very

rotten and does not contain over five or six per cent of the mineral. The rock is crushed in presence of running water, and by a system of separating troughs, the light scales arefloated into settling basins,and are finally separated from the stone powder. A fine quality of graphite is here obtained. Hence this graphite vein extends southwestward, and I have seen it at several places. On the property of Mr. Jasper Williams,the bed appears somewhat richer, and has a thickness of about 75 feet. Graphite is also found southwest of Hillabee; near Louina, on the Tallapoosa River ; and elsewhere, but some of the samples are more massive than those described, and although richer in the mineral, they would probably yield an inferior quality. With the opening up of railway facilties, the graphite promises to be an important industry. The value in New York is about $20.00 a ton, but much higher for that fine enough for the manufacture of pencils.

I—BARYTES, ASBESTOS, MICA, CORUNDUM, AND TIN.

Barytes or Sulphate of Barium.

This is a mineral commonly white, and softer than marble, which it somewhat resembles, but it is a very heavy mineral, hence its name of Heavy Spar. When of a white color, it is extensively used for mixing with white lead in making paint. In fact, very little white paint is now made which does not contain more or less barytes. The principal localities, which I visited were about three miles south of Leeds, occurring in limestones of the Knox series. On section 31 T. 17, R. I E., there is a bed about five feet wide. Upon an adjacent ridge there is another deposit, and still others are reported. Much of the mineral is white or bluish white, and would make a fine white powder. The quantity appears to be sufficient for working. Barytes was

originally used for adulterating the lead. When simply ground, it appears to be of no service to the paint, but a manufacturer informed me that, when by flotation process the powder could be rendered fine enough, there are advantages in its use. At any rate the demand is considerable.

Asbestos or Mineral Wool.

This mineral is used largely in the manufacture of fire-proof safes, fire-proof roofing, packing for steam pipes etc. It is reported as occurring Alabama, but I have seen none along the line of our survey.

Mica.

Whilst mica is a common constituent of many of the rocks passed over, yet its occurence in sheets large enough for use is more rare. Mica is reported to have been found some three miles northeast of Porter's Gap. I did not find the locality, but several men had seen large sheets that had been obtained there.

Corundum.

This mineral is extensively used for the manufacture of grinding-wheels and powder, etc. The less pure variety, of a dark color, is known as emery. West of the Tallapoosa River, I picked up some specimens in the field, but did not find the position of the beds.

Tin.

Tin ore is reported as occurring near Ashland. But I did not visit the locality.

J—GRANITE.

Granite is composed of quartz feldspar and mica, or hornblende. The constituents vary so as to sometimes give

the rock a fine grained, at other times a coarse, texture. There are several localities along the Macon and Birmingham Railway where excellent granites occur.

The granite deposits usually rise up as more or less rounded hummocks through decayed gneisses. These hummocks are sometimes of small area, but again they are of some acres in extent. The value of these deposits depends upon the absence of earth covering, and upon the soundness of the surface of the rock. However, in all cases the quality of the rock will improve in the deeper parts of the quarries.

The localities of the granites. The most western locality of granite is a mile or two west of the Tallapoosa River, adjacent to the survey. Here, there is a chain of granite hummocks trending from northeast to southwest. The quantity is practically unlimited. It forms the surfaces of low ridges, and some of the exposed surfaces are of acres extent. It is a good stone of a texture somewhat coarser than that of Stone Mountain, Ga. From this locality, the supply for Birmingham and the southwest would be most naturally derived. At the time of my last visit to Birmingham, I found the streets of the city being paved with Stone Mountain granite. This latter locality is about twice the distance from Birmingham of the Tallapoosa granites, which last are somewhat less than a hundred miles away. This stone is also favorably situated for supplying any town that may grow up about the crossing of the river, as at Louina.

Between Roanoke and Rock Mill, there are again hummocks of good granite, as also near the mill.

In Georgia, about three miles east of Greenville, there is granite fit for building. The rock, which I saw west of Greenville, is very much decayed upon the surface. At two or three places between the Greenville and Woodbury, there are granite exposures. Farther eastward, near Warm

Springs, there are mica schists breaking up into good flagstones.

At Potato Creek, there is a very fine exposure of dark granite, from which the decayed rock has been washed off, by the waters of the river. Exposed, there is an abundance of good rock for the factories that may be built here. (See plate of the rapids beyond).

East of Thomaston, there are other deposits of granite. At Toblers, there are some good building stones at the rapids; and also along Rocky Creek, a few miles west of Macon, there was seen good building stone exposed in limited quantities.

K—SANDSTONES AND FLAGS.

For building purposes, the sandstones along the line of the survey are mostly confined to the rocks of the Carboniferous system, and except in the Millstone grit, east of Leeds, they are not easily available, as they are all dipping at considerable angles, beneath a thick covering. On the eastern side of Oak Mountain, as near the tunnel at Thompson's Gap, there are some fine sandstones in smooth thin layers, which would make excellent flagstones for sidewalks. It is proposed to utilized them for the streets of Birmingham. They are also fit for furnace hearths.

Just east of Red Mountain, there are some Lower Carboniferous sandstones. In some places, these are so friable as to crumble between the fingers. They are composed of the purest quartz sand. This is the sand that is used at the Gate City Glass Works. It is also crushed, at a nominal expense, and used largely at the iron furnaces of Birmingham, and for mortar.

Beneath the ore beds in Red Mountain, belonging to the Clinton series, there is a very beautiful brown sandstone. Where the streams have cut into the mountain, this is often laid bare, as at Gate City, on the property of Messrs Sloss.

L—SANDS, GRAVELS AND CLAYS.

Adjacent to the creeks, there is generally enough sand for local building purposes, but inferior to the white sand from the rock at Gate City. Again, for fifteen or twenty miles west of Macon an abundance of clean sand can easily be obtained from beds belonging to the Lower Cretaceous series. Small round gravel is abundant on some of the hills about Macon. Again, it is found on the borders of the Chattahoochee and Tallapoosa Rivers, adjacent to Talladega, and on the hills along the Coosa River. It is only on some of the hills that the gravels are at the surface, as they are apt to be covered with red loam. The deposits vary from one to rarely eight or ten feet thick. The greatest height at which I have found them was near Talladega, at about 685 feet above the sea. At Gate City, there is some angular chert used for road making. All these localities would furnish good ballast for the Railway.

Brick clays occur in the alluvial bottoms along the streams, and in many clay hills. Amongst, the best brick seen were those made at Leeds and at the Chamber's brick yard at Talladega. Here, at Talladega the bricks are in part of buff color and others are of chocolate color.

Fire clays should be somewhat silicious, of light color, and contain very little iron, lime or alkalis, which renders them fusible. Immediately beneath beds of coal, fire clay is commonly found. Amongst the brown ore deposits, as at Anniston and near Talladega, there are "horses" of white clay which would make fine fire clay. Mr. Chambers of Talladega has had such clay tested for white earthenware manufacture, with farely good results. Above the sandstones near Thomson's Gap, there is some fire clay. Near Taylor's Mills, in the Talladega valley there is fire clay. These are some of the places where I have seen fire clays along the survey.

M—ROOFING SLATES.

On the northwestern side of the metamorphic rocks, there are several places, where highly fissile slates occur, which would make admirable roofing and other slates,as near Rendalia, and south of Sycamore. Also on section 23, T. 21, R. VI E., in Clay County, there is good slate. These are of the hydromic type.

III—FOREST TREES.

Along the line of the Macon and Birmingham Railway survey, the most valuable trees are the pines and the oaks, and of these trees there is an abundance. For timber, the pines are at present the most valuable, and must of necessity furnish a great amount of freight.

The Pines. The chief varieties are the long-leaf, the short leaf, and the old field pine. The long-leaf pine is of great value, for it is one of the strongest and most durable of timbers. It furnishes the resin, turpentine, tar and pitch of commerce. The heart wood predominates in this tree.

The short-leaf pine has a large proportion of sap wood, but makes good lumber. The old field pine is largely composed of sap wood, but is valuable for inside work. The value of all these pines is on the increase.

Along the line of the survey, there is suffiicient old field pine, with some short leaf pine, for local use. Only here and there, is a long-leaf pine to be seen in this part of Georgia. But after crossing the State Line, and on nearing the Tallapoosa River, the long leaf pine is met with, especially a few miles beyond the western side of the river. A great zone of pines composed of narrow belts trending northeast and southwestward, occupy more or less of the country between Hillabee and Taylor's Mills (east of Talladega). This zone is about twenty miles wide, and contains several belts of pines, varying in width from one to three miles. Here we find the long-leaf pine predominating, but there are some belts of short-leaf pine. These pines are mostly upon ridges covered with loose cherty stones or upon shaly rocks only thinly covered with light soil. The next pine belt of note is along the Coosa River. It is most largely developed upon the western side, and is made up of several subordinate belts. This zone of pine, in interrupted belts, extends

to the ridges east of Leeds. Some of the Coosa valley pines are amongst the finest timber trees in Alabama.

In many places, the pines have interspersed with the various varieties of oaks. The timber along the line of the survey is mostly in its primitive condition, as far as the pine ridges are concerned, but a small proportion has been removed for local use. Still, where the pines have grown upon the more arable hillsides, they have been cleared in order that the land may be cultivated; and in many places I saw large fields of dead trees, which had been killed prior to their clearing of the land—the pines being useless, as there is now no means of shipping the lumber.

Oaks. Oaks form the commonest trees along the whole line of the survey. Of these, the most abundant are the black, red, Spanish, black Jack, post, white, and on certain ridges the chestnut or mountain oak. In some localities, the trees are of large size, in others the smaller trees prevail. Apart from the abundant supply of timber for the local use, and for railway ties, etc., the most important consideration here is tan bark available for shipment. The red and black oaks furnish the ordinary tan bark, but the chestnut or mountain oak is that which is used in the so-called *white oak—tanned leather*. The mountain oak has an extra-ordinarily thick bark, so that a very large per centage of the tree can be thus used. The quantity obtainable for the labor expended, and the high price per cord will be sufficent inducement for the land owners, who are so fortunate as to have the trees, to develope the tan bark industry, especially that of the mountain oak bark. The mountain oak is principally found on the ridges adjacent to the Tallapoosa, and on various ridges about Hillabee and westward. It also occurs on some of the ridges west of the Coosa River. The quantity is sufficient for a considerable trade.

Hickory and other useful timber trees are seen in smaller quantities than the oaks and pines.

IV—SOILS.

The soils are as varied as the geological formations from which they are derived. Along the first few miles of the survey, there are loamy, gravelly and especially sandy soils, derived from the Southern Drift and from the Cretaceous formation. Thence, to the eastern side of the Talladega valley, the soils are derived from metamorphic rocks. Westward of this region, the soils are the results of the decomposition of the various formations of Palæozoic group. Thus we see that about three-fourths of the length of the railway passes over land derived from metamorphic rocks, but the soils throughout this region vary from good to bad.

The purpose of this part of the report is to give information concerning the soils, in order to call attention to what extent the country is adapted for further development, and to aid those people who wish to find homes in the country along the Macon and Birmingham Railway.

When the minerals necessary for the production of plant food are not present, then the natural soils must of necessity be poor. Chemical analyses will show such an absence. But it sometimes happens that analyses show an abundance of all necessary constituents, yet the soil is poor. This condition arises from the minerals required for food not being in such forms as plants can absorb. Still, with time and further decay of the rock-dust, the productiveness of the land increases. The non-productiveness often arises from the absence of only one or two constituents, and when these are artificially supplied, good crops are obtained. The substances which most affect the fertility of the soil are lime, potash and phosphoric acid. The other ingredients of plant food are apt to be present, if these are in sufficient quanti-

ties. In order to estimate the value of the soil from the chemical analyses, Prof. Hillgard does not determine the absolute amount of the materials which afford plant food, but only that portion which is soluble in hydrochloric acid, as those portions which are not thus soluble are not likely to furnish nourishment for years to come. From observation, he has found that the minimum quantity, obtainable by solution, in productive soils cannot fall below:—of lime 0.10 per cent, for light sandy land, and 0.25 for clay loam, and double that amount for heavy clay soil; of potash, 0.06 per cent in virgin soils; of phosphoric acid, 0.05 per cent, and double this amount in sandy lands will then hold up the soil for only from eight to fifteen years.

Compared with the chemical composition of the soil, the productiveness of land depends equally upon the physical conditions, such as its porosity, capability of retaining moisture, slope of the country, climate etc. As the climate is excellent, it need not be considered; but all the other conditions are constantly varying.

ARCHÆAN SOILS.

These extend from near Macon to the eastern portion of Talladega County, Alabama. Just beyond that line, for a few miles, there is a belt of metamorphic Lower Paleozoic rocks, which will be treated along with the metamorphic Archæan group. It is from the decay of the surface rocks that the soils are formed. This decay sometimes reaches down to only a few inches, but again the stone are so rotten that wells can be dug to a depth of sixty feet or more, by the use of the pick and shovel in the rocks, which were once hard gneisses. When these Archæan lands are properly cultivated, some of them form the best agricultural counties from Pennsylvania to Alabama. Still the quality is variable, dependent upon the source from which they were

derived. The most common materials which have produced the soils are ordinary gneiss,(and sometimes granite),wherein the mica is muscovite; biotite gneiss, wherein the mica is biotite; and hornblende gneiss, in which case the mica is wholy or mostly replaced by hornblende; mica schist; and hydromica and clay slates.

The farmers distinguish the soils of the metamorphic region into red and gray lands. The former are derived from the decay of hornblendic gneiss and have a dark brown or red color. Occasionally the red land arises from the decomposition of other iron bearing schists. The gray lands arise from the disintegration of gneisses or granites containing common mica, and of mica schists. There are both good and poor lands of each kind.

The Gray Lands. When these are derived from gneisses, which are rich in fieldspar, the land is apt to be fertile. But the diffierent varieties of gneiss contain variable proportions of fieldspar, which ingredient may so diminish, that it may pass into mica schists, composed of quartz and mica. Thus we find the gradation from good to poor land. All of these soils are more or less sandy. Sometimes the rocks from which they have been derived were mostly made up of quartz; in which case the land becomes very light and sandy. In many localities, the gray lands hold considerable quantities of quartz fragments upon the surface, to such an extent as to render the ground very stoney. As an example of a typical fairly good gray soil derived from gneiss, the analysis of samples taken from six miles north of Opelika,at a depth of eight inches, shows according to the analysis of the Geological Survey of Alabama:—potash 0.067; lime 0.167; phosphoric Acid 0,229 per cent. The soils derived from mica schists are inferior. Those derived from hydromica slates are still poorer. The analysis of a sample of this last soil, from north of Roanoke gave:—potash

0.536; lime 0.010; phosphoric acid 0.067 per cent. Thus we see that the land is deficient in both lime and phosphoric acid.

The Red Lands. These soils are derived from hornblendic gneisses or slates rich in iron-bearing minerals. An ordinary sample from near Opelika gave:—potash, 0.350; lime, 0.43; phosphoric acid, 0.17 per cent. This sample is deficient in potash, but it is found to retain the moisture better than the gray land. The red soils are much more loamy or clayey than the gray As an example of other red lands than those derived from hornblende rocks, the following analysis is that of a garnetiferous mica schist from Clay County, Ala.:—potash, 0.351; lime, 0.038; phosphoric acid, 0.137 per cent. It is deficient in lime, but in good seasons this soil is fairly productive.*

The red lands are considered the best for corn and grains, and formerly were generally regarded as the best soil. Now-a-day, the farmers prefer the gray soil, as it is the more easily worked, the more certain of good crops, and is better cotton land. The micaceous soils require to be artificially fertilized with phosphoric acid (including the contained lime) and ammonia. Some of the red soils would be rendered fertile by the application of lime alone. Of limestone, there is abundance along the Macon and Birmingham Railway.

The trees growing upon the richer red and gray lands are very much alike, consisting of oak and hickory, with a few short-leaf pines.

The distribution of the different lands cannot be sharply defined as the red-producing-soil rocks are frequently alternating with those producing gray soils. But the poorest gray

*All of these analyses are taken from the Report of the Geological Survey of Alabama for 1881.

lands are mostly confined to the western portion of the metamorphic region, where they are derived from the hydromica slates.

The Physical Features. Throughout the whole metamorphic region the country is rolling, and has generally a rounded appearance, with very few abrupt hills or deep water courses. When the slope of the land is less than twenty degrees, it is arable. Not many of the hills are even as steep as this angle. In fact, the hill tops are flattened rounded surfaces, and the valleys are relatively broad and shallow. Only adjacent to a few of the rivers in Georgia and eastern Alabama is the country so rough as to greatly interfere with agriculture. But from the region of the Tallapoosa River to the western margin of the metamorphic country, there rises a considerable number of ridges that interrupt farming operations.

Distribution of the Soils along the Line of the Railroad.

For the first twenty miles from Macon, the gray land predominates. From the region of Culloden to beyond Thomaston the red soils are much the commoner. For several miles on either side of Woodbury the land is gray, and about that village it is very sandy and light. Hence, westward, the red and gray soils are somewhat more commingled. From a few miles east of Lagrange, and thence extending to beyond the State Line, the red soils mostly predominate. These red earths being richer in clay than the gray are more apt to be cut into deep gullies than the gray lands, by the action of rains. After the first few miles of Alabama are passed, the predominance of wide belts of red land are less frequent than in Georgia. At the same time, the country becomes more rugged, especially through Clay County and in the eastern part of Talladega. There the soils

are in part derived from the rocks of the gneiss ridges, but the valleys are in part more or less underlaid by hydromica schists. In the more western portion of the metamorphic region, the hills are of slates or schists, which produce very poor land. But the portion of the county which contains more or less gneissic ridges, is of better quality than at first sight might appear; for most of the surface soils have been shifted somewhat during the long ages of their formation, and thus the poorer hydromica lands have mixed with them the richer washes of the hill sides, which are productive. The gold belt embraces the rocks beneath the very poor ridges of hydromicas. In some places, these last earths pass into others, derived from a more slaty rock, as on the ridges both east and west of Porter's Gap, where the soil is scanty and is composed of almost undecomposed shale coming to the surface. Rough quartz stones almost completely cover the ground in many places, but as these are usually only on the surface, good soil may be found beneath, when it has been derived from the decomposition of gneiss. Except the slaty ridges, there are few that are not fit for fruits, where otherwise too steep for cultivation. Although Clay County is so broken, and at first sight the rocks might seem to indicate that the land is poor, yet there are many fine farms. Indeed, I have seen there in the troughs between the ridges, some of the finest farms along the Railway, as in the region of Hillabee.

LOWER PALÆOZOIC SOILS.

These extend from the margin of the metamorphic rocks, about four miles east of Talladega to about six miles west of the Coosa River, where the Carboniferous system begins. This region, as has been noted before, consists of a series of ridges and troughs composed mostly of rocks of the Knox series (except a limited development of the Potsdam). As to

the ridges, they are usually covered with cherty nodules to such an extent that the land is not used. These are the remnants of the upper silicious dolomite of the Knox series, and the soil is gray. Whilst some of these ridges are almost barren, others are shown to be fertile, where not thickly covered with the chert, or where it has been removed, as it is only superficial. These ridges, in their original condition, are often covered with good pines. Some of them have sandy soil. Many of them are excellently adapted to fruit growing. The lands in the valleys are to some extent derived from the Knox shales, in which case they are thin. But much of it is derived from the decay of the impure Knox dolomite. Here then, occupying a large proportion of the valley, are some most fertile parts of Alabama. The best of this soil is that derived from the lower portion of the series. It is commonly of a reddish color, from the presence of the iron in the rock. In short, this land is derived from the same rock as that which furnished the brown ore beds. The soils derived from the Knox dolmite usually contain sufficient potash, lime and phosphoric acid.

Thus the lands in the valley of Talladega Creek, and in the valley of the Coosa River, as also in the outlying valley of the Little Cahaba River, at Leeds, are very excellent. However, some of the soils in the region of Talladega, and along the Coosa River are composed of red loams, and to a small extent of gravel, belonging to the Southern drift, this being derived by washes from the higher dolomitic beds, at a time when the waters were backed to high levels, far up the valleys.

The soils derived from the Trenton and Clinton series occupy too narrow an area, a few miles east of Birmingham, to be considered, yet such as are cultivated are fertile.

CARBONIFEROUS SOILS.

The Lower Carboniferous limestones yield good soils, but the surface distribution is too limited to be of much importance. The Carboniferons soils along the Railway are those which cover the Coosa and Cahaba coal fields, and are derived from the decay of the shales, sandstones and conglomerates. They are generally sandy, although with a clay subsoil. In color, they vary from reddish to gray, the lighter being usually the more productive land. But they are all indifferent soils, being deficient in lime and vegetable matter. Still they are capable of improvement, as they hold the fertilizers.

CRETACEOUS AND SOUTHERN DRIFT SOILS.

The very light sandy soils, on or along the sides of the hills, for a few miles westward of Macon are the only soils belonging to the Cretaceous series. The sands are often underlaid by whitish clays. The land is very poor.

The red loam and the snbjacent gravel, on the hills adjacent to Macon, belong to the Southern Drift. There are also small developments of this along the Chattahoochee and Tallapoosa Rivers, in the valley of Talladega, and along the Coosa River. These deposits are found on the hills to sixty, and in some cases, to a hundred and twenty feet above the respective streams. These loams are generally fertile and are especially adapted to fruit growing.

Simple alluvial lands are developed to only a very small extent along the line of the Macon and Birmingham Railway, as the rivers do not overflow broad bottoms. Still along some of the streams the lands are enriched by the overflows.

The Cultivation and the Price of the Land. But a small proportion of the country along the Macon and Birm-

ingham Railway, east of Clay County, Alabama, is unfit for cultivation. From this county westward, there is a much larger amount of the land which is of little valne, yet in the western district, there are to be found some of the most fertile belts of Alabama, in the broad depressions, amongst the ridges, and adjacent to the streams.

The price of land is generally very low, as much of the road is far from other railways, and these cross the zone, at only a few points, in place of running through it. Perhaps the highest priced land, adjacent to snch places as Lagrange and Thomaston, is $20.00 an acre. But a few miles away from the Railway, both in Georgia and in the Talladega and Coosa valleys, the highest price does not exceed twelve dollars an acre, and that very soon diminishes to from five to seven dollars for the best farms. Fair land, partly in cultivation can be obtained for as low as three dollars. The reason for the low price of land is the want of population. The farms are being held in too large tracts, of which only a small proportion is being cultivated.

The mode of cultivation is most commonly wasteful,—taking everything from the land and giving nothing back. Everywhere, the value of fertilizers to the land is such that they abundantly repay the outlay. These will come into more extensive nse, when the country is made more accessible by the Railway, and when a denser population resorts to more frugal farming. Indeed, in Georgia, with the modern use of artificial fertilizers, the cotton belt has crept fifty miles inland, upon the metamorphic soils. But it is not always the more expensive guano that the soil needs. Often the simple return of the cotton seed, or its meal, to the land is all that is necessary. To this, however, the addition of lime over the metamorphic lands is always desirable. The lime can be obtained from the marls of the southern part of the State or from the limestones of the Talladega val-

ley. But throughout many portions of the country, the cotton seed, where not sold, is fed to cattle, and the barn-yard manure is allowed to go to waste. One farmer informed me that on some soil that would not yield a half a bale of cotton to the acre, he had obtained by the use of the barn-yard manure two and a quarter bales. This is in keeping with the results of experiments quoted by Prof. Ruffner, which showed that the manure from the feeding of a ton of cotton-seed cake was found to be worth to the land, $27.80 gold; for with only the removal of the cotton lint, and with the return of the rest of the crop to the land, the soil retains its fertility. Besides cotton, which is the money crop, corn and other small grain thrive well. On the richer valley lands, ribbon or sugar cane is found to be a most profitable crop. Fruits grow in abundance, and are of excellent quality. In fact, the country traversed by the Macon and Birmingham Railway produces nearly everything that the farmer wants.

The Population. Along the line of the Macon and Birmingham Railway, in Georgia, there is a considerable per centage of negro population, yet smaller than in other portions of the State. But as soon as we pass into Alabama, there is a great paucity of the colored race, except adjacent to Talladega town. The people are almost entirely white. The whole belt is thinly settled, at least the farms are several times too large for the labor available. In Alabama, this thinness of population is still more noticeable than in Georgia, but, there, the county has been farther away from railroad facilities. There is plenty of room for thousands of new homes, and even then, the country would not be thickly settled.

The Climate is excellent. As the country is high with generally porous land, there is the general absence of malarial diseases. Homes scattered over the rolling hills of Geor-

gia, and in the valleys of Alabama are amongst the most happily situated in the South. Nor does one feel the heat excessively in this region. Whilst making the survey I did not feel the heat more oppressive than had I been doing the same work in Ohio or New York, the difference being that it was more continuous, but the extremes were not so great, and the nights were cool.

Everywhere throughout the region good water is easily obtainable. There is at the present time, few regions that offer such cheap and good farms in a pleasant, healthful climate, with varied surroundings, than the homes available along the Macon and Birmingham Railway.

V—WATER-POWERS.

The rapid growth of Manufactures in the South has, in part, arisen from the occurrence of many water-powers. Along or adjacent to, the Macon and Birmingham Railway, there are numerous water-powers, many of which are now utilized, as the sites of small local mills. These powers are usually from ten to fifteen feet high, but by daming they could often be raised somewhat higher, and the supply of water, during dry seasons, rendered more constant.

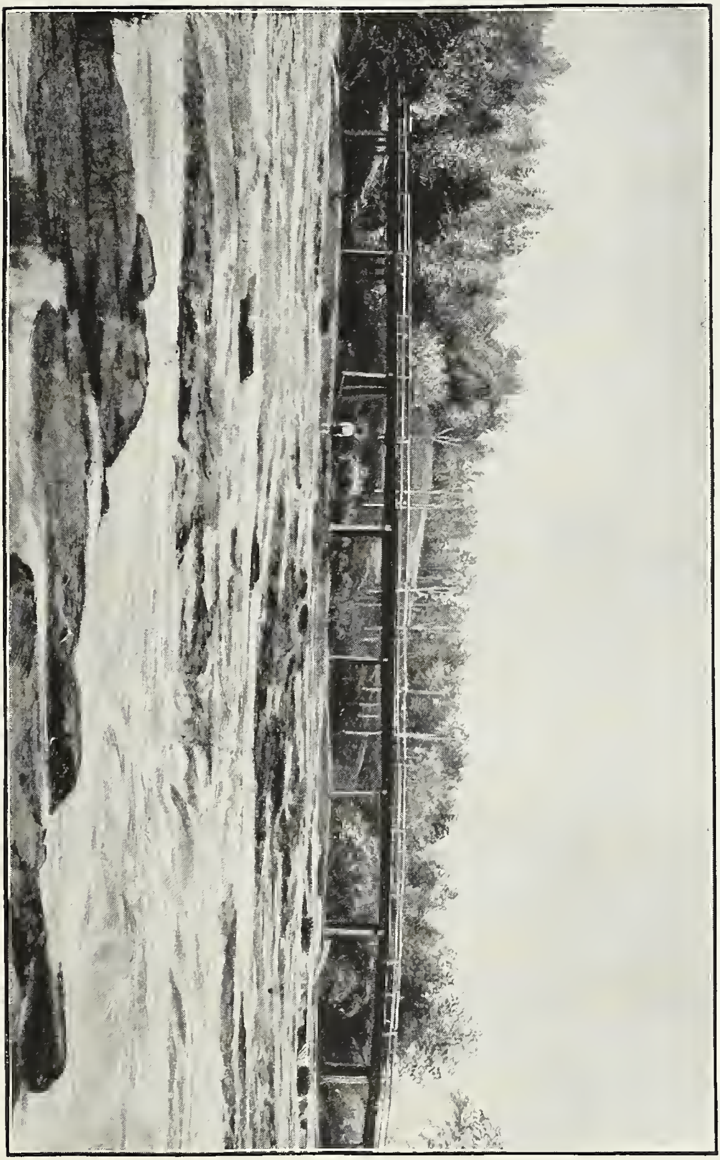
In Georgia, the two best powers on the Railway, are Roger's Shoals on Potato Creek, two and a half miles west of Thomaston, and at Tobler's.

Roger's Shoals. This is one of the best powers in Georgia. It consists of a succession of shoals, and within half a mile, the fall exeeeds sixty feet, most of which is at three or four points. As the valley is deep and narrow, the waters could be dammed to any desired height. The volume of water is large,and even without being accumulated by a dam, it is capable of supplying power to several large mills. The Engraving facing this page represents the surface of one of the main shoals, at a point where there is a fall of about fifteen feet. The photograph was taken from an elevated island in the rapids, and thus does not show the fall of the water. Here also, there is an abundance of gneiss or granite rock (over which the waters rush) for either building, or for dam construction.

Tobler's Rapids are over two exeellent shoals, and in situation are not inferior to the Roger's, but the volume of water is smaller, yet the daming facilities are excellent.

In Alabama, there are several good powers along the Railway.

At Louina, there is now a dam of six feet, thrown across the Tallapoosa River. The volume of water is very large, and the river is wide. Below the village, near where



the Railway crosses, there is a lower dam. But at about two miles above Louina, the rapids are much greater. In fact, it is the best power along the Railway, in Alabama. The height would be fifteen feet or more. The width of the river is considerable, but it is broken by islands, which would be favorable for the building of factories, and thus the full extent of the broad water-power could be more easily utilized.

There are smaller powers at Bluff Springs, and near Hillabee. Off the survey, a short distance, there is now a large factory at Rock Mills, and there are several other factories only a few miles from the Railway.

Craigdale or Taylor's Mills. West of the Tallapoosa, we find an excellent power at Craigdale, about four miles east of Talladega. Here, there is a stream cutting a *canon* through slaty rocks. The present dam across the narrow gorge is fifteen feet high. But a dam, or a succesion of dams, could be easily raised to seventy feet. At the head of the present dam, across the Talladega Creek, there is a low water-fall as shown in the picture opposite page 83. This is by far the best water-power in the vacinity of Talladga, and it would doubtless be used to its full extent, if railroads were passing close to it. It is an excellent site for any of the rising iron or other manufacturing industries of the Talladega valley.

West of Talladega, the most important water-power is the dam at the crossing of the Coosa River. It is now six feet high, but could raised to double that height. The government is at work in rendering the river navagable. The river is several hundred feet wide, and the volume of water is great. Beyond this point, there are no important powers, although, there are several of small volumes, such as that at Landrum's Mills.

As the whole of the country, traversed by the Railway, is through a cotton belt, there is every reason that many factories should spring up. There are scores of small mill-sites near the road, some of which are now used for corn or other mills. In fact, with the railway facilities for getting grain, the local millers could afford to grind it in place of importing the flour already made.

Many local industries will doubtless spring up as the country is opened to further settlement, and more easy commercial facilities; and these industries will in many cases cause towns to arise adjacent to natural water powers.

VI.—SPRINGS AND RESORTS.

Warm Springs, a few miles westward of Thomaston, is a local resort. The water is only a few degrees above the natural temperature of other springs of the district. Here there is a very large stream of beautiful water, welling out from the foot of a hill, covered with loose stones, the size of cobble, which is led into some bath houses. With the expenditure of some capital in the building of a small hotel, the importance of these Springs would increase, for there is no other particularly favored resort in this part of country.

Chandler's Springs. These are situated one mile east of Porter's Gap, upon the eastern side of the Blue Mountains of Talladega, and have an elevation of nearly a thousand feet above the sea. The situation is rather beautiful. The springs are chalybiate. Around them, there are twenty cabins or more, and at times as many as two hun-

dred people have been summering here. But, at present, the Springs are rather inaccessible, requiring the traveller to take a along drive over the mountains from Talladega. When the Railway will pass through Porter's Gap, there seems to be good reason to suppose a more important resort might be built up.

Craigdale.—The *canon* of Talladega Creek, as it emerges from the mountains at Taylor's Mills, into the smiling valley, is by far the most beautiful situation for a summer resort along the whole line of the Macon and Birmingham Railway. The gorge is one of the most beautiful and picturesque sites in Alabama or the South, Here, at the lower end of the gorge, there is a dam which backs up the water about half a mile, between bold walls of slaty rock, which often overhang the creek, and give shelter to boats which may rest beneath them. At the head of the dam (which ought to be raised eight feet) there is a picturesque fall amongst the rocks as shown on the plate facing this page. Above the falls the rapids may be ascended for miles. The creek is one of the few streams that cut across these mountains, and hence the features are bolder than those of the valleys which run parallel the mountains. The hills about Cragdale are as picturesque as the gorge itself. There are very few resorts which have, in addition to the general attractiveness, such a beautiful lake. The future of Craigdale is perhaps unsettled—whether the water-power will cause it to become the site of a manufacturing suburb of Talladega; or whether, with the Railway a mile or two off, it becomes a summer resort, remains to be seen.

VII SUMMARY OF THE FREIGHT-PRODUCING RESOURCES ALONG THE MACON AND BIRMINGHAM RAILWAY.

The physical features along belt explored are such that the Railway can be built with a maximum grade of only fifty-three feet per mile, across a comparatively direct course, so as to reduce the distance to about 240 miles. The different geological formations are discribed (p. p. 5-20), so as to show those which contain useful minerals, and those from which the different soils are derived.

Of the different minerals, iron, coal and limestone are the most important, as they make this South country amongst the richest regions in America.

In the Birmingham district, there are already about twenty-five furnaces, and more are in construction. The capacity, in 1890 will reach about 800,000 tons of pig iron, the cost of which can be reduced to between seven and eight dollars a ton. The present freight, by way of Savannah and the sea, to New York is about $3.85 a ton (see p. 50 and following). The route to the sea, by the Macon and Birmingham Railway, will be more direct and of easier grade than any of the existing roads. A large amount of the iron produced now, reaches the northern market by way of longer roads and the sea.

Although the production of iron is very large, the manufactures from it are still in their infancy in the South, but they are rapidly growing.

The valley, in which Talladega, Anniston, etc., are situated, furnishes an enormous quantity of ore, but the production is as yet less than a fourth of that in the Birmingham district—the capacity for 1890 being about 175,000 tons. Much of this is charcoal iron. About Talladega there is room for many new furnaces. And this is the finest iron in the South. The first Talladega furnace has a

capacity of about 35,000 tons a year, and a second is shortly to be built. The natural outlet for this iron is by the Macon and Birmingham Railway; either to the east or west. Besides freight on iron, the furnace consumes about 450 tons of coke a day, which would naturally come over the road from the west. And I think it quite safe to predict that as many as eight or ten furnaces can be developed, in the valley adjacent to the survey. All of the coke,carried to the Talladega region for new furnaces would naturally pass over the Macon and Birmingham road, and this would add enormously to the tonnage. A portion of the iron from Anniston, Janiper and Ironaton would also find its way over this road, as it is now carried by longer routes to the sea.

Another large source of tonnage for the road will be the brown ores for Birmingham, as they are sought after for mixing with the local ores. (see p. 27 and following.)

A number of other localities (p. p. 33-35) is given, which will yield ores for shipment, if not for local furnaces, at local towns.

Some idea of the magnitude of the mineral industries of the Birmingham district may be drawn from the quantity of the coal product, which now reaches about 4,500,000 tons a year (p. 45). Not only the supply of coke for the furnaces along the Railway, but also the supply of coal for the whole line, and for much of Central Georgia, should be carried over the Macon and Birmingham Railway. This road passes over the Cahaba coal fields (p. 37 and following). The quantity is practically unlimited, and the quality is amongst the finest in the United States. It is generally better than the more western coals.

The marble and the limestones (p. 45 and following) are in large quantities and will furnish considerable freight for the road the largest tonnage being for furnaces, and for the sup-

plying lime along the Railway, and to Central Georgia. The land would also be benefitted by the free use of lime.

Gold, pyrites and graphite will add to the industries of the country, and thus to the tonnage. (p. p. 56, 59, 60).

The fine beds of granite and of roofing slate will doubtless afford freight both ways (p.p. 62, 66) as well as the limestone and marble for building purposes.

The timbers and the tan-bark will furnish large quantities of freight for some time to come.

The water-powers afford excellent sites for mills and factories, several of which already exist (p. 80.)

A large proportion of the belt forms an excellent agricultural country, much of which is now very distant from railway facilities (p. p. 69-77). As the population is thin, (and mostly of Whites) there is room for the development of thousands of new homes, (p.78).

From the agricultural and commercial points of view, the necessity of the road is felt. Add to this, the mineral wealth. The railroad is certain to get a fair share of the 800,000 tons of iron which represent the the capacity of the furnaces of the Birmingham district. Also much of the 175,000 tons of the Talladega and Anniston district, will pass over the road, besides a large amount of the incoming coke. A still larger proportion of the future tonnage of the immediate Talladega region may be looked for, which, from the natural resources, promises to reach in a few years, to three or four hundred thousand tons of iron, and much more than that of coke.

THE GEOLOGICAL MAP.

The outlines of the Geological formations were determined by the Geological Survey of Alabama. Although a belt of rocks, extending in both directions from Porter's Gap, is crystalline, it is represented as Palæozoic (and not Archæan) for it is regarded as a metamorphic Cambrian formation.