GEOLOGISTS'
TRAVELING HAND-BOOK
AND
GEOLOGICAL RAILWAY GUIDE

WACHARIAH

THE GEOLOGIST'S TRAVELING HAND-BOOK.

AN AMERICAN

GEOLOGICAL RAILWAY GUIDE,

GIVING THE

GEOLOGICAL FORMATION AT EVERY RAILWAY STATION,

WITH

NOTES ON INTERESTING PLACES ON THE ROUTES,

AND

A DESCRIPTION OF EACH OF THE FORMATIONS,

BY

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WITH THE COÖPERATION OF THE STATE GEOLOGISTS, AND OTHER SCIENTIFIC GENTLEMEN.

NEW YORK:
D. APPLETON AND COMPANY,
549 & 551 BROADWAY.
1879.

THE OBJECTS AND USES OF THIS WORK.

1. FOR THOSE WHO ARE NOT GEOLOGISTS.

The United States are intersected by numerous railroads leading in all directions, and nearly every one has occasion more or less to travel on them for considerable distances. In these railway journeys no person who has the least power of observation can fail to notice the peculiarities in the scenery and the great variety in the formations of rock to be seen in the railway cuts and cropping out on the hillsides. If we always had a professor of geology for our traveling companion, we would be glad to learn from him what these various formations of rock are, what place they occupy in the series of strata that are visible on the earth's surface, and their mineral and other productions; also at what other localities the same rocks occur, and whether they are entirely new to us or the same we have seen elsewhere. This work is a substitute for the supposed traveling professor of geology, giving in a small space the names of the geological formations which occur along the lines of the railroads, and in another part of the book is to be found a plain but full description of each of them. There are also foot notes directing attention to interesting geological places and objects on the routes of the railroads. One object of the work is to teach persons not versed in geology something of this science during the tedious and unprofitable hours of traveling, without study, not as in a text book, but by pointing to the things themselves as seen at railway stations and through the windows of a railway car.

No person could be so stupid as to travel all over the United States without learning the name of a single state or city through which he passes, yet how few persons know even the names of the geological formations on which they have spent their lifetimes. Every one is taught geography, and there is scarcely a child of sufficient age who cannot tell the name of the town, county and state in which he lives. But geology, which is just as well worth knowing, is neglected, and there is but little opportunity for learning any thing practically in regard to it from those about us. This is not owing to a want of a desire for knowledge, but to a want of instruction in this science, and of the practical application of what is learned by adding local geological information in a handy, cheap and accessible form, and this, which no other work affords, it is the aim of this book to furnish.

There are some kinds of knowledge too that cannot be obtained from books, but must be gathered by actual observation. The inspection of a formation in nature, which is pointed out to you, will teach you more in regard to it in a few minutes than you could learn from lectures or from reading books in as many hours, and the lesson so received will be better remembered. This book is intended as an intelligent guide to such observations. It tells you where the various formations are, and you can then see for yourself in traveling what they are.

How lonely would be a journey on which you would see not a single face that you know, and how different it would be if every one you meet were an old friend. So to the tourist new charms must be given to scenery, however attractive it may already be, if he knows something about its geology. The rocks, mountains, valleys and plains, although he sees them for the first time, are old friends in perhaps new and interesting forms. He meets them with a certain pleasure, for he understands what he sees and he is given the materials for many a happy hour of quiet and profitable reflection at home, on what he has seen on his railway journey.

2. FOR GEOLOGISTS.

But while the book is thus intended primarily as a series of object lessons for those to whom geology is yet a novelty, for the purpose of exciting an interest in, and which may ripen into a love for the science, it is believed that, being in a more convenient form than geological maps, and as no other work has attempted what is here done, all geologists, and especially students, will find it a most useful hand book on their railway journeys as well as for reference at home. It will be useful in laying down the geology in colors on any map which gives the railroads. Accurate geological maps can thus be made without expense, and there is no better exercise for students. It will also be invaluable in selecting a route of travel for geological study or for pleasure, and no geologist should make an excursion over new ground without this guide. It is a scientific catalogue of the great panorama that passes with its ever shifting scenery before the eyes of the American railway traveler, and even an artist finds a catalogue of a picture gallery very necessary. No geologist need be told that it embraces the result of a vast amount of learning, labor and research in a very small compass, and a minuteness of local geology for which he might ransack libraries in vain, and which no one man could possibly furnish. Many men for many years have devoted the finest talents in America to the study of the geology of these states, and all have contributed by their published reports, or by direct original contributions to this work, portions of the knowledge which is here indexed, otherwise it would not be becoming for the author to say so much in its praise. In order that the guide might be as accurate as possible the assistance of the state geologist of each state, or that of some scientific gentleman best acquainted with its local geology, has been invoked to revise and correct the list of formations found along the railroads. Without a single exception, and with characteristic devotion to the cause of science,* this aid has been very cheerfully and promptly rendered, and in not a few instances, where the necessary information was only in the knowledge of these gentlemen, they have filled in the geology from original sources not yet published. Due credit is given to all contributors in the notes of the proper chapter. The general accuracy of the book can be relied upon as to the formations of each locality as they were understood at the time of its publication, and it may be regarded as in harmony with the latest results of geological research. If errors are found, consider the great number of railroad stations and you will wonder there are so few.

*Scientific men freely give the results of their labors to the world, expecting only in return to enjoy the consciousness of having added by their investigations to the sum of human knowledge, and to receive the credit to which they might justly entitle them. PROF. JOSEPH HENRY.

3. FOR USEFUL, PRACTICAL PURPOSES.

To those who take only utilitarian views and care nothing for pure science, and to all those in any way interested in the country, a means is here furnished for ascertaining the natural advantages or disadvantages of any district where there is a railroad, for it is now pretty well known to all intelligent persons that the capabilities or resources of a country, what it is and what it can become, depend chiefly on its geology.

No one in our day can doubt, that there is a definite and orderly arrangement of the rocks, that it is only in certain rocks that certain useful materials and minerals are to be obtained, and that the soil of each formation has a certain fixed value for agriculture. It was long ago shown that a geological map of England, is a map also of the distribution of its manufactures. Even the kind of people inhabiting a district, often depends on its geology. A considerable portion of the work of geologists, is devoted to tracing out the distribution of the various formations as they come out from beneath one another, and spread over the face of the country. This book is made up of a minute tabular statement or division of all places on the American railways, into classes, some of which yield useful materials or productions peculiar to them. It points out the limits to be observed in searching out new locations producing any material. Besides, if accompanied by a correct scientific knowledge of the country, it will make any man's discovery of anything useful available to his neighbors in hundreds of other places, over the whole region covered by the same formation.

The physical structure of a country being then, the means by which we can learn the range and distribution of useful materials, a strict attention to fossils is necessary, to enable us to determine the relative position of rock groups, each group, within certain limits, holding its own peculiar fossil forms, and certain economic products being confined, over wide areas, either wholly or principally to certain rocks. Many persons, ignorantly confounding the means with the end, think geologists are good authorities upon fossils, but not as to the useful properties of the formations. Sir William E. Logan, the great Canadian geologist, in answer to this objection, once said: "I am not a naturalist; I do not describe fossils, but use them. They are the geologist's friends, who direct him in the way to what is valuable. To get the necessary information from them, you must be able to recognize their aspect, and in order to state your authority, you must give their names. Some of them tell of coal—they are cosmopolites; while some give local intelligence of gypsum, or salt, or building stone. One of them helped us last year to trace out, in Canada, upwards of fifty miles of hydraulic limestone."

But it is not practicable for ordinary readers to understand the difficult science of paleontology; all they can expect to know are the results as ascertained by professional geologists, and those results are given in this little book, for every place on every railroad in America. There are many other things that might have been given, especially the structural geology of each State, geological maps, more minute lists of elevations and general physical geography, but the book contains enough for one little volume to be carried about on railway journeys.

TOWANDA, Pa., 1878. JAMES MACFARLANE.

Business Office, Syracuse, N.Y.

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Prof. J. D. Dana's Table of the Geological Formations (1878).

Systems or Ages.	Groups or Periods.	Formations or Epochs.
Age of Man.	20. Quaternary.	20. Quaternary.
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	16. Triassic.	16. Triassic.
Carboniferous.	15. Permian.	15. Permian.
	14. Carboniferous.	14 c. Upper Coal Measures. 14 b. Lower " " 14 a. Millstone Grit.
	13. Subcarboniferous.	13 b. Upper Subcarboniferous. 13 a. Lower "
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	7. Lower Helderberg.	7. Lower Helderberg.
	6. Salina.	6. Salina.
	5. Niagara.	5 c. Niagara. 5 b. Clinton. 5 a. Medina.
Lower Silurian.	4. Trenton.	4 c. Cincinnati. 4 b. Utica. 4 a. Trenton.
	3. Canadian.	3 c. Chazy. 3 b. Quebec. 3 a. Calciferous.
	2. Primordial or Cambrian.	2 b. Potsdam. 2 a. Acadian.
	1. Archæan.	1 b. Huronian. 1 a. Laurentian.

The numbers and letters of this table are attached to the same formations or their equivalents throughout the book.

DESCRIPTIONS OF THE GEOLOGICAL FORMATIONS.

INTENDED FOR RAILWAY TRAVELERS WHO ARE NOT VERSED IN GEOLOGY.

All the rock-formations which appear on the surface of the globe, have been scientifically classified by geologists, according to the order in which they are found lying one upon another, and by the fossils they contain, and for our object may be conveniently included in twenty divisions or groups. In this work, the table of the names of the formations, groups and systems, published by Prof. J. D. Dana in his "Manual of Geology" and in his "Text Book of Geology," has been taken as the general basis, by the geologists of many of the states who have assisted in preparing the following guide, but other valuable tables and especially one arranged by Dr. T. Sterry Hunt, preceding the chapter on Canada, and a list for each state at the beginning of the proper chapter, are also given. Numbers are attached to the names of the groups wherever they occur, making 20 in all. The subordinate members of each group, which are called formations, have the same number, but these sub-divisions are distinguished by the addition of small letters, a, b, c, etc., thus making in all 40 sub-divisions. By this means, the reader, although not familiar with geological tables, is at once enabled to see to what part of the general series any formation belongs, number 1 designating the oldest and number 20 the upper and last formed of all. Wherever the formations are found, they occur in the order as they are numbered, but the series in nature is never full, and in almost every locality one or more members of it are wanting.

The true method by which each of the great stratified formations is distinguished is by its own characteristic fossils, but these descriptions, having been prepared for travelers, are confined to the general aspect of the rocks as seen in passing them on the railways. They are intended to be popular rather than scientific, informing the reader what the formations are, what they look like, and their useful and valuable characters, qualities, and productions. It must also be borne in mind that this is a country of vast dimensions, and that the formations undergo important changes in their lithological character from place to place.

Paleontology, and other interesting branches constituting the purely technical portion of the subject, are omitted. That ground has been well covered by all of the excellent illustrated text-books on geology, and one object of this work is to induce persons to take up their study. Results only are here given, not the method, by which they are attained. The thicknesses of the formations are sometimes stated, but as this might mislead the unprofessional reader, it should be observed, that the width of the surface occupied by a formation depends on the amount of dip in the beds. A group less than a hundred feet thick, lying horizontally, may cover several miles, while one of several thousand feet thick, if lying at a high angle, is soon passed over.

I. EOZOIC, (ARCHÆAN, AZOIC.)

I. PRIMARY OR CRYSTALLINE ROCKS.

The late investigations of American geologists have enabled them to establish several divisions in the crystalline stratified rocks, which were originally called Primary or Primitive. The name Azoic, formerly given to the Primary rocks to distinguish them from the Paleozoic formations, has, since the discovery of Eozoon in the former, been exchanged for that of Eozoic. The designation Archæan or ancient rocks, is used by Professor Dana and others, and applies to the Primitive formations without distinction. Among those who have made the Primitive or crystalline rocks a special subject of study for many years, no one is more eminent than Dr. T. Sterry Hunt, and as no proper account of the four groups into which he divides them;—namely, 1 a. Laurentian, 1 b. Norian, 1 c. Huronian, and 1 d. Montalban, has yet appeared, the following descriptions, which he has kindly furnished for this work, are a very valuable contribution to the science of geology.

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1 a. Laurentian.—The name of Laurentian was given in 1854, by the geological survey of Canada, to the ancient crystalline terrane which forms the chief portion of the Laurentide hills of Canada, and the Adirondacks of Northern New York.

Throughout these areas the prevailing rock is a strong, massive gneiss, reddish or grayish in color, sparingly micaceous, but very often hornblendic. The predominance of this mineral occasionally gives rise to a nearly pure hornblende-rock, sometimes with a little intermixed feldspar. The gneisses are, for the most part, distinctly stratified, but occasionally the evidences of stratification are not very apparent, so that these rocks have often been designated granites. This series is distinguished by the absence of chloritic, talcose, argillaceous or micaceous schists. It includes, however, crystalline limestones, of which there are supposed to exist, on the Ottawa, three distinct formations in the Laurentian series, each of which is, in parts, according to Logan, more than 1000 feet in thickness. These limestones, which are generally coarsely crystalline, are often magnesian, and abound in foreign minerals, chief among which are serpentine, chondrodite, hornblende, pyroxene, magnesian mica, apatite and graphite. All of these occur both disseminated in the beds, and, aggregated with other minerals, in veins, or endogeneous masses. Associated with these limestones are often considerable beds of quartz-rock, sometimes garnetiferous. Great masses of magnetic oxide of iron are also found interstratified in this series. The measured thickness of the Laurentian gneisses, with their included limestones and other rocks, on the Ottawa, where the strata are nearly vertical in attitude, has been estimated at over 17,000 feet. Beneath these, known as the Grenville series, there is a great mass of granitoid gneiss, without limestones, and of undetermined thickness, called the Ottawa gneiss, which, it is conjectured, may not be conformable with the upper portions, but is, as yet, included in the Laurentian series.

In the Atlantic belt, considerable areas of Laurentian occur in Newfoundland, and probably in several parts of New England. A range of Laurentian rocks from the western part of Connecticut extends southwestward, forming the Highlands of the Hudson, and making the South Mountain as far as the Schuylkill; while a smaller range of the same, to the southeastward, forms the Welsh Mountain, in Pennsylvania. Little is known of the distribution of the Laurentian farther southward along the Atlantic belt, but the gneisses near Richmond in Virginia, and those of Roan Mountain, in North Carolina, are referred to this terrane.

Large areas of Laurentian occur around Lake Superior, and farther west in the Rocky Mountains, where they form the crystalline rocks of the Colorado range in the east, and the Wahsatch in the west, and probably occur in many other parts of the region. To the Laurentian belong the gneisses of the Western Islands of Scotland, those of Scandinavia and Finland, and large portions of those of the Alps. The limestones of the Laurentian contain the remains of a foraminiferal organism known as *Eozoon Canadense*, (Dawson) which has been found in several localities in Canada, and also in Bavaria, and in Finland. Accompanying it are several other small forms. regarded as organic, and referred to the protozoa.

1 b. Norian.—The upper portion of the Laurentian series on the Ottawa river, was originally defined by the geological survey of Canada as consisting of a rock, gnessoid or granitoid in character, made up chiefly of labradorite, or related anorthic feldspars, but including also true gneisses and crystalline limestones, not unlike those already described in the Laurentian. Subsequent studies in Canada led to the conclusion that these rocks constitute a distinct terrane, resting unconformably upon the gneisses and crystalline limestones of the preceding series, and the two were respectively designated as Lower Laurentian, and Upper Laurentian or Labradorian. As the newer is very distinct from the older terrane, it has, however, been thought better to restrict the name of Laurentian to the latter. A series precisely similar to the upper one occurs in Norway, where, as in North America, it rests upon Laurentian gneisses, and where the name of norite has been given to the feldspathic rock which is its chief characteristic. Hence the name of Norian, which has been chosen, in place of Upper Laurentian, as the designation of the terrane. It is conjectured, from the fact that it has yet been found only in contact with the Laurentian, and from its including gneisses and limestones lithologically similar to those of the latter, that it is next in age.

The norites consist, for the greater part, of anorthic feldspar, sometimes almost without admixture, but at other times accompanied by small portions of hornblende, of pyroxene or of hypersthene, constituting what has been called hypersthenite or hyperite. Red garnet, green epidote, biotite, and ilmenite are often present, and all of these minerals are generally arranged in such a way as to give a gneissoid structure to the rock. The texture is sometimes fine-grained and compact, and at other times more coarsely granular, and even granitoid, displaying great masses of anorthic feldspar, frequently opalescent, and varying in composition from anorthite to andesine. The colors of the norites vary from white, pale bluish or greenish to dark lavender or smoke-blue, or nearly black The characters of the associated gneisses and limestones, as already remarked, are similar to those of the Laurentian. Great beds of highly titaniferous iron ore abound in the Norian series.

The principal area of this terrane known in the United States is in Essex County, New York, where it covers several hundred square miles, and, although highly inclined, rests unconformably, according to Professor Hall, upon the Laurentian. It is well displayed upon the shore of Lake Champlain between Port Kent and Westport, and forms some of the the highest hills of the interior. A second large area of Norian occurs north of Montreal, where it is similarly related to the Laurentian, and passes below the Potsdam sandstone. Other localities along the valley of the St. Lawrence are at Château Richer near Quebec, at Bay St. Paul, the Bay of Seven Islands, and on the River Moisic. Extensive areas of it also exist on the coast of Labrador. The same rock has been found on the east shore of Lake Huron, and in Wyoming Territory. Boulders of it are occasionally found along the eastern shores of Maine and Massachusetts, and also in northern New Jersey, whence it is conjectured that the Norian terrane may occur in the South Mountain.

1 c. Huronian.—The name of Huronian was given, in 1855, by the geological survey of Canada, to a great series of more or less schistose crystalline rocks, shown to rest unconformably upon the Laurentian gneisses, on the north shores of the lakes Huron and Superior, and to make up a part of the Huron Mountains, on the south side of the latter. A similar terrane forms a great portion of the Atlantic belt in Newfoundland, in the province of Quebec, and in western New England, where these rocks have been described as the Green-Mountain series, and are traced southwestward along the Blue Ridge. Another range of the same stretches along the northwest side of the Bay of Fundy, and thence is traced, at points, along the coast of Maine, to eastern Massachusetts and Rhode Island. The rocks of this series are everywhere highly disturbed, often vertical, and have a thickness of many thousand feet.

In this series, the gneisses of the Laurentian are represented by rocks consisting essentially of an admixture of orthoclase-feldspar and quartz, which frequently assumes the character of a jaspery petrosilex, becoming porphyritic by the presence of crystals of feldspar, and of quartz, in a compact base. In other cases, it becomes granular, constituting a eurite, and passing into a fine-grained gneissic rock, the colors being generally of some reddish or purplish tint. These petrosilex rocks, which resemble the *hälleflinta* of the Swedish geologists, are sometimes schistose, and finely laminated, but at other times are compact, and almost destitute of stratification. The basic portions of this terrane are represented by varieties of greenstone (diorite or diabase) which are often chloritic, and pass by insensible degrees into chloritic schists, frequently with epidote. Steatites and dark colored serpentines also abound in parts of this series, besides what are commonly called talcose or nacreous schists, owing their peculiar characters to a soft hydrous mica, which is not unfrequently disseminated in very quartzose beds, and gives to such a schistose character. The limestones of this series are, for the most part, dolomitic, and often weather to a rusty yellow, from the presence of more or less carbonate of iron. These dolomites are sometimes replaced by crystalline magnesite. Portions of this terrane, including alike chloritic, dioritic and quartzose rocks, are conglomerate in character, frequently containing pebbles derived from the Laurentian, with others from unknown sources. The Huronian series abounds in ores of copper, chrome, nickel and iron. To it belong the specular and magnetic ores of northern Michigan; while the ores of these same species in southeastern Missouri are found in Huronian petrosilex-porphyries. These last are best seen in

the region just named, in the South Mountain in Pennsylvania, south of the Susquehanna, and along the eastern coasts of Massachusetts and New Brunswick. The Huronian rocks are penetrated in many cases by eruptive rocks, both granites and dolerites. A series of rocks, which the writer has referred to the Huronian, appears in parts of the British Islands, notably in Donegal, Ireland, in Anglesea, and in Caernarvonshire. The crystalline rocks which underlie unconformably the Lower Cambrian strata in South Wales, and to which the name of Dimetian has lately been given, seem, from the descriptions, to belong to the Huronian terrane. The great series in the Alps, called by the Italians the greenstone group, or *pietri verdi*, has both the lithological characters, and the geognostic relations, of the Huronian; and the similar crystalline schists found in California, in the foot-hills of the Sierras, and in the Coast range, are probably to be referred to the same horizon. The gold-bearing veins of California are found both in these crystalline schists and in the eruptive granites.

1 d. Montalban.—This name was given, in 1872, to a great mass of crystalline schists, which are lithologically and geognostically distinguished from the Huronian, and are well displayed in the White Mountains (whence their name). They occupy large areas in New England, and constitute the gneisses and mica-schists of New York Island, of Philadelphia, Baltimore and Washington. A similar group of rocks is found at the summit of the Huronian series, in northern Michigan; and from this, as well as from the facts observed on the Schuylkill, and many other places, they are believed to be younger than the Huronian, although some geologists have supposed them to be older. Similar rocks are traced southwestward from the Potomac, throughout the Blue Ridge, of which they form, in Virginia, North and South Carolina and Georgia, an important part, and are there gold-bearing.

The gneisses of this series are distinguished from those of the Laurentian by being finer grained, and having white feldspar. They are, moreover, less firm, and more tender, often containing silvery mica, and pass by insensible gradations into the coarse mica-schists of the series, which are very unlike in aspect to the soft unctuous mica-schists of the Huronian. Hornblende prevails in many parts of the series, and the gneisses, by its predominance, pass into a bluish-black hornblende-rock, often thin-bedded. Noticeable among the basic members of the terrane, is the granular olivine or chrysolite-rock, which, often accompanied by enstatite, and by serpentine, appears to be interstratified in the micaceous and hornblendic schists of the Montalban, in North Carolina, and in Georgia. Crystalline limestones are found in this terrane, often in considerable masses, and resemble somewhat, in the presence of hornblende, apatite and graphite, the limestones of the Laurentian.

The Montalban series exhibits beds and veins of iron-pyrites and copper-pyrites, in many localities, but the oxidized iron-ores which abound in the preceding series, are scarcely known in this. The fine-grained gneisses of the Montalban, are commonly known in New England by the name of granites, but the series is also penetrated by great masses of true eruptive granite. The mica-schists of the series are remarkable for the abundance of crystallized garnet, staurolite, chiastolite and cyanite which they contain; these species, with the exception of the first, not being, so far as known, found in the Laurentian series. The endogenous granitic veins, carrying muscovite, dichroite, spodumene, tourmaline, beryl, columbite, tinstone, and apatite, in the Atlantic belt, are chiefly, if not wholly, found in the Montalban series.

T. Sterry Hunt.

2-15. PALEOZOIC.

2-4. CAMBRIAN (OR LOWER SILURIAN) AGE.

2 a. Acadian.—This series is found at Braintree, in Massachusetts, at St. John, in New Brunswick, and at St. John, in Newfoundland. It includes one thousand feet or more of fossiliferous sandstone and shale, and according to Dr. Hunt, corresponds to the Menevian of Great Britain. It has only been found along the north-eastern border of the Atlantic belt. It is remarkable as a fossiliferous rock below the Potsdam, which had, before its discovery, always been considered as the lowest formation of that description on the continent.

2 b. Potsdam.—The Potsdam sandstone, was for a long time considered as the lowest sedimentary fossiliferous rock. It is usually of a purely quartzose character, generally gray, though often striped, and sometimes partially or entirely red. In places it appears as a conglomerate, but sometimes the enclosed masses are angular, showing them to be near their source.—Hall, N. Y. R., 27. It is a hard silicious sandstone, white, red, gray, yellowish, and frequently striped. Some strata of this rock are covered with the most beautifully characterized ripple-marks as perfect as if just formed on the sand of a sea-beach, while the rock is the most indurated kind of sandstone. Its lower portion is a granitic conglomerate, in which large masses of quartz, the size of a peck measure, are often enveloped; they are rounded and water-worn, and held together by a finer variety of the same material. On the Canada slope, where the mass is 300 feet thick, it is wholly a conglomerate, made up of coarse materials. The part which is properly a sandstone, has two principal varieties, a close grained, sharp edged mass, with natural joints traversing it in two directions, but so closely wedged together that it is quarried with difficulty. This is the Keeseville variety, and that of Pa. and N. J. The other, the typical mass at Potsdam, is an even bedded and somewhat porous rock, at many places a distinct friable sandstone, in others a yellowish-brown sandstone, the particles of which are compacted together, so as to form a firm, even-grained mass, with the planes of deposition perfectly smooth and separable from each other, the layers being from two inches to four feet thick. At Potsdam quarries, a layer of 100 square feet may be raised and split into rails, six inches wide and ten feet long, or it may be broken into pieces the size of a brick, with even edges of fracture, and each layer may be separated into many. The color here is yellowish-brown, and a deep red variety occurs at Chazy, resting immediately upon the primitive rock.—Mather, 102. It is nowhere charged with mineral matter, either disseminated or in veins. The native copper of Lake Superior is in an old trappean formation, and has no relation to the neighboring extensive formation of Potsdam. In an economical point of view, the Potsdam is unimportant as a depository of useful substances.

The general color of the stone at Potsdam is yellowish-brown, but the tint of each layer differs somewhat from those adjacent to it, so that the rock, upon the fractured edges, wears a slightly striped aspect. It is the finest quarry stone in the state, being so perfectly workable and manageable.—360. It is an excellent building material, holding mortar well, and makes a dry house.—29. Under the Potsdam, and upon the primary rock, is the position of the specular and red oxide of iron.—V. 267.

In Minnesota, the lower portion of the formation is 400 feet thick, and is hard and often vitreous, and usually of a brick-red color, with very distinct layers, often separated into slaty layers by partings of red shale, strongly marked with fucoidal impressions, frequently ripple-marked and cracked. The upper part of the formation, there called the St. Croix sandstone, is white or buff in color, often friable, and constitutes a heavy bedded or massive sandstone of rounded quartzose grains.—N. H. Winchell.

In Minnesota and Iowa, the Potsdam proper, omitting the St. Croix sandstone, is a friable, crumbling mass, of no value for building purposes except as sand, consisting of a pure silicious sand in minute grains, with a very slight amount of cementing matter. Unless protected by some more resisting rock above it the Potsdam appears in steep slopes, or low, gently swelling hills and mound-like eminences. Those portions which are hard and enduring are cemented by oxide of iron, and have a brown color.

In Wisconsin, the Potsdam is 800 to 1000 feet thick, and has a much larger surface-development than elsewhere, as will be seen by the great number of railway-stations on it. It extends over 12,000 square miles, and contains many fossils not found in New York. Where the Potsdam in Wisconsin is on the surface, and not covered by drift, there is usually a loose, sandy soil, with a sparse growth of small oak and pine timber. This formation is one that has been very properly allowed to retain its original name almost undisputed all over the United States, except that Professor Owen at first called it the Lower Sandstone, in the North West to distinguish it from the 3 c., St. Peters or Upper Sandstone.

In Michigan, the Potsdam is the red sandstone, which is emphatically the chief rock that appears upon the immediate coast of the whole south shore of Lake Superior, and forms the Pictured Rocks and the Falls of St. Marie. Here it is of inconsiderable thickness, but it regularly thickens in going westward.—Houghton, 4th R., 500. Some have referred the Lake Superior sandstone to the age of the Chazy, but the late studies of Rominger show that it is really of Potsdam age. The Chicago Tribune office building is of this Lake Superior sandstone, and the Court House at Milwaukee is another conspicuous specimen.

In Pennsylvania, the Potsdam is a compact, fine-grained, white and yellowish vitreous sandstone, containing specks of Kaolin.

The Potsdam formation is supposed by some to be represented in the Green Pond Mountain of New Jersey by a local deposit of coarse conglomerate, 3000 feet thick, but others deny that this mountain is Potsdam. It is less than 30 feet thick where it is seen rising from beneath the limestones of the Lehigh River, but increases in thickness westward and southward, until it comes to be represented in Tennessee by many thousand feet of alternate coarse and fine deposits. See Safford's Geol. R. of Tenn.

3 a. Calciferous.--This group embraces in New York three distinct masses as to character and position, and these alternate and intermix with each other. The first is silicious, compact, and may probably be the continuation of the Potsdam sandstone. The second is a variable mixture of fine, yellow, silicious sand and dolomite or magnesian carbonate of lime, which, when fractured, presents a fine, sparkling grain. It is in irregular layers, which have a shattered appearance, from numerous cracks, the parts being more or less separated from each other. This is the mass from which the name Calciferous sandrock was derived. The third is a mixture of the dolomitic material, which is usually yellowish, very granular when fresh broken, and of a compact limestone, which resembles the Birdseye. The action of the weather gives these layers the appearance of Gothic fret-work, and the color becomes a dark yellow-brown.—V 21. As its name indicates, it is a sandy magnesian limestone, but it is not destitute of beds of pure limestone. The mixture of a variety of mineral matter causes the rock to weather unequally; hence it is often rough externally, portions of the silicious part standing out in relief. There are two quite uniform characters which distinguish the Calciferous, viz: A fine crystalline structure intermixed with earthy matter, and numerous small masses of calcareous spar.—E. 105. Great numbers of quartz crystals are found in the cavities of this formation, many of them very perfect as to form and transparency.—V. 30.

In the Mississippi basin this formation is called the Lower Magnesian Limestone, to distinguish it from the Upper or Trenton limestone. The eastern name, Calciferous or lime-bearing sandrock, does not apply, as it is almost free from sand. As its western name indicates, it is a dolomite or magnesian limestone, and makes an excellent lime for building-purposes. It usually contains about one equivalent or forty-five per cent. of carbonate of magnesia. This limestone forms the summits of the bluffs of the Mississippi; it supports high table-lands that extend back from the river, and forms prominent angles to the summits of the bluffs on either side of that river. These even and heavy layers are those usually quarried for building-stone. D. D. Owen gives descriptions of the picturesque character of the landscape in the region of the Upper Mississippi, and especially the striking similarity which the rock exposures present to ruined structures, and his report is illustrated by beautiful engravings showing the castellated appearance of the cliffs of the Lower Magnesian limestone on the Iowa River. In Pennsylvania it is a coarse, gray calcareous sandstone, containing cavities enclosing very minute crystals of quartz and calcareous spar.

3 b. Quebec.—This group was divided by Sir W. E. Logan into three parts, consisting, in the ascending order, of 1. Levis, 2. Lauzon, and 3. Sillery. But it afterwards appeared that the section on which this order was based was an inverted one, and that the Sillery was the oldest.

The Quebec group is about 7,000 feet in thickness. The lowest, or 1. Sillery subdivision, is a massive greenish sandstone, fine and coarse grained, frequently a conglomerate of white quartz pebbles, and is 2,000 feet thick. The sandstones are sometimes slightly micaceous, with small scales of green and black shale. They usually present massive beds, and at Sillery some of the layers are quarried and used for building purposes at Quebec. The 2. Levis, or middle portion of the Quebec, is 1400 feet thick. It is named from Point Levis, opposite Quebec, and consists chiefly of fossiliferous limestone-conglomerates. The 3. Lauzon or upper

member, as the order is now understood, is 1,839 feet thick, of black graptolitic slates. The Quebec group, however, presents somewhat different characters in various parts of its distribution. The districts where it is developed are characterized by great faults and inversions of the strata, rendering, as appears above, even their order uncertain.

Dr. Hunt, in his table of formations, places the Sillery below the Potsdam and Calciferous, and the Levis above them, including in the Levis alike the graptolitic slates, the Lauzon, and the fossiliferous limestones of the Levis of Logan. The Quebec group extends along the west side of the Green Mountain range, and covers a considerable part of the State of New York, east of the River Hudson, the rocks being part of the non-fossiliferous clay-slate formerly called the Hudson River slate, which outcrops near Poughkeepsie. The area is divided, on the west, from the true Hudson-River slate formation by the great fault mentioned in note 8 of New York.

3 c. Chazy.—To the Quebec group succeeds the Chazy limestone. As a whole, it is a dark, irregular, thick-bedded limestone. At Chazy, New York, on Lake Champlain, it contains many rough, irregular, flinty or cherty masses. At Essex the beds are more regular, and form, in consequence, a better building stone. As a limestone it is purer than the Calciferous, being non-magnesian ; the principal foreign matter is silica in the form of chert. It is free from the brown earthy spots, and the masses of brown calcareous spar so common in the Calciferous sandrock.

This formation is 130 feet thick on Lake Champlain, but it is less constant in the series than the others, and as it is not an important formation on the lines of the railroads, an extended description is not here necessary. It is not found in the valley of the Mohawk. Its fossils are found in Pennsylvania and Virginia, but its limits are not there defined. In the Northwestern States the St. Peter's sandstone occupies the same place in the series as the Chazy in the east.

3 c. St. Peter's Sandstone, (Upper Sandstone of Owen).—This is a western formation and does not occur in the Eastern states, but Prof. Lesley thinks it may have representatives in the massive silicious members of the great limestone-mass of from 5,000 to 6,000 feet thick, as measured along the two branches of the Juniata in Pennsylvania. It is first recognized in going west, to the southwest of Winnebago Lake. It is also seen up the Mississippi, near St. Paul and St. Anthony, and on the streams of northeast Iowa, and at La Salle, Illinois, where it is brought to the surface by an anticlinal axis. It is remarkable for its uniform thickness, which is from 72 to 100 feet over a space of 500 miles in length and 400 miles in width. In Central Wisconsin, however, its thickness is very irregular. It is also of the same character throughout, being composed of wonderfully uniform and exceedingly minute grains of sand, held together by the merest trace of cement, so that the mass may easily be moved with shovel and pick, as is everywhere done for the purpose of obtaining sand for mortar. This sandstone, though usually white, sometimes assumes a buff or brown color from the presence of iron, and in some localities it becomes red or is marked by bands of a bright green color. It appears like a recurrence of the Lower or Potsdam sandstone. Being composed almost entirely of pure silica it is, when not colored by oxide of iron, one of the very best materials yet discovered in the west for the manufacture of glass. It is the same as that known in Missouri as saccharoidal sandstone, which is carried to Pittsburg, Pennsylvania, and used by the glass-makers in manufacturing the best kinds of glass. See Note 2, Missouri.

4 a. Trenton Limestone.—Next in ascending order occurs the 4 *a. Trenton* limestone which, in the Northwestern States, is divided into the Buff limestone and the Blue limestone. In Wisconsin there are two buff and two blue beds alternating. They are undoubtedly the same as the well known Chazy, Birdseye, Black River and Trenton limestones of New York and other Eastern States. They are known in the West wherever the exposures reach to the upper sandstone.

The upper member of the 4 a. Trenton limestone, in South Western Wisconsin and the adjoining parts of Illinois and Iowa, is the very important GALENA or lead-producing limestone, which has no exact representation in the Eastern States. It is a light gray or yellowish-gray, heavy-bedded rock. It is compact, minutely crystalline throughout, often with small cavities lined with crystals of brown spar, and the whole thickness of the formation is 250 feet. The Galena or lead ore contains 13.4 per cent. of sulphur and 86.6 per cent. of lead, and is found in heavy bodies in crevices in this Galena dolomite or magnesian limestone. Prof. J. D. Whitney, in his admirable report on the geology of the lead region of Southwestern Wisconsin, has proved that these lead deposits must have been introduced into the fissures by precipitation from above. The lead mines of Missouri are chiefly in the Lower Magnesian limestone.

In Wisconsin, a very noticeable feature of the Trenton limestone is its marked division into the two parts before mentioned. One, which is the lower half, is very heavy bedded, in layers of two or three feet thick, known as the glass-rock, and the other thin bedded, in layers of two or three inches. There is always a stratum of carbonaceous shale from a quarter of an inch to a foot or more in thickness, which separates the blue or Trenton from the thin bedded Galena limestone above it.

Professor R. D. Irving describes the Galena limestone as almost invariably a very compact, hard, crystalline rock, of a yellowish-gray color, with numerous small cavities filled with a softer material, or lined with crystals of calcite. The upper portion is thick-bedded and free from flints, the layers being from one to four feet thick, while the lower portion almost invariably consists of several feet of layers from one to two inches thick. Good exposures of parts of the Galena limestone are frequently to be met with. It may be seen in cliffs and ledges, on nearly all the streams in the lead-region, where it weathers irregularly, leaving the surface full of small cavities, due to the removal of its softer parts. The formation contains masses of flint in layers, or in irregular pieces, which are principally confined to the middle and lower parts of the formation, although not entirely absent from any part.

In the interior valleys of Pennsylvania, as for example, in Sinking Valley, Blair Co., considerable quantities of zinc-ore, and some galena, have been found in the Trenton limestone group, which is there at least 1,000 feet thick. The lead-mines of Wythe Co., Virginia, are at the same, or at a somewhat lower horizon. The zinc mines near Bethlehem, Pennsylvania, and near Landisville, Lancaster Co., are nearly of the same geological age. Isolated crystals or small masses of galena occur in crevices in the limestone beds of this age throughout the entire range of the great valley from Newburgh, on the Hudson, to Chattanooga, in Tennessee. The limestones in this valley, which are the Auroral limestones of Rogers', are, by some geologists, referred to an older series. See, in this connection, the foot note on page 21.

In the State of New York the lower part of the Trenton is called the Birdseye. It is a perfectly pure limestone, and the next layer, which is the middle or Black River sub-division, is sometimes used as a marble. It is solid, hard and easily worked, by reason of its conchoidal fracture, and is valuable for lime and for building.

The upper part of the formation, or Trenton limestone proper in New York, consists of two distinct varieties, at Trenton Falls. The first or upper part, is a dark or black colored, fine grained limestone, in thin layers, separated regularly by black shale or slate, forming the great mass in which the creek has worn its channel, and in which are all the falls. See Note 62, New York.

The second, or lower part of the Trenton proper, is a gray, coarse grained limestone, in thick layers, and it is quite crystalline. This is the quarry-stone at Prospect, above Trenton Falls. At Montreal, the church of Notre Dame and many other structures, are constructed of the gray variety of the Trenton limestone, quarried behind the city, but the thinner layers, when not dressed, are of a more pleasing color, and make a handsomer building-stone.

The Trenton formation in all parts of the United States, is almost always a limestone. A conspicuous example of the Trenton, Utica and Hudson River formations, is seen in the long continuous and beautiful valley of the Hudson and Lake Champlain, the Kittatinny valley of New Jersey, the Cumberland valley of Pennsylvania, the Shenandoah valley of Virginia, and the valley of East Tennessee. The fertility of its limestone land is almost inexhaustible. The deposits of brown hematite iron-ore, found in the soil, and occupying hollows or basins in the softer limestones below the Trenton in so many places, and in such large quantities, are supposed by some to be of aqueous origin, and not strictly a product of this formation, which is only its receptacle. But many other geologists,—R. M. S. Jackson, A. A. Henderson, Lesley, Platt, Prime and Frazer, have all agreed in advocating the opposite view, each from his own independent studies. They derive the limonite beds either from the solution of the ferriferous limestone layers, or from the intercalated micaceous slates, or from the pyrites-bearing slates of the neighborhood. According to Dr. Hunt, it comes from the change of masses of iron-pyrites and of carbonate of iron, originally imbedded in the limestones and slates. See the foot note on page 21.

4 b. Utica Slate.—The Trenton limestone is succeeded by a dark or black carbonaceous slate, called the Utica slate. In Pennsylvania this formation is everywhere darkly colored, and the coloring matter is probably derived from abundant remains of marine plants or animals. While the black color of some of the clays in the brown hematite ore banks of the upper range (immediately beneath the Utica slate) as at the mines in Lehigh Co., Pa., and the Brandon ore mine in Vermont, seems to be derived from the black slates of the Utica, the gray color of some of the limestones, and of the carbonate ores, (as at the Saucon zinc mines) is known to be due to disseminated graphite.

Within the State of New York, it is everywhere black, and usually soft and fissile. Thin beds of impure limestone are associated with it in many places, and sometimes thin layers of carbonate of iron, and it passes into the Trenton limestone by gradual interstratification. Thus bands of slate are interstratified in the limestone, and thin strata of limestone containing fossil remains in the lower part of the slate. These crumbling shales may generally be distinguished by their dark blue-black and brownish-black color, but there are some strata among the

grits of the Hudson River that can scarcely be distinguished from these. The Utica slate weathers ash-gray, rapidly disintegrates, and, where it is exposed in cliffs, frost and other agents constantly break it into small fragments, which collect at the base in the form of a talus. In Pennsylvania, it outcrops, with little or no variation, as a dark blue carbonaceous slate and shale, extremely fissile in its lower beds. It forms the surface-rock along a narrow region in the Mohawk Valley. In East Tennessee, the beds both of Utica and Hudson River, or Cincinnati, are of great extent, and consist of blue calcareous and sandy shales, with some layers of calcareous sandstone. Professor Hall considers the Utica slate as properly the lower member of the Hudson River group.

4 c. Hudson River, (Cincinnati, Nashville, Loraine and Frankfort sandstone and shale.)—The rocks of this group in New York are mostly slates, shales and gray, slaty and thick-bedded grits. The slates and shales are generally dark brown, blue and black, and the grits are gray, greenish and bluish-gray. They are stratified and conformable, alternating a great number of times, without any regular order of alternation, and in Eastern New York are from 500 to 800 feet thick. The first New York geologists called this formation the Greywacke, and it is still so called by the stone-cutters on the River Hudson. Its lower portion was called the *Frankfort* slate and sandstone, and the upper part the *Pulaski* shale and sandstone, which latter were afterwards called the *Loraine* shale. Wherever streams have passed over it they have, in process of time, worn in the rocks a deep channel or gorge, sometimes preventing a free communication across them, as at Loraine, (See note No 69, New York.) By decomposition, it produces a tenacious, clayey soil, favorable for grass, forming the best dairy-land, as in Orange Co., New York, about Goshen and Middletown. It increases in thickness southward so rapidly that at the Delaware and Lehigh water-gaps, measurements of 5,000 feet have been made through it, from its top downwards, without reaching its lower limit.

In many places along its last outcrop towards the Atlantic, it has furnished many masses of a substance resembling anthracite, also beds of impure limestone, and beds of red shale, which increase very much going south into Virginia.

In Pennsylvania, the Hudson River slate consists of blue and greenish-gray shale, alternating with gray calcareous and argillaceous sandstone in thin beds. The sandstones grow more abundant as we ascend in the formation. The middle portion, where much metamorphosed and intersected by cleavage-planes, in certain localities, produces a good roofing-slate, as at Slatington and Delaware Water Gap, Pa.

The geologists of the western states generally, have dropped the designation of Hudson-River, at least in regard to strata west of the Alleghanies, and have substituted for it the name, CINCINNATI, proposed by Worthen and Meek; making this term co-extensive with the former. In this guide, Hudson-River is used in the Eastern and Cincinnati in the Western States. At Cincinnati the whole series is about 800 feet thick, and, according to Dr. Newberry, by its fossils, is the equivalent of the Chazy, Trenton, Utica and Hudson-River, all blended together. In Ohio it is composed of alternating beds of limestone and shale, the latter sometimes called blue clay. The limestone is an even-bedded, firm, durable, semi-crystalline limestone, crowded with fossils. It is commonly called the blue limestone, but the prevailing color is grayish-blue, and the weathered surfaces show yellowish or light gray shades. In Southern Illinois the lower part of the Cincinnati is composed of brown sandy shales and sandstone, and the upper portion is a thin-

bedded, dark bluish-gray, fine grained limestone, two to six inches thick, with shaly partings between the layers. In Northern Illinois it is bituminous, and consists of sandy shales with thin bands of limestone. In Iowa it is the Maqueketa shales, which are bluish and brownish shales forming a stiff clay soil. In Missouri the upper shale bed only is found, with an occasional flag-like limestone layer.

On the west bank of the River Hudson this formation continues uninterruptedly from Kingston to Saratoga Lake, and on the east side of the river also, it is clearly defined along the valley, with a width of from one to several miles, varying and irregular in outline from Rhinebeck to Lake Champlain, its eastern limit approaching the river at the former place.—J. Hall, A. A. A. Sci. 1877.

The N.Y. C. & H. R. R. R. runs on it for 65 miles, from below Rhinebeck to Troy, and the formation continues along the river many miles further northward. The name Hudson River is, therefore, highly appropriate for the formation. The shales and impure sandstones are upturned, and thereby modified in character along the river, but they are no older than the horizontal rocks in the Mohawk valley, a few miles west of the River Hudson, and at Frankfort, Loraine and Pulaski. They have the same fossil contents, and their direct continuity can be traced. There is, it is true, a great mass of metamorphic shale and sandstones to the eastward of those on the river above described, and between them and the state-line, which contains different fossils, and belongs to an older formation, called the Quebec group. But the Hudson River formation is the same which extends through Canada and the Northwestern States, and southward through Ohio, Kentucky and Tennesee, where it is called the Cincinnati and Nashville formation. It is very much to be regretted that the original name of Hudson River has not been everywhere retained.

There is more confusion and uncertainty about the Cambrian or Lower Silurian formations in many localities than about any other portion of the whole series. The difficulties arise from the scarcity of fossils, the disturbed and altered state of the greater part of its rocks, from the absence of those which should immediately precede and follow them, and which if present would show their position in the series, and also from the difficulty of distinguishing them from those of greater age adjoining them, and with which they are really or apparently blended.*

*Overlying the various crystalline terranes described on pages 10–13, along the western border of the Appalachian mountain belt from the Gulf of St. Lawrence to Alabama, are found extensive formations, differing, it is said, from those, and from the fossiliferous rocks above them, which have been the subject of much discussion. To these rocks, as displayed in the Taconic hills of New England, Prof. Emmons gave the name of the *Taconic system*, which he divided into a lower and an upper series. The views of Emmons are still held by Dr. T. Sterry Hunt, and others, and there is a growing belief in favor of the existence of such a series of rocks; but they are opposed by Mather, Hall, Logan, Rogers, Dana, and the great majority of American geologists, who hold that Emmons's Lower Taconic series is the stratigraphical equivalent of the Potsdam, Calciferous, Quebec, Chazy, Trenton, Utica and Hudson River, and his Upper Taconic, of the succeeding Oneida and Medina formations; their lithological differences from the same formations further west, being due to some agency which has changed them, inducing crystallization, and obliterating their organic remains. The purposes of this work will be best subserved by describing the formations in accordance with the received opinions, of geologists, generally, without entering on controverted ground, and merely stating briefly, that what is designated as the Upper Taconic, extends from Orange County, New York, above Newburg, across the River Hudson, and through Dutchess and other counties of Eastern New York; thence through Western Vermont and Canada, as far as the city of Quebec and beyond. The Lower Taconic, including a granular quartz-rock, and the Stockbridge limestone, with roofing-slates, and soft, so-called talcose slates, extends from Vermont along the western base of the South Mountain and the Blue Ridge, underlying the great Appalachian valley, as far as Alabama, and having a thickness of 5000 feet. There is also a range, more or less continuous, of this formation, from Delaware into North Carolina, where it is found at the eastern base of the Blue Ridge, resting on the Montalban.

According to Dr. Hunt, the Lower Taconic constitutes a fifth crystalline series, younger than the Montalban, and by him distinguished by the name of TACONIAN, which includes the Auroral limestones and the Primal slates of the Appalachian valley, with their limonites and crystalline iron-ores, and also the itacolumites and the pyrophyllite slates of North Carolina. The Upper Taconic, which comprehends the Quebec group of Logan, consists, in his view, of uncrystalline strata of Cambrian age, below the horizon of the Trenton limestone.

5-8. SILURIAN (OR UPPER SILURIAN) AGE.

5 a. Medina.—The lower member of this formation is a pebbly sandstone or grit called the Oneida conglomerate, being the same as the Shawangunk conglomerate. The upper member is called distinctively the Medina sandstone, and is usually a red or mottled argillaceous sandstone.

1. The Oneida conglomerate in New York is composed of quartz pebbles rarely exceeding three-fourths of an inch in diameter, and of white or yellowish quartz-sand. In some localities there is some interposed greenish shale. The source of its materials was to the south, the rock being 500 feet thick in the Shawangunk Mountain at Wurtsburg, on the N.Y. & Os. Mid. R. R., and 1000 feet thick in some parts of Pennsylvania and Tennessee. The greatest thickness of the Oneida in the eastern part of New York is 30 to 40 feet, but in the western part the same place is occupied by a gray quartzose sandstone, fine grained and compact. Passing upwards, the gray sandstone intermingles with the Medina sandstone, which, in its lower parts, differs chiefly in color. The red color of the Medina sandstone seems to be partially communicated to the gray below, which is often striped and spotted with red. There is, lithologically, no very strong line of demarcation between the two rocks. The oxide of iron, the red coloring matter of the upper member, has been transfused through the material of the lower as far as its particles could find admittance. The flagstones in the side-walks of Buffalo and Rochester, of a white color clouded with red, are of this formation.

In New Jersey the gray sandstone formation consists of a thick series of hard, white and whitish gray siliceous rocks, of various degrees of coarseness, from that of a fine grained, pure sandstone to that of a quartzose conglomerate with thickly-set pebbles averaging half an inch in diameter. This is the summit of the long, straight mountain ridge called the Kittatinny or North Mountain, extending from near the Hudson River into Virginia.

In Pennsylvania the Oneida conglomerate is a compact, greenish-gray, massive sandstone, containing in many places thick beds of siliceous conglomerate, and the Medina sandstone proper is a thick mass of alternating red shales and red and gray earthy sandstones. It is the North Mountain of the great Cumberland valley.

At the Delaware Water-Gap the whole mass of Oneida and Medina consists of seven massive plates of coarse sand and conglomerate, separated by more argillaceous layers from each other. Going west, the number, according to Prof. Lesley, is reduced to five, and finally in Middle Pennsylvania to two, each of them very thick, and making its own mountain-crest when the dip is vertical, while the intermediate softer red mass forms a little valley between the crests. The whole formation is about 1,900 feet thick. When the dip is gentle, the Oneida makes a beautiful lofty terrace upon the flank of the mountain, the crest of which is always made by the Upper Medina. Traced southward through Virginia into Tennessee, this formation gradually thins away to 50 feet, as seen west of Knoxville.

2. The Medina sandstone proper succeeds the gray sandstone, there being no definite line of division between them. In this rock is found the *Fucoides Harlani* affording a positive character whereby to recognize it in the series. This sandstone is almost invariably of a red color, generally a brown-red, more rarely variegated light red and yellowish, and in a few rare instances of a light or whitish color,

partially greenish. It is both fine grained and coarse grained, the latter usually of the deepest color, the former more variegated. The lower falls of the Genesee, below Rochester, 110 feet in height, are formed by this rock. The deep gorge and high cliffs on both sides of the Niagara River, at Lewiston, New York, are more than one-half excavated in the Medina.

In New Jersey it is a thick formation of red and variegated sandstones and shales. Its lower beds are a dark red sandstone of a very ferruginous composition, and extreme hardness, and in the middle and upper divisions of a brownish red shale and a very argillaceous sandstone, partly calcareous.

Neither the Oneida nor Medina are found west of Ohio. Some large masses of galena and copper-pyrites with blende, have been found in the Oneida or Shawangunk grit, on the Erie R. R. east of Port Jervis and at Ellenville, but they were soon exhausted. When the Medina is a heavy coarse rock it produces a poor, barren country, but in Western New York it is more calcareous, and the soil is much better.

5 b. Clinton.—This group consists of many different kinds of rocks or masses, from which circumstance it was first called the Protean group. The name of Clinton was given to it on account of the characteristic masses being found around the village of Clinton, in Oneida County, New York. It consists of green and black-blue shale, greenish, gray and red, soft marly layers, often laminated calcareous sandstone, encrinal sandstone, and red fossiliferous iron-ore beds. The most persistent member of the group is the shale. It is bluish when fresh quarried, but when long exposed it is always of a greenish hue. The next member is the greenish sandstone, which is in thin layers, having its surface generally covered with *fucoides*. This also has a bluish tint when fresh quarried. The third persistent member consists of two iron-ore beds in New York and several in Pennsylvania.

The term Protean is still applicable to the Clinton group, which, in some places, consists of thin shaly sandstones, shales, and even conglomerates; in others, of thin bedded, impure limestones, shaly sandstones, iron-ores, etc: still again it appears as a duplicate series of shales, limestones and iron-ores, with some intermixture of sandy matter, all containing an abundance of marine shells. In the west the formation is limestone, and is of a more uniform character.

The Clinton formation produces the celebrated fossiliferous iron-ore, generally known as the FOSSIL ORE, which occurs in it in every state from New York to Alabama. In all its localities this ore is red or brownish-red, very hard, and where unaltered, invariably oolitic or in larger sized concretions. In New York, where it is extensively mined, there are two beds of it, generally about 20 feet apart, and upon an average about a foot and more in thickness. The oolitic particles are usually more abundant in the lower, the larger sized concretions in the upper bed. The two beds never appear at the same locality, or in the same line of section, but where the lower one occurs the upper one is wanting, and where the upper one occurs the lower one is not found.

In Pennsylvania the Clinton is a very extensive formation, nearly 2,000 feet thick, of slate, shales, sandstones and iron-ore, with the same variety as elsewhere, and its iron ore is very rich, productive and valuable. The outcrop of the ore-beds have been traced for hundreds of miles. In Dodge County, Wisconsin, near Milwaukee, the Clinton iron-ore, at Iron Ridge, is from 15 to 18 feet thick, but this is very unusual, and it is not in the same part of the formation as the fossil ore in the east. The deposits of this ore in East Tennessee and in Alabama, called the Dye-stone ore, are still more extensive.

5 c. Niagara.—This group consists of two distinct members, a shale below and a limestone above.

The shale in New York constitutes a very uniform deposit, while the limestone, from a thin concretionary mass in the east, becomes an extensive and conspicuous rock, constantly increasing in thickness, in a western direction, even far beyond the limits of that state. The cataract of Niagara is produced by the passage of the river over this limestone and shale, and, from being a well known and extremely interesting point, as well as exhibiting the greatest natural development of these rocks in New York, this name was adopted for its designation. In this vicinity, the limestone is 164 feet thick, with the shale beneath 80 feet thick. The lower part of the Niagara group exhibits a great development of dark bluish shale, which, on exposure, gradually changes to gray or ashen color, and forms a bluish or grayish marly clay. In this state it is undistinguishable from the ordinary clays, and its outcropping edges, when long weathered, are often considered as clay beds. The Niagara is a very extensive formation, but its shales are much more persistent and wide spread than its limestone member in the east, but the limestone is more widely spread in the west. The gorge below the upper falls at Rochester is the best place to study these shales. In an agricultural point of view, this formation, like all limestones, is an admirable one. There is no better soil than that of the Niagara about Rochester, New York.

A silico-argillaceous limestone, in New York, forms the beds of passage from the soft shale below to the purer limestone above. It is of a dark or bluish color when freshly exposed, but soon changes to light gray or ashen. These beds of passage are succeeded by a dark bluish gray sub-crystalline limestone, of a rough fracture. and separated into thin courses by dark shaly matter. The third member is a coarse grained concretionary mass, in irregular layers, exhibiting a very peculiar contorted appearance, as if much disturbed while in a semi-fluid or yielding condition. The concretions often present cavities lined with crystals, or contain the remains of some organic body. This is the surface-rock in West Avenue in Rochester.

The Niagara limestone is the great limestone which, in Wisconsin, occupies the peninsula between Green Bay and Lake Michigan, and then stretches southward to the south limits of the state, and far into Illinois and Indiana. It will be noticed in looking over the Guide, how many railroad-stations in the western states, just mentioned are on the 5 c. Niagara, and how very extensive the formation must be. Its general appearance is that of a regularly bedded brown or buff dolomite, with occasional intercalations of beds of massive gray limestone. The quarries of beautiful buff limestone at Athens and Joliet, Illinois, so much used in Chicago for building-purposes, are in this formation. At Joliet there is 40 feet in thickness of this buff and gray limestone. West and northwest of Chicago the Niagara limestone is highly charged with petroleum, which oozes from the stone, blackening the face of walls built of it. On Goat Island, at Niagara Falls, the petroleum is also seen on the limestone in small quantities. In Michigan it is a grey crystalline, rather fine grained, moderately fossiliferous, dolomitic mass, 218 feet thick on Green Bay.

In Western Canada the upper part of the Niagara limestone contains peculiar fossils, and is called the Guelph, and in Wisconsin it is subdivided into the 4. Guelph, 3. Racine, 2. Waukesha and 1. Mayville beds.

This formation establishes the topographical distinction between the lower plain of Canada, in which lie Lake Ontario and Georgian Bay, and the upper plain of the United States, on which lie Lakes Erie, Huron and Michigan. Its terrace crosses Ontario, growing loftier as the thickness of the formation increases northwestward, until it becomes a range of limestone mountain-land, forming the peninsula between Lake Huron and Georgian Bay. It is there broken down in a range of islands, and reappears as a peninsula, just mentioned, cutting off Green Bay from the western shore of Lake Michigan.

The Niagara and other limestones above it, seem not to have been deposited in Pennsylvania between the Delaware and Susquehanna rivers, and in Middle Pennsylvania. While the limestones below it are well represented, the Niagara is wanting as a separate formation, and its characteristic fossils are scattered through the Clinton rocks.

6. Salina, (Onondaga Salt Group.)—This is an important group in the State of New York, containing all the gypsum and water-lime, and furnishing all the salt water of the salines of the city of Syracuse, which produce more salt in a small territory than any other in the world. Its soil is excellent for agricultural purposes, forming, with those south of it, including the Hamilton, the garden-region of the State of New York. The whole group is about 700 feet in thickness, and is divided into five deposits, but there are no well defined lines of division between them, except the last two.

1. The first or lowest is a red shale, showing green spots at the upper part of the mass. The great mass is of a blood red color, fine grained, earthy in fracture, with no regular lines of division, but breaking or crumbling into irregular fragments, and shows but little variation. In several localities the red shale shows numerous green spots, varying from an inch or less to several inches in diameter, which strongly contrast with the red ground on which they are placed. The green color is the result of a chemical change, the peroxide of iron being reduced to protoxide. This red shale is of great extent along the railroad, and presents a thickness of from one to five hundred feet, yet nowhere has a fossil been found in it, or a pebble, or anything extraneous, excepting a few thin layers of sandstone. The main line of the N. Y. C. & H. R. R. R. runs on the Salina formation 107 miles, from Canastota to Brighton, and nearly all of this distance on this lower or red shale portion.

2. The second deposit is the lower gypseous shales, the lower part of it alternating with the red shale, which ceases with this mass. This second deposit consists of shales and calcareous slates of a light green and drab color, with alternations of different colored masses, red, green, bluish and yellow, with a little whitish and greenish sandstone, different colors predominating in different places. In this deposit gypsum occurs in fibrous masses, either reddish or of a salmon color, which colors are peculiar to this deposit. The quantity of gypsum in this second deposit is comparatively small, and it is unimportant in an economical point of view.

Both the second and third deposits are permeable to water, which cannot be obtained in any of the hills composed of them unless the wells are sunk to the level of the water-courses, a fact which explains the absence of all brine-springs above the level of the country.

3. The third member of the Salina formation is the gypseous deposit, which embraces the great masses quarried for plaster or gypsum, consisting of two ranges, between which are the hopper-shaped cavities, the vermicular lime-rock, and other porous rocks. This is the most important deposit, not only on account of its plaster-beds, but because it is only in this deposit that we have positive evidence that salt has existed in a solid state, and, therefore, the only source whence the saline springs of Syracuse could have been derived. The great mass of the deposit consists of rather soft yellowish or drab and brownish colored shale and slate, and of more compact masses which are hard, a brownish color predominating. It is usually denominated a gypseous marl, being earthy and indurated, slaty and compact. Some of it when weathered, presents a peculiar appearance, as of having been hacked by a cutting-instrument, with some regularity. The gypsum does not appear in layers or beds, but it occurs in insulated masses, and it assumes irregular not globular forms. The dark color of the gypsum is owing to carbonaceous matter. In many localities there are two ranges of these masses or plaster-beds, generally separated by the vermicular rock and the hopper-shaped cavities. There are two masses of the vermicular rock, the upper one four feet thick, with large porous cavities, the lower one twenty feet thick, with small pores. This vermicular limestone is a porous or cellular rock, resembling lava. It is dark gray or blue in color, and perforated everywhere with curvelinear holes, but otherwise very compact. The holes or cells vary from microscopic size to half an inch in diameter, the cells being very irregular, and communicating with each other, some being spherical, and the resemblance in structure to a porous lava is complete. Forms which are due to common salt have been discovered in this rock, showing the presence of crystals of this substance, which were removed by solution.

The most interesting products of the group are the hopper-shaped cavities, which must have been produced by common salt, as no other soluble mineral presents similar ones. They show conclusively that salt existed in this third deposit. When salt crystallizes, a cube first makes its appearance upon the surface of the brine, then similar cubes form around its border, being attached to its upper surface, near the edges, while it gradually sinks, and additional particles are added, forming another row of cubes upon the first range. This is many times repeated, until the density of the mass formed becomes greater than the liquid, when it falls to the bottom. When examined, being turned upside down, it shows a pyramid of regular steps, terminated by a cube, and when its position is reversed it presents a form like the hopper of a mill. Where two ranges of plaster beds are seen the hoppers occur between them, and between the two massses of vermicular rocks, and are from one inch to three inches and more in diameter. These hopper cavities are formed in the gypseous marl, or in the more solid parts of the vermicular rock. Testaceous animals cannot live in water saturated with gypsum, hence no fossils are found in the deposit. No trace of rock-salt in New York has met the eye of any one, but the existence of it is a matter of no doubt.* The fact of the difficulty of obtaining water in the gypseous hills, in either the second or third deposit, show there is little probability of finding salt above the level of the waters on account of its having long since been dissolved. See Note 27, New York, as to the salt-wells at Syracuse.

*After the above was written, rock-salt was first found, in June 1878, in a boring south of Rochester.

The "Old Road," or the division of the N. Y. C. & H. R. R. R., from Syracuse to Rochester, via Auburn, runs on the gypseous portion of the formation, and the plaster-beds can be inspected at Marcellus station, close to the railroad, but the best gypsum quarries are on Cayuga Lake, just north of Union Springs, the masses being from fifteen to twenty-five feet thick. Sulphuric acid springs, and numerous sulphur springs occur in the State of New York, in the Salina formation, often rising through the crevices of the overlying Water-lime group.

4. The fourth or succeeding portion of the Salina formation, consists of those rocks which show groups of needle-form cavities, placed side by side, caused by the crystallization of sulphate of magnesia, and presenting a finely striated columnar appearance. The rock is a dark gray or drab colored, impure limestone, with cavities containing crystals and often embracing shaly beds. It appears to be a magnesian limestone, its usual color is a brownish drab, also dove color, and it breaks with an earthy fracture.

The Salina formation extends westward across Canada, and the salt-deposits of Goderich in Ontario are in it. Six large beds of rock salt have been found there in boring, measuring in all 126 feet in thickness, at from 1,027 to 1,385 feet in depth from the surface, the beds measuring from 6 feet to 35 feet each in thickness.

The salt-deposits and brine-springs of the world are by no means confined to the Salina formation; on the contrary, they are found in almost all the formations from the oldest to the youngest, and always accompanied by gypsum and red and vareigated marls.

5. The fifth division of the Salina or Onondaga Salt group is the Water-lime, which has generally been considered as belonging to the Lower Helderberg, but which properly is part of the Salina. All the hydraulic cement of the State of New York, known as Rosendale Cement, and Syracuse or Manlius Water-lime, is manufactured from a portion of the stone of this Water-lime formation. It is an earthy, drab-colored limestone and usually consists of two layers of drab limestone, always separated by an intervening mass of blue; it is easily recognized by its gray or ash color when weathered. It has a thickness of not less than 30 feet, and often attains a thickness of 100 feet or more in New York. When the Water-lime is burnt the stone does not slake, if of a good quality. It is ground in a mill, and then it hardens or sets when mixed with water. and remains so under water, its goodness depending on the hardness or cohesion when set. Its peculiar quality is owing to the proportion of silica and alumina it contains. The Water-lime continues across the State of New York, the drab layers which constitute it being always found. The courses into which the layers of Water-lime are sometimes divided show a crenulated or notched surface, like the sutures of a skull, the two surfaces interlocking each other. Professor Hall says the Water-lime is a distinct member, which does not belong to the 7. Lower Helderberg group of strata, but to that below it, the 6. Salina, of which it is the upper member. It is not closely related to either, but more nearly to the Salina, and is much more widely spread than the other members of the Salina. The cement quarries of the Delaware River, between Pennsylvania and New Jersey are in this formation, but cease after passing the Lehigh River westward. The beds near Copley are Trenton or older. In Middle Pennsylvania, where the Salina group, destitute of gypsum and salt, measures 440 feet, the cement beds above measure 580 feet, and the Lewistown limestone (Lower Helderberg) 162 feet, as measured by Ashburner and Billin, in 1876.

7. Lower Helderberg.—In consequence of these rocks being so well developed on the Helderberg Mountains, near Albany, New York, they have received that name. The Lower Helderberg series consists of five limestone sub-divisions, and the Upper Helderberg of four members. They are separated by an important sandstone formation—the Oriskany. The Lower Helderberg, which is well developed in the eastern part of New York, thins out in going west, and at Syracuse disappears entirely. The sandstones also thin out and disappear, so that at Syracuse the Upper Helderberg rests on the Water-lime, the upper member of the Onondaga Salt group. The Lower Helderberg consists, in ascending order, of the 1. Tentaculite limestone, the 2. Pentamerus limestone, the 3. Delthyris shaly limestone, the 4. Encrinal limestone, and 5. Upper Pentamerus limestone.

1. The Tentaculite limestone is the lowest member of the series. Portions of it afford fine building stone, which can be procured in blocks of large size, perfectly solid, and free from cracks or flaws. They vary from ash-gray to black, and present almost every shade between these colors. The strata are intersected by two main systems of joints nearly perpendicular to each other, hence the rock can easily be quarried in large blocks. But much of it is thin-bedded, often thinly laminated, dark blue; its color, texture and composition contrasting strongly with the Water-lime below.—H. The 2. Pentamerus limestone is rarely pure, being more or less mixed with black shale, which gives a dark color to the rock, it being usually a dark gray. It is crystalline in grain, and is in layers, but the lines of division are not straight, and the surface is not even. The whole mass has a rough appearance, and it does not make a good building stone.—V. The 3. Delthyris shaly limestone, as its name implies, is a shaly mass, and consists of alternate beds of shaly and compact limestone. It is an exceedingly interesting rock from the great number of species, the abundance and perfection of its fossils.—Hall, 144. The 4. Encrinal is a compact crinoidal limestone, and the 5. Upper Pentamerus is a bluish gray limestone. In Pennsylvania, according to Rogers, the Lower Helderberg is 50 to 100 feet thick, a diversified calcareous formation, of some shade of blue, argillaceous and flaggy in its lower beds, and shaly towards the middle, with layers and nodules of chert.

8. Oriskany Sandstone.—In New York the greatest thickness of this rock is not more than thirty feet, and usually much less, but in Pennsylvania, Maryland and Virginia it is, in places, as much as 700 feet; even in New York it covers an extensive surface, and is strongly marked in its fossils, which are generally of a large size, and attract the attention of travelers. At the typical locality, Oriskany Falls, the sandstone is twenty feet thick, and is of a light yellow color, friable, and readily crumbling into pure sand; no part of it being sufficiently solid for durable work. One characteristic of this rock is the abundance of small cavities, which have been formed by the destruction of fossils. These present themselves in all cases where the rock is well developed. The porous nature of the mass has admitted the percolation of water, which has dissolved the calcareous matter of the shells, usually leaving casts of their internal structure. As a mass the Oriskany sandstone is a coarse, rather loosely cemented, purely silicious sandstone, of a yellowish white color. Sometimes it is shaded brown or some other dark color. In Pennsylvania it forms rough ridges, with a poor sandy soil. It is used for glass-making, and contains an iron-ore too silicious to be valuable. Some of our geologists (Hall, Rogers, Dana, etc.) place the Oriskany at the top of the Silurian series, and others (Newberry, Lesley, Hunt, etc.) at the bottom of the Devonian.

9-12. DEVONIAN AGE.

9. LOWER DEVONIAN.

9 Upper Helderberg or Corniferous.—This very widely extended formation consists of four important members, the Cauda-galli, the Schoharie grit, the Onondaga limestone, and the Corniferous limestone, the upper member. But in the recent text-books on geology the whole formation is called the Corniferous, which was the name given by Eaton to the whole formation of limestone. It forms the Helderberg range, a high ridge which extends through the State of New York, forming a very rich and productive tract of country. This group of strata, as above limited, and designated the Upper Helderberg by Professor James Hall, is, in his opinion, deserving of recognition as the base of the Devonian, the Hamilton group being the middle, and the Portage, Chemung and Catskill the Upper Devonian.

9 a. Cauda-galli.—This is a fine-grained calcareous and argillaceous sandstone, usually drab and brownish, and blanching by long weathering. It readily strikes the eye by its contrast with its associated rocks, and by the singular marking of impressions strongly resembling the tail of the common barn-yard fowl, from whence its Latin name of Cauda-galli or cock's-tail. Its fossils have been found in New York and at Crab Orchard, in Kentucky. In New Jersey, northeast of the Delaware Water Gap, this and the Schoharie are three hundred feet thick.

9 b. Schoharie Grit.—This is very much like the preceding, but altogether different in its fossils. It is a fine-grained, very calcareous grit, or an arenaceous limestone, naturally brown, but weathering to a gray or drab color, containing a great number of fossils peculiar to this stratum, and is found in the mountain one and one-half miles northwest and northeast of Schoharie, New York, and extends by the Helderberg range to Kingston. The Schoharie Grit is a highly fossiliferous formation, and has a wide geographical extension. Its great number of cephalopods gives it a marked character, but it contains other fossils identical with the limestones above.—H.

The **9 c. Onondaga Limestone** in New York rarely exceeds ten to fourteen feet in thickness, but is very persistent, and is readily recognized by its light gray color, crystalline structure, toughness, and its numerous organic remains. This is one of the most valuable building stones in the Helderberg division, and has been largely quarried near Syracuse for the canal. It is an imperishable stone, having great power to resist the action of air, water and frost. It is generally the rock over which the water flows at the water-falls on the Helderberg range, as at Perryville and Chittenango Falls, and is remarkably uniform in its character. It is more extensive than the Corniferous proper, and it is very rich in beautiful and characteristic fossils. The limestones used for flagging in Syracuse are Onondaga limestone, brought from the typical localities Onondaga Valley and Split-Rock on Onondaga Hill. When wet they make a fine display of fossils of this formation. This stone is also used for building everywhere in Central New York.

9 d. Corniferous Limestone.—For all practical purposes, this and the Onondaga limestone may be regarded as one formation. It extends from the Hudson River to the Niagara River, which it crosses at Black Rock, producing there a rapid current at the International Bridge, at Buffalo, and forming a small island just above the water. It extends far into Canada, is seen at Sandusky City, Ohio, and there forms the bottom of Lake Erie. Its color varies from a light grayish-blue to a black, and is sometimes even a light gray or drab. It contains numerous nodules of flint or hornstone, from which it derives its name. But few if any of the layers afford a pure limestone. Its color varies from black to gray, brownish and light blue. It is usually in regular courses from six to eighteen inches thick, separated by layers of hornstone, and sometimes embracing flattened nodules of the same. This rock is crossed by vertical joints in two directions, giving rise to numerous copious springs of water. An upper division, called the Seneca limestone, is now included in the Corniferous. In New Jersey and Pennsylvania it is a blue and sometimes sparry limestone, including bands and nodules of chert. In Canada and the Western States it is a straw-colored and light gray rock. In its general eastern exposures it is generally bluish. Above the Corniferous are no general limestone masses in the Eastern States, but partial deposits only, the most extensive of which is the Tully limestone, found only in Central New York. There is an astonishing change from the top of the Corniferous limestone to the black shales of Marcellus. Two formations more unlike cannot anywhere be found. Both the Corniferous and Onondaga are included in the Upper Helderberg limestone of Pennsylvania, and on the Juniata they measure together only sixty feet. Immediately upon the upper surface of the Corniferous limestone, lies the valuable and extensive MARCELLUS IRON ORE. This consists of carbonate of iron, which occurs in a bed of pyritous clay, and near the outcrop is changed into limonite.

10. MIDDLE DEVONIAN.

10 a. Marcellus Shales are of a black color, usually dark brown when altered. They greatly resemble the Utica slate in mineral character, and could readily be mistaken for it. They extend in New York from the Hudson River to Lake Erie. The lower part contains some impure black limestone, not in layers or beds, but in interrupted flattened masses. The upper shales are not so highly colored as the lower ones, and are disposed to separate, when long exposed, into small, thin-edged fragments, the result of a peculiar accretionary structure. The fragments often exhibit stains, in spots, from iron rust, and also minute crystals of gypsum, the effect of the action of decomposed pyrites and limestone particles. Some portions of the lower shales are black and friable from small carbonaceous fucoids. Along the whole line of its outcrop it has been dug into in vain attempts to find coal.—Van U. 147. It has two joint planes, nearly at right angles to each other, causing projecting corners of rock, with smooth nearly vertical surfaces. These are sometimes seen in the upper members also of the Hamilton group, and the *septaria* or flattened balls of black limestone also occur in the Genesee shales.

The lower part is very black, slaty and bituminous, and contains iron pyrites in great profusion. In general character the lower part resembles the Utica slate and is not distinguishable from the 10 c. Genesee slate, in its general aspect. When long exposed, the lower part weathers to a brownish or iron-rust color, partly from the presence and decomposition of iron pyrites and partly from bituminous matter. In some situations it retains its purely black color, and scarcely separates

into thin laminæ after long exposure. In many places this rock contains so much bitumen as to give out flame when thrown upon a fire of hot coals. In Western New York it is fifty feet thick, and farther east much thicker.—H.

This important formation carries its broad black outcrops across many of the Middle and Southern States, with comparatively little change, but in the South the black shale is supposed to be Genesee. In the Juniata region of Pennsylvania the Marcellus has been found to measure 875 feet thick, and is there divisible into an upper, middle and lower member, the last consisting of black and brown shales, the surface being stained with iron rust, &c., coated with bituminous matter. In Perry County, Pennsylvania, small coal beds occur in this formation, constituting the oldest known coal-measures, and significantly marking the great change in the general condition of things which either followed or was introduced by the deposit of the Oriskany sandstone.—Lesley.

In speculating upon the origin of petroleum, some geologists have sought it in a process of distillation from the black Marcellus and Genesee shales upward, and of condensation in the oil-bearing gravels and fissures of the overlying formations. Chemists, like T. Sterry Hunt, oppose this view on chemical grounds, others oppose it from other considerations of apparently equal weight. It is a curious fact, however, that at this horizon, and in the Upper Helderberg or Corniferous, occur the petroleum deposits of Upper Canada, while the Pennsylvania oil-deposits lie at successively higher and higher stages in the series.

10 b. Hamilton.—This group takes its name from the town of Hamilton, in Madison County, New York, which contains no other rock, and where the best opportunity exists of examining the members of which it is composed, and where its fossils are in great abundance. It includes all the masses between the upper shales of Marcellus, and the Tully limestone, and is from 300 to 700 feet in thickness in New York. It is important from its fine agricultural qualities, its thickness and extent, commencing at the Hudson and extending to Lake Erie. It consists of slate, shale and sandstone, with endless mixtures of these materials, or, in other words, sandy shale and shaly sandstones, and is not very easily described. There are three distinct mineral masses as to kinds, but not as to arrangement. The first, in the order of the tenuity of particles, is rather a fine grained shale, often fissile or slaty, its color some shade of blue, usually dark or blackish. The second is a coarse shale, often mixed with carbonate of lime, its color blue or dark gray when fresh, but becoming of an olive or brown color by long exposure to the weather, the color being due to manganese. It has no tendency whatever to separate into regular layers, but when a mass has been long exposed it shows numerous curved divisions, the curves very short and irregular, giving it a very peculiar appearance, which is unmistakable. The third kind, which is not so common as the two first, is a well characterized sandstone, and is generally in the upper part of the group, but more or less mixed with either of the two others. It is often in layers, though rarely straight, and usually short, interrupted, sometimes mixed with carbonate of lime. The colors of this kind are of more various shades, olive, greenish and yellowish. One thin layer produces excellent flagstones, but the group generally is deficient in building materials, the shale of the first kind readily crumbling by exposure to the air; the two latter kinds alone furnishing building stone. The best is where limestone forms the cement, and sand is in the

greatest abundance. So rare is the occurrence of regular layers in the group, that their absence is a good negative character, and its brownish or yellowish color, externally, or where weathered, a good positive one of the group generally. This applies to the central, but not to the eastern part of the State of New York. It abounds in fossils, and is admirably characterized by them, numerous species and even genera commencing with the group, and ending with it.—Van U. 150.

In the western part of the State of New York, instead of sandy shale and shaly sandstone, and even tolerably pure sandstone, as in the east, the sand has diminished and the clay increased. The group, as a whole, presents an immense development of dull olive, bluish-gray calcareous shales, which, on weathering, assume a light gray or ashen tint, some thin portions becoming brownish on exposure. The formation thins out very much in going westward, and at Lake Erie has only half the thickness found at Seneca Lake, and is so different that doubt of the identity of the two might arise, if one judged by the appearance only. The Hamilton is the New York lake formation, the following lakes being excavated in it: Otsego, Cazenovia, Skaneateles, Otisco, Owasco, Cayuga, Seneca, Canandaigua, and the north end of Hemlock Lake. The east end of Lake Erie is also cut out of the Hamilton. The upper part of the Hamilton was called the Moscow shale, from a place between Mt. Morris and Rochester, on the Genesee River.

In Pennsylvania the Hamilton shale has been measured on the Juniata, 635 feet thick. It has many hundreds of miles of outcrop, in repeated zig-zags, forming, in combination with the Genesee and Portage above it, ranges of smooth, cultivated hills, of an entirely characteristic shape, in long lines of ruffled slopes, regularly indented with short and smooth ravines. This striking topographical feature, maintains itself throughout the mountain-region into Virginia, and still farther south. The abundance of shells, without limestone beds, in Pennsylvania, furnishes a partial clue to the deposit of the (next succeeding) Tully limestone in New York.

10 b. Tully Limestone.—This is the dividing line, easy to find, between the Hamilton and Genesee, being the upper part of the former, and it is important in New York as the most southern mass of limestone in the State. It is only local, and is an impure limestone, fine-grained, usually a dark or blackish blue, often brownish. The usual thickness of the rock is about fourteen feet, and its greatest thickness twenty feet. It makes a good but not a white lime. It receives its name from the township of Tully, in Onondaga County, New York. This limestone often shows an accretionary structure, and a roughed, notched appearance, where its layers separate as in some of the layers of the water-lime. One of the lower layers is thick, the bottom one being frequently five feet in thickness, and it is owing to this circumstance, and to the softness of the shale beneath, that whenever a waterfall exists, the shale has been washed out to some depth, leaving a chamber or cavern, of which the limestone forms the roof or ceiling.—V. 169. It is a marked geological horizon in Central New York, being the termination of the Hamilton, and is succeeded by shales of a widely different character. It is often thick-bedded, but it is often divided by numerous irregular seams into small fragments. Its color, on first exposure, is blue or nearly black, but weathers to an ashen hue. It is best seen on the Cayuga Southern R. R., where it stands out in the face of the cliffs as a prominent band. It is absent west of Canandaigua Lake and in the eastern part of the state.—H. 212.

10 c. Genesee, (Black Slate of the west and south). — This is a great development of argillaceous fissile black slate. Where its edges only are exposed, it withstands the weather for a great length of time, and often presents mural banks in the ravines, river-courses, and upon the shores of lakes. When the surface of the strata is exposed it rapidly exfoliates in thin even laminæ. On disintegration it is often stained with iron, owing to decomposition of pyrites, but in many instances, and the greater number of localities, it retains a deep black color. In this it is distinguished from some beds of black slate in higher situations, which always become stained with hydrate of iron on their edges, and upon the surface of the laminæ. In color and general character it greatly resembles the Marcellus shale, and, aside from position, it would be difficult to distinguish the two, in the absence of fossils. It forms no conspicuous feature in the scenery or topography of the general surface. In ravines, and river and lake banks, it is usually seen in connection with the rocks below or above. Its greatest development, and a point where it appears more prominently alone, and the typical locality from which it was named, is at the opening of the gorge of the Genesee, at Mount Morris, where it is seen in the perpendicular cliffs for more than a mile in length. See note No. 112, New York. Another great exposure of the Genesee slate is along the Cayuga Southern Railway south of Ludlowville, where it shows from eighty to one hundred feet thick, with the Tully limestone below and the Portage shales above it. See note 83, New York. The mass decomposes much less rapidly than the soft calcareous Hamilton or Moscow shales below it, and the thin slaty laminæ resist atmospheric action a long time. In lithological character it is entirely uniform, having, from Cayuga Lake to Lake Erie, the same deep black color and laminated slaty structure, nor is there any change in its organic remains. Its fossils in Indiana are precisely identical with those of New York.—Hall 218.

There are few formations in Central New York of which the limits are so well defined as this, lying between the Tully limestone below, and the sandstone flags of the base of the Portage group, above. It may also readily be found by the black color and slaty fracture. This shale has been regarded as the main original source of the petroleum in the oil region of Ohio and Western Pennsylvania, but there is reason to believe that part, at least, of the supply of these regions has come from the Corniferous limestone below it, as maintained by Dr. Hunt.

All through the western and southwestern states there is always found a Black Shale, which is often the only representative of the Devonian rocks. This is generally considered to be 10 c. Genesee. It is very remarkable that a formation of its composition, of so inconsiderable a thickness, and otherwise so unimportant, should be so widely extended, and retain throughout its character unchanged as a black shale. The researches of Dr. Newbery in Ohio tend to show its fossils to be of the Portage type. It is there 350 feet thick, and he pronounces it to be the equivalent of the Genesee and lower Portage. All the divisions of the Hamilton group, Marcellus, Hamilton and Genesee, are converted, by exposure, into a deep soil of an excellent quality for agricultural purposes, sometimes quite hilly, but forming smooth land free from stones. Some of the finest wheat-growing and hop-raising land in New York is on the Hamilton, and its rich shales have been carried south by drift and diluvial agencies, and spread over the Genesee, Portage and Chemung, greatly to their improvement.

11–12. UPPER DEVONIAN.

11 a. Portage.—This group represents an extensive development of shales and flagstones, and finally some thick-bedded sandstone towards its upper part. It is extremely variable in character at different and distant points. In New York the Portage rises sometimes in a gentle slope, and at other times abruptly from the softer shales below. Between the deep north and south valleys, in which the railroads run, the enduring sandstones of the upper part extend far northward, presenting, on the north side, a gentle slope, while on the east and west sides of the same hills, the slope is abrupt, the valleys being bounded by steep hills. *The change in the external appearance of the country indicates the commencement of these Portage rocks, although they are not seen.* Throughout the Hamilton shales, the valleys present gently sloping sides, and the country rarely rises far above the valley bottom. But on approaching the northern margin of the Portage group, the railway traveler sees a gradually increasing elevation of the hills on either side, and an abruptness in their slope, and in a short time finds himself in a deep valley bounded on either side by hills rising 400 or 500 feet, and in some instances, even 800 feet above the bed of the stream. These elevations often extend several miles unbroken, except by the deep ravines which indent their sides. The higher sandstones of the group, and in many instances the intermediate ones, produce falls in the streams which pass over them, and some of the most beautiful cascades in the State of New York, and many of the highest perpendicular falls of water, are produced by the rocks of this group, and in none others do we meet with more grand and striking scenery.—J. Hall's Report.

The pedestrian often finds his course impeded by a gorge of several hundred feet in depth, such as Watkins Glen and Havana Glen. The Portage upper, middle and lower falls are 66, 110 and 96 feet, and between the middle and lower the rocks rise in perpendicular cliffs 351 feet in height. See note No. 110, New York, as to Portage on Erie Railroad. Taghanic, Hector, and Lodi falls are also in the Portage. These points afford some of the grandest views of scenery, and admirable facilities for geological investigations. The lower division of the Portage is the 1. *Chasaqua shales*, a green shale, with thin flagstones, and sandy shale. 2. The middle portion is the *Gardeau shale* and flagstones, a great development of green and black slaty and sandy shales, with thin layers of sandstone, from which are quarried beautiful and durable flagstones. The rocks of this part of the group form high, almost perpendicular, banks on the Genesee. In a westerly direction the sandstones disappear, and the shales increase. 3. The upper part of the Portage consists of the *Portage* sandstones, thick bedded sandstones, with little shale, while below, the sandy layers become thinner, and shale beds more frequent; still it must be acknowledged that there is no abrupt change from the beginning of the Portage to the top of the Chemung. In the Portage, the sandstones and shales are less separated than above, and the sandy strata are finer grained, and contain more lime than in the Chemung. Towards the southern extremity of Cayuga and Seneca Lakes, the Portage rocks form cliffs of considerable height, which present alternating hard and soft layers, and the numerous vertical joints present the appearance of solid walls of masonry, in distinct and regular courses. The vertical joints are well seen in Havana Glen. Isolated masses, like huge columns, are often seen, standing out in bold relief from the line of the cliff, being the remains of previously exposed surfaces, which

had crumbled away. On the Genesee River the group is not less than 1000 feet thick. The Portage yields less lime to the soil than the Hamilton, but for pasturage it is superior to it.—H. 224. The great dairy-country of Cortland, and other counties in Central New York, is on the Portage formation. The water of the Portage group is remarkably pure and soft. The Portage rocks have not been recognized in the eastern part of New York. In Ohio the Portage forms the upper part of the Huron shale, and the lower part of the Erie shale, of Dr. Newberry.

In Middle Pennsylvania, according to Lesley, the Portage flags are 1,450 feet thick, and the Chemung shales over them, 1,860 feet thick. It is very hard to draw a line of demarcation between them, but, as a whole, the Chemung strata are more silicious and the Portage more argillaceous. The Portage sandstones are flaggy, and, at times, very shaly, and their alternations with shale frequent, the individual beds being thin, and the shales predominant. The Chemung sandstones are more massive, ferruginous and micaceous, with fewer alternations of shale. Brachiopods and other shells are abundant in the upper Chemung shales, while the Portage rocks are almost destitute of animal forms except crinoids and fucoids. Fucoidal impressions are also very abundant in the upper Chemung, and to the decomposition of this abundant marine vegetation, Lesquereux and others ascribe the origin of the petroleum, at its various local horizons, from the Portage up to the Mahoning sandstone in the Coal Measures.

11 b. Chemung.—These rocks can everywhere be described as a series of thin-bedded sandstones and flagstones, with intervening shales, and mixtures in various proportions of these, and very rarely beds of impure limestone, resulting from the aggregation of organic remains. The whole series weathers to a brownish olive, and even the deeper green of the shales assumes that hue. The shales vary in color from a deep black to olive and green, with every grade and mixture of these. The sandstones are often brownish-gray or olive, and sometimes light gray. More generally, however, there is a tinge of green or olive pervading these strata. Towards the upper part of the group, in some localities, there is a tendency to conglomerate, and in a few places the mass becomes a well defined pudding-stone, with sometimes 150 to 200 feet of Chemung shales and sandstones above it. Towards the upper part of the group the shales are reddish, coarse and fissile, with much mica in small glimmering scales.—Hall 251. From their red color these have sometimes been mistaken for the Catskill formation.

In a few localities in Pennsylvania it contains a very excellent variety of iron ore. As a general thing, however, this formation, and all others above it, up to near the coal conglomerate, are singularly deficient in iron ore. There is little of geological interest throughout the whole extent of the Chemung group. The N. Y. L. E. & W., or Erie Railway, runs for 300 miles west of Susquehanna on this formation, and on nearly the same portion of it. In the northwestern portion of Pennsylvania the celebrated OIL REGION is in the Chemung, the oil being found stored-up in certain coarse porous sandstones, but these are merely the repository of the oil originating in lower strata. It is a very extensive formation in Southern New York, all the southern tier of counties, west of Great Bend, being covered by it, and it forms an excellent grazing and agricultural country, not quite equal to the Portage, but much superior to the Catskill. In Northern Pennsylvania this formation, as in Southern New York, consists of a vast succession of thin layers of shale, of every hue, from a deep olive and dark green to a light slaty gray, alternating with thin beds of brownish gray sandstones.

In Pennsylvania, ninety feet of strata have been carefully studied and measured on Sideling Hill, consisting of alternate beds of red and olive shales and sandstones with Chemung fossils, ripple-marks and fucoids, and a bed of iron ore long known by the name of the Larry's Creek ore, which outcrops everywhere along the face of the Allegheny Mountain. In the gaps at Blairsville and Connellsville, in Southwestern Pennsylvania, Prof. Stevenson finds Chemung fossils in what have always been called the Catskill rocks, on account of their being of a red color, and other geologists have made the same observation in Northern Pennsylvania. In Southern New York, adjacent to Pennsylvania, Professor Hall reports 150 feet of red rocks, and then thin gray rocks above with Chemung fossils.

The Erie shale of Ohio is the equivalent of the 11 b. Chemung, and the upper part of the 11 a. Portage. At Cleveland, it consists of green, gray and blue shales, soft and fine, with sheets of micaceous, silvery sandstone, from half an inch to two inches in thickness, and flattened masses of argillaceous iron ore.—Newberry. The formation also occurs in Kentucky, and Chemung fossils have been found in Utah and Nevada by Clarence King and Arnold Hague.

12. Catskill.—There is no observable line of demarcation between the Chemung and Catskill. The first sign of change is a more solid or hard rock appearing, often accompanied by red sandstone or red shale. The group consists of light colored gray sandstone, usually hard; of fine-grained red sandstone, red shale or slate; of dark colored slate and shale, of grindstone-grit, and a peculiarly accretionary and fragmentary mass, appearing like fragments of hard slate cemented by limestone, similar to what is well known in England as cornstone. The hard gray sandstone often presents a highly characteristic structure, the layers, one or more inches thick, being disposed in oblique divisions, the divisions usually overlapping each other. This peculiar angular arrangement presents altogether a singular conformation, and forms a highly picturesque rock.—V. You can see this at Ralston, Pennsylvania.

The prevailing color of the sandstone is brick-red, though often it is lighter, and sometimes of a deeper color, from a larger proportion of iron, while the coarser parts are often gray, and the shales are green. Beds of green shaly sandstone are interstratified with the red friable sandstone, and these are succeeded by a compact kind of conglomerate rock. The formation expands, and augments in thickness, in passing eastward, till it finally rises in the high and prominent peaks of the Catskill Mountain, nearly 4,000 feet above the sea, from which the formation derives its name. See note No. 9, of New York.

The formation extends from this locality southwestward into Pennsylvania, where its outcrop, 3,000 feet thick, in combination with that of the Pocono sandstone above it, 2,000 feet thick, forms a terraced mountain, which surrounds each of the Anthracite coal fields; the red rocks of the Catskill making the terrace, and the white rocks of the Pocono forming the crest. Piled upon one another in inclined strata, they constitute the bulk of the Catskill Mountains in New York, of the Pocono plateau in Pennsylvania, and the Allegheny, Savage and Cumberland Mountains, far into Virginia and Tennessee.

On all the railroads approaching the anthracite coal regions of Pennsylvania one passes over these Catskill rocks, often for many miles. They contain no coal, but fossil ferns are abundant in some localities. This is the last and upper formation of the Devonian period, and is the foundation on which rests the carboniferous

system. On the Delaware division of the N. Y. L. E. & W., or Erie Railway, is an opportunity of seeing the red rocks of the Catskill formation for a number of miles, and also on the N.Y. & O. Midland Railroad north of the Bloomingburgh tunnel.

In Pennsylvania it is composed of a vast succession of thin-bedded red and gray sandstones, with thin seams of red, green and mottled shales, also coarse and fine sandstones of various hues of red, brown, gray and greenish; together with red and greenish coarse silicious conglomerate of white quartz pebbles, the whole being thick bedded, and with an oblique laminated structure. It has not much of interest, either to the scientific or practical inquirer. Its most interesting fossils are fish-remains, which, in the Catskills, extend through 100 feet in thickness of strata. It is the *Old Red sandstone* of England, lying under the coal. The English *New Red sandstone* is over the coal, being the Permian, Jurassic and Triassic formations, but these are not found directly over the coal in America.

The Catskill formation is a poor one for agricultural purposes. The fields are stony, with many projecting ledges of red rocks. Its sandstones are too hard, and too destitute of lime to produce a fertile soil, and the country covered by it is either a wilderness, or very thinly populated.

13-15 CARBONIFEROUS AGE.

13 a. Lower Sub-Carboniferous.—To a superficial observer, the remarkable substitution of great sandstone and conglomerate deposits, under the coal-measures in the east, for generally limestone deposits, under the coal-measures of the west, must seem inexplicable. But the simple explanation is, that all the sub-carboniferous sand-beds of Pennsylvania, formed near the old continent, thin away, and gradually disappear, before they reach the Mississippi; while the five great sub-carboniferous limestones of Illinois, Iowa, and Missouri, formed in a deep quiet sea, on the contrary, thin away, in going eastward, to 40 feet in Westmoreland County, and 25 feet in Somerset County, Pennsylvania; and totally disappear before reaching the Schuylkill and Lehigh Rivers. But the same limestone deposits thicken southward to 600 and 1,000 feet in Virginia, and even more in Tennessee.

In the Pennsylvania Anthracite country, the next formation above the Catskill is a gray sandstone, called by Prof. H. D. Rodgers the Vespertine. In the second geological survey, Prof. Lesley calls it the Pocono, from the name of the mountain bounding Wyoming Valley, on the south side. The miners call it the second conglomerate. It contains carboniferous fossils, but no coal of value. Invariably the Vespertine is the outside mountain surrounding the coal-basins, the inside one being the 14 a. Pottsville conglomerate, or Millstone grit, and they are separated by 13 b. Mauch Chunk red shale, of Lesley, or Umbral, of Rogers, a soft rock, which forms a valley; and all four, 12. Catskill or Ponent, 13 a. Vespertine or Pocono, 13 b. Umbral or Mauch Chunk, and 14 a. Seral or Pottsville conglomerate, are worthless for farming purposes.

In Pennsylvania, the Vespertine is a white, gray and yellowish sandstone, alternating with coarse silicious conglomerates, and dark-blue, olive and black slates, and occasionally thin beds of coal. In Michigan, it is the Marshall group, which is mostly a somewhat friable rock, with a reddish, buffish, or olive color, though in some regions becoming gray or bluish-gray. It forms the receptacle into which the brine descends, and accumulates from the next over-lying Michigan salt group, which is 13 b., and also sub-carboniferous. The Waverly group of Ohio is proved, by its fossils, to be of this same age. Its sub-divisions are given at the head of the chapter on Ohio. It produces the Berea grindstones and Waverly sandstone, the finest building-stone in Ohio, if not in the United States. In Tennessee there is a great development of the lower sub-carboniferous group, the 13 a. Barren group, and 13 b. Coral, or St. Louis limestone, formerly called by Prof. Safford the Silicious. Its upper part is the equivalent of the St. Louis limestone of Missouri; the lower is a series of silico-calcareous rocks, characterized by heavy layers of chert, one inch to two feet thick.

In Illinois the series of sub-carboniferous strata consists of the 1. Kinderhook group, 2. Burlington group, 3. Keokuk group, 4. St. Louis group, the base of which was formerly called the Warsaw limestone, and the 5. Chester group; all of these are limestones and shale, with some sandstone in the first and last named. These embrace both the lower and upper sub-carboniferous, and are 1,200 to 1,500 feet thick in the south-western part of Illinois, but thin-out in going north, and entirely disappear before reaching Rock Island, where the coal-measures rest on the Devonian limestone. In Iowa the four lower members occur, but the Chester, the thickest member, is wanting, and it is almost entirely wanting in Missouri.

In Pennsylvania a small coal-bed has been opened on the Susquehanna River, in the Pocono sandstone; and in Huntingdon County more than a dozen small layers of coal may be traced, running through the formation. In Montgomery County, Virginia, two similar coal-beds attain a local importance, being on Tom's Creek, respectively 4 and 8 feet thick. These represent the lower coal of East Kentucky, Tennessee, and Alabama.

In Ohio the Subcarboniferous limestone extends through some of the south-eastern counties. It is quite thin, and represents only the upper or Chester member of the group. Two workable seams of coal—the Jackson and Wallston coals—are found below it.—Newberry.

13 b. Upper Sub-Carboniferous.—In Pennsylvania this is the Umbral red shale of Rogers, and the Mauch Chunk of Lesley, sometimes 3,000 feet thick, and here consists almost entirely of very soft red shales and argillaceous red sandstone, without fossils. It gradually becomes in Virginia a triple mass of buff, green and red shales below, a thick body of light-blue limestone, full of fossils, in the middle, and the upper part blue, olive and red calcareous shales, with massive strata of gray and brownish sandstone. It contains beds of iron ore, which are sometimes very valuable. In the Western States the limestone is the principal rock. It is the limestone of Greenbriar Valley in West Virginia. In Northern Pennsylvania, gray and greenish shales, and gray argillaceous sandstones, are introduced among the red shales, and farther west it consists of two or more strata of soft red shales, separated by a thick body of gray, flaggy sandstone. It is generally well marked in Pennsylvania as the softest of rocks, or simply dry red mud, and is to be noticed by those in search of coal, none of which is ever found in or below it. In Tennessee this formation is the mountain limestone,

beneath the coal-measures. It is a heavy body of limestones and shale, the latter almost one-fourth of the mass; and there is also a sandstone. See the above description of 13 a. in Illinois.

In Middle Pennsylvania, around the Broad Top coal-basin, Prof. J. P. Lesley says there appears, for the first time in this formation, going west, distinct traces of the great mountain limestone formation, which underlies all the southern and western coal-fields, and becomes one of the principal features of the geology of the Rocky Mountains, as it is also of the geology of Europe. The red shale formation is here seen, divided in two—910 feet of it above, and 141 feet of it below; a middle group of red and gray, mottled calcareous shales, and thin limestone layers, full of fossil shells—in all 49 feet thick—separating the upper and lower members of nearly pure red shale.

The narrow red shale valleys, which surround this Broad Top coal-basin, the Cumberland basin in Maryland, and the three principal groups of anthracite basins in Eastern Pennsylvania, are due to the thickness and softness of this important formation. But while it is 3,000 feet thick at Pottsville, it is but 300 feet thick along the Allegheny Mountain, and less than 100 feet thick around the coal-basins of Tioga and Bradford counties; and, therefore, instead of making valleys, only marks the top of the mountain steep slopes with a narrow terrace, over which dominates the vertical cliffs of the outcrop of the coal conglomerate.

14 a. Millstone Grit.—This is a mass of white or yellow sandstone, containing vast numbers of quartz pebbles, and forming a pudding-stone, or conglomerate. It is called the Millstone Grit, from being used for the manufacture of millstones. In Pennsylvania and Virginia the formation is 1,000 feet thick, but becomes reduced to from 10 to 175 feet in Ohio. In Kentucky it is from 50 to 500, and in Indiana from 50 to 100 feet. It is a very peculiar rock, and very wide spread, extending out beyond the coal measures proper, of which it is the base and support. There is not in the entire geological series, says Dr. Newberry, another stratum of rock so widely distributed, and presenting as strongly marked lithological characters, as this. The pebbles are generally of quartz, and well rounded. The sand, which forms the paste, and holds together the pebbles of the conglomerate, is generally coarse, and consists of rounded grains of quartz, which differ from the pebbles only in size. In the anthracite region of Pennsylvania, conglomerate rocks sometimes occur between coal-beds, but in the other coal regions they are below all the workable coal-beds. Any cases of thin beds of good coal being found in or below the conglomerate, are exceptional and rare. It does not always maintain its character as a conglomerate, being sometimes an ordinary sandstone. The great lead mines of Joplin and Granby, in Missouri, are in a ferruginous sandstone, the equivalent of the Millstone Grit, or the Chester group, and the Hot Springs of Arkansas are in the Millstone Grit, greatly metamorphosed.

14 b. and c. Lower and Upper Coal Measures.—The series of rock-strata, among which the carboniferous coal-beds are found, are called the Coal Measures, which produce all the best coal of America. They consist of repeated alternations of exceedingly diversified rocks, of every degree of coarseness, from the smoothest fire-clay to exceedingly rough, silicious conglomerates, including within those extremes a wide variety of coal-shales, or mud-rocks, of almost every color and texture—marls, argillaceous sandstones and quartzose grits, also thin bands of limestones, both pure and magnesian, and numerous seams of carbonate of iron.

The numerous coal-beds themselves, which occur among this series of strata, the most interesting and important of them all, are also found in America in all their known varieties, from the most compact anthracite to the most fusible and bituminous kinds of coal. There is no invariable order for the strata of coal measures, but usually the bed of coal has a fire-clay bed below it, and shale immediately over it. Extending our view over a considerable district, we find these rocks are coarser and more massive towards the east or south-east; that they become more fine-grained, and less sandy and earthy, and the limestones increase in size and number as we proceed westward or north-westward; that many of the strata become reduced in thickness, and some of them entirely disappear. In Pennsylvania and Ohio the middle portion of the coal measures contains no coal seams, and hence is called the Barren Measures, thus dividing the formation into Upper and Lower Productive Coal Measures. The Lower Coal Measures sometimes contain valuable beds of iron ore. Salt is produced from the Lower Coal Measures in Western Pennsylvania, Virginia, Ohio, Indiana, Illinois, and Kentucky.*

15. Permian.—On the Kansas Pacific, and on the Missouri, Kansas & Texas Railroads, several stations are given in Western Kansas, in the annexed Guide, as being on the Permian formation, which is found in America only in this locality. The Permian rocks, according to Dana, are limestones, sandstones, red, greenish, and gray marlites or shales, gypsum beds and conglomerates, among which the limestones, in some regions, predominate. In Kansas they consist, according to Prof. Mudge, of calcareous and arenaceous shales and beds of limestone. The latter are quite impure, but sometimes massive magnesian limestone, of a drab and buff color, is found, which furnishes an excellent building material. Prof. Swallow describes them as a series of limestones, marls, shales, sandstones, conglomerates, and gypsums. The State capitol of Kansas, at Topeka, is built of Junction City limestone of the Permian formation. It is also used at Manhattan, and the buildings at Fort Riley are also conspicuous specimens of Permian limestone. The rocks here called Permian, are conformable to the coal-measures, and contain many coal-measure fossils, with some not found below. Some geologists think there is no good reason for separating them from the Carboniferous system, of which they form the upper member. Strata of the same age occur in Indiana, Texas, and Mexico, where they contain many new and interesting reptilian remains. In most parts of the United States, however, the coal-measures are not overlaid by these so-called Permian or Permo-Carboniferons beds, either because they were never deposited, or have been removed by erosion. One of the remarkable facts in American geology is the extremely small extent of the Permian and Jurassic groups of formations in the eastern half of the continent. The Permian forms part of the New Red Sandstone of England, lying over the coal. The name is derived from Permia, a province in Russia.

* Having been for twenty-one years actively engaged in mining, transporting and selling coal, the author's business led him to the study of geology, particularly in its economic bearings, and he has given to the world all he knows about coal in another work entitled, "THE COAL REGIONS OF AMERICA: THEIR TOPOGRAPHY, GEOLOGY, AND DEVELOPMENT," with a colored geological map of Pennsylvania, a railroad map of all the coal regions, and numerous other maps and illustrations. By James Macfarlane, Ph. D. One 8vo. volume of 700 pages. Price, in cloth, $5; in sheep, $6. Published and for sale by D. Appleton & Co., New York.

15-18. MESOZOIC.

16. Triassic.—As the railroads from Philadelphia to New York, the greatest lines of travel in this country, run on this formation, it is the most conspicuous and well known in the State of New Jersey, and one in which geologists are now taking great interest. Every observing person must have noticed it, and its aspect and composition are so uniform and well marked, that a description of it here will answer for the whole belt through the States of Pennsylvania, Maryland, Virginia, and North Carolina, from the Hudson River to Deep River, in the latter State, and in the Connecticut Valley.

The Triassic consists of dark reddish-brown sandstone, soft, crumbly brown shales, and the upper beds are coarse conglomerates. The almost invariable dip is towards the north-west, at angles ranging from 15° to 25°. Prof. H. D. Rogers thought this uniform dip was not caused by any uplifting agency, but that the rocks were originally laid down in this manner. His theory is that the formation owes its origin to an extensive ancient river, having its source at the eastern base of the Blue Ridge, in North Carolina. Following the remnants of the Triassic formation thence north-east, it gradually, from small beginnings, becomes larger, and has throughout a descending course. At the James River, it is four, at the Potomac six, at the Susquehanna twelve, and at the Delaware, thirty miles wide—the estuary being in the region of the Raritan and the Hudson. In New Jersey, therefore, this river was at its maximum.

The uniform dip was supposed by Prof. H. D. Rogers to be the result of the oblique or slanting mode in which the sediment has been laid down by a rapid and steady current washing the material from the south-east side or shore of the river. If it were due to an upheaval, this formation, measured in the usual way, would show an unheard-of thickness. In fact, it is very thin, as is shown in the exposures of limestone in the interior of the belt. All the appearances of the formation indicate, and there is much to sustain his opinion, that it never was tilted.

But more recent study of this interesting formation, has proven two facts: (1) that it was originally extensive, far beyond its present limits; and, (2) that, in at least its middle beds, the original deposits were horizontal, and have been since upturned. The two great belts of Triassic, which cross from Virginia into North Carolina, and one of them into South Carolina, not only have their rocks dipping in opposite directions, showing a long and broad uplifted country between Raleigh and Danville; but certain groups of coal-beds, which, though now dipping in contrary directions, must of course have been originally horizontal. Traces of coal-beds have been found in the Triassic of Pennsylvania, in York county, and at Phœnixville. The intermediate country in North Carolina was, therefore, presumably once covered with the formation, and probably all Virginia, east of the Blue Ridge, and all south-eastern Pennsylvania. The formation is seen passing under the plastic clays of New Jersey, and may extend far under the bed of the Atlantic, being thus connected with the beds of the Connecticut, and even those of the Bay of Fundy.—Lesley.

Relics of vegetation are occasionally found in the Triassic, in the form of highly compact and bituminous lignite, the longitudinal sections exhibiting the fibrous structure of the wood, whence it was formed. This lignite, occurring sometimes in seams of two or three inches in thickness, amid dark shales, has been a fertile source of delusion, some persons having been induced by the hope of finding valuable coal-mines, to waste much labor in the search. Although the Richmond and North Carolina coals are Triassic, all the geological facts discountenance the notion that it contains coal in New Jersey and Pennsylvania, the detached fragments of plants, which we meet with in the form of lignite, having evidently been loosely drifted into these sediments from the land. Prof. Emmons says there is nothing which can be regarded as equivalent to the coal measures of the Chatham (N. C.) and Richmond (Va.) series in the northern beds. All this formation was produced at a period subsequent to the great Carboniferous or coal-bearing rocks. There are great numbers of fossil fish in the Trias of New Jersey and Connecticut valleys, among them twenty species of *ganoids;* also the famous bird-tracks of Dr. Hitchcock. See notes 7 and 8 on Massachusetts. Fossil plants are numerous in the Trias of Virginia and North Carolina.

When a large portion of the pebbles are of limestone, in the Triassic conglomerate, and the cementing red earth which unites them, contains an adequate quantity of the same material, the rock possesses the character of a marble, as on the Potomac River. The Portland stone, or reddish-brown sandstone, so much used for building purposes in New York and other eastern cities, is from the Triassic formation.

Extensive mines for copper ore have been wrought in the Triassic, in the State of New Jersey, the ore occurring in every case adjacent to igneous traps, but not in contact with them. All these mining operations have failed, on account of the ore being diffused or disseminated through the mass of the formation, and not being found compacted in regular veins. In Europe, the upper part of the Triassic is called Keuper, or copper.

Trap-Dikes.—Numerous parallel ridges and dikes of Trap, some of them many miles in length, and with the elevation of mountains 400 feet high, and ridges of all sizes, traverse the Triassic. Indeed, nearly all the trap-dikes are confined to this formation. The material which composes these rough, rocky ridges, undoubtedly protruded in a state of fusion, slowly and gently through long narrow fissures, produced by the gaping asunder of the rocks, and not by enormous violent disruptions, like those of volcanoes, as the strata through which they passed are very little disturbed, and the dip of the strata is very little affected by them. These trap-dikes have burst through the red shale and sandstone, after they were deposited, overflowing, while in a melted and highly heated condition, the adjacent beds, and greatly altering their texture, color and mineral aspect. The finest of these trap-dikes is the Palisades, on the west side of the Hudson River, above Jersey City, and extending north of that place. (See note 5, in chapter on New York). The tunnels and deep railroad-cuts through it, in Jersey City, afford good opportunities to observe the appearance of the stone, the principal constituents of which are hornblende, feldspar, and titaniferous oxide of iron. The little mountain of iron ore at Cornwall, in Lebanon county, Pennsylvania, was thrown up by a trap-dike of the Triassic.

That the trap is not confined, however, to the Triassic rock surface, is beautifully shown by the very numerous trap-dikes which cut the Highlands of Orange county, N.Y., and of New Jersey; by the long, straight, narrow dike which issues from the South Mountain, opposite Carlisle, in Pennsylvania, and cuts across all the formations, from the Potsdam up to the Subcarboniferous, at the mouth of the Juniata, (see notes 9, 77 and 170, in chapter on Pennsylvania), and especially by the still longer trap-dike recently discovered by Prof. Frazer, in Lancaster county, Pa., which not only penetrates the Welsh hills of gneiss, but cuts across the west end of the Chester county (Pa.) Valley, near the famous nickel mine, and reaches the Susquehanna River near the roofing slates quarries at Peach Bottom.—Lesley.

The Triassic formation yields the rock-salt and brine of the greater part of Europe, especially in England, Ireland, France, and part of Germany.

17. Jurassic.—The upper portion of what is commonly called the Triassic, on the Atlantic border, may belong to the Jurassic, and is so described by Prof. P. R. Uhler, in the annexed Guide for Maryland; and by Prof. W. B. Rogers, as Juro-Triassic and Juro-Cretaceous, in Virginia. But there are beds which are undoubtedly Jurassic in several of the eastern ridges of the Rocky Mountains, and other districts of the far West. The rocks are, in general, a gray or whitish marly or arenaceous limestone, with occasional pure compact limestone beds, intercalated with laminated marls. The enormous *Dinosauri*, recently obtained by Marsh and Cope from Colorado, are from the Jurassic. It is much less important here than in England, where it is subdivided into the Liassic, Oolytic and Wealden. The name is derived from Mount Jura, in Switzerland.

18. Cretaceous.—The Cretaceous formation, along the Atlantic Coast and the lower Mississippi Valley, consists of a series of beds of strata, differing from each other; but they are all earthy in form, consisting of beds of sand and sandy-clay, except at a few points, where the strata have been cemented by oxide of iron into a kind of sandstone, or conglomerate. In Texas it contains extensive beds of gypsum. In New Jersey it produces the lower two beds of green-sand, called marl, which is extensively used in agriculture, the value of which is due to the potash and phosphates which it contains. Ninety per cent. of it is a green silicate of iron and potash, the rest being ordinary sand, and it contains no lime. But in Wyoming, Utah, and Colorado, the Cretaceous attains a thickness of 9,000 feet, and its rocks comprise beds of sand, marlite, clay, loosely aggregated shell-limestone, or rotten limestone, and compact limestone. At the middle of the Cretaceous, lie the beds of plastic-clay, outcropping across New Jersey, from Trenton to Amboy, and of great importance to the fire-brick and pottery factories, as described in the Report of Prof. Cook, of New Jersey, for 1876.

The name Cretaceous is from the Latin word for chalk, the chalk of England and Europe, being one of the rocks of this period; but in this country it contains no chalk, except in Western Kansas, 322 miles west of Kansas City, where a large bed exists. It is within one mile of Trego station on the Kansas Pacific Railroad, and is found over a tract 125 by 30 miles.

The Cretaceous formation, in the far West, passes upwards into a coal-bearing formation, several thousand feet thick, and covering on the upper Missouri River not less than 100,000 square miles in the United States, besides the portion of the belt extending into the British possessions. The area of other lignitic basins farther south, cannot be estimated, their width being unknown. Dr. Hayden

regards this coal-formation as transitional, or Lower Eocene 19. Tertiary, and in the within Guide for Colorado it is called the Lignitic Group, lying between the Cretaceous and Tertiary. Mr. Lesquereux is of the same opinion as to its Tertiary age, but nearly all other geologists regard it as Cretaceous.

In the annexed Guide for Wyoming and Utah, the formation is given at points where the coal is mined—Carbon, Separation, Black Buttes, Point of Rocks, Rock Springs, and Evanston. All the coal now mined in Wyoming is, according to the Guide, in the 18 d. Laramie Cretaceous, which corresponds with Hayden's Lignitic beds. Every division of the Cretaceous is said to be lignitic or coal-bearing, and may some day produce good coal. The Evanston beds are in the Laramie, but the Coalsville beds are probably in the 18 b. Colorado Cretaceous. The Rock Creek coal may be 18 c. Fox Hill.—A. Hague. There is no Carboniferous coal in the far west. The difference of opinion as to the age of the Lignitic or coal-bearing group, arises from the fact of its lying at the transition point from the Cretaceous to the Tertiary, where, as is not unusual, the fossils of both are mingled; and the controversy is as to precisely where the Cretaceous ends, and the Tertiary begins.

19-20. CENOZOIC.

19. Tertiary.—The Tertiary formation of the Atlantic coast is wholly of an earthy character, without solid rocks, consisting of sands and sandy blue clays, and above these yellow and brown ferruginous sand; also clays and sands imbedding extensive layers of uncemented fossil shells. But as we trace them south and southwest through the Southern cotton-growing states, it becomes more calcareous, consisting of lead-colored sandy clays, and whitish and bluish friable limestone in North and South Carolina and Eastern Georgia. West of that, the upper member consists of two limestone strata, the middle of sand and sandy marl, and the lower part of limestone and marl. H. D. Rogers suggests that on the Atlantic slope, opposite the Appalachian Mountains, the older rocks furnished only sandy and clayey sediments, and the Tertiary deposits composed of the ruins of the former, are of that character; while farther west a wide expanse of limestones fills the upper valley of the Mississippi, and hence the Tertiary deposits bordering the Gulf of Mexico, and extending up the Mississippi River, are of a greatly more calcareous or lime-bearing character. The cotton-growing lands of the Southern States are chiefly Tertiary. In the central part of the continent, the Tertiary beds are lake sediments, or fresh-water deposits; while on the west coast they are marine. The Tertiary, in the southern part of New Jersey, furnishes great quantities of bog iron-ore, but bog iron-ore is not peculiar to the Tertiary formation. The upper bed of the green-sand of New Jersey is Tertiary. In the far-west the Tertiary strata are in a greatly more indurated or rocky condition than those of the eastern coast. The 19 a. Eocene consists of beds of clay and sand, with round ferruginous concretions and numerous seams and local deposits of lignite, according to Mr. Lesquereux. Also gray and ash-colored sandstone, with more or less argillaceous layers. The 19 b. Miocene consists of white and light drab clays, with some beds of sandstone and local layers of limestone. The 19 c. Pliocene is composed of fine, loose sand, with some layers of limestone, and contains fossil bones of animals, which are scarcely distinguishable from living species.

20. Quaternary.—In no part of the United States are the phenomena of the drift displayed on a grander scale than in the Lake Superior region and on the northern borders of Wisconsin. These drift materials consist of vast accumulations of sand, pebbles and boulders, belonging invariably to rocks lying north or north-west of their present position, with beds of clay of great thickness, evidently brought from a great distance from the north by causes quite different from any now in operation, and which nearly all geologists now believe to have been glaciers. This material is spread over the whole breadth of the North American continent, down to 38° or 40° of latitude, with long tails projecting farther south along the valleys, and it is also spread in the same way over the northern part of Europe.

Minnesota and Dakota are very deeply buried in drift. At the south side of Lake Superior the drift is frequently 200 to 300 feet deep, and at the west end of that lake, from 300 to 600 feet thick, and it is 220 feet deep at Fargo, Minnesota. The whole of the lower peninsula of Michigan is covered from 200 to 300 feet deep. To the southward the drift diminishes, and it becomes more evenly spread over the country. It is a singular fact that in the Galena lead region, at the corner of Illinois, Iowa and Wisconsin, bounded by the Mississippi, Wisconsin and Rock Rivers, and in a considerable extent of territory north of it, no trace of transported drift material can be found. The driftless region is 12,000 square miles in Wisconsin alone, or one-fourth the area of the state. Prof. N. H. Winchell explains its removal by the action of glacial rivers; but Professors Chamberlin and Irving produce much evidence to show that this district never was covered with drift, the glacier terminating northeast of it in the moraine called the Kettle Range, so named from the great number of kettle-shaped depressions it contains on its surface. No other state has so complete a series of these deposits as Ohio, although not in so heavy a body as at places farther north, and it has been well studied and described by Dr. Newberry. He has classified the drift deposits as follows, in the ascending order: 1—The Erie clay, a blue or gray unstratified boulder clay, so conspicuous in the North-west, and in which the tunnels at Chicago are dug. 2—The forest-bed, consisting of a bed of soil, with timber, the remains of an ancient forest, found in Ohio, Indiana, etc., at various depths from the present surface. 3—Lacustrine deposits, stratified sands and clays in Northern Ohio; yellow clay, abounding with gravel, in Southern Ohio. The Loess or Bluff formation of the West, Dr. Newberry thinks is simply the silt brought down by the Missouri River, and deposited in a lake or great inland sea.

Nearly every recently uncovered ledge of rock in the drift-covered region has its surface marked with the characteristic striæ and furrows. These scratched, polished and grooved surfaces prove the former existence, according to Agassiz's theory, of an ice sheet, many thousand feet in thickness, moving across the continent over open level plains, as well as along enclosed valleys. When softer and harder rocks alternate, they are planed off to one outline or level, as if a rigid rasp had moved over the land levelling all before it. On the contrary, on any surface where water flows we find the softer materials have yielded first and been worn out, while hard rocks will be left standing out, and show greater resistance. Glacial surfaces are highly polished, and are marked with scratches, grooves and deeper furrows. Sometimes the smooth surfaces are like polished marble, showing that the grinding material was held steadily down in firm, permanent contact with the rocky surface against which it moved, as is the case with the glacier. There are many deep ancient channels filled by the drift.

The usual characteristic marks of glaciers extend, according to Agassiz, over the whole surface of the east half of the continent, from the Atlantic shores to the states west of the Mississippi, and from the Arctic Sea to the latitude of the Ohio, about the 40th degree of north latitude. The glacier marks tend from north to south, with occasional slight inclinations to the east or west, according to the minor irregularities of the surface. The ice of the great glacial period in America is supposed to have moved over the continent as one continuous sheet, over-riding nearly all the inequalities of the surface. The drift spread in one vast sheet over the whole land, consisting of an indiscriminate medley of clay, sand, gravels, pebbles, boulders of all dimensions, so uniformly mixed together that in all parts of the country it presents hardly any difference. The total absence of stratification is one important characteristic of glacial drift. There is no arrangement of the materials according to size or weight, whereas in water the lighter materials are carried farther than the heavier ones, and the heavier ones are at the bottom and the lighter on top. In glacial drift there are large angular fragments by which it may be distinguished from alluvium, and it retains the mud gathered during the journey, and spread through its mass, while the water-worn deposits are washed clean, and consist always of well-rounded pebbles, and there are no scratches on the exposed surfaces of the solid rocks.

There appeared in 1878 a map of New Jersey, on which the ice-covered area of that state is laid down, with a description of the terminal moraine, extending from below Belvidere, on the Delaware, first east and then south and southeast to South Amboy, across Staten Island and through the middle length of Long Island. Prof. Hitchcock has traced it thence eastwardly to Massachusetts Bay. Ice covered the highest peaks of the northern mountains of New Jersey, as it did all the mountain crests of Eastern Pennsylvania, to within ten or fifteen miles of Harrisburgh. The southern limit of the moraine has been fixed, by Mr. Carll, at Titusville, in Venango County, and by Prof. White, at Newcastle and Beaver Falls, in Beaver County. There blocks of granite from Canada lie perched on hill-tops of Coal Measures 1,300 feet above tide level.

Much of the configuration of the country has been attributed to the action of glaciers, but Professor J. P. Lesley has advanced the theory that most of the topographical features of the Atlantic half of the United States, including the erosion of Lakes Champlain and Ontario, and Georgian and Green Bays, the Blue-grass country of Kentucky, the central basin of Tennessee, the great valley of Eastern Tennessee, Virginia, Pennsylvania and New Jersey, the Taconic valleys of Western New England, and the rich valleys of the interior parts of the Appalachian Mountain belt, have been due, as he thinks, to the *underground* dissolution of the Lower Silurian limestone formations, and to the consequent breaking down of the Paleozoic roof above the caverns thus excavated; the process, however, beginning with the limestones of the carboniferous and sub-carboniferous age, being continued by the second subterranean erosion of the Upper and Lower Helderberg limestones, causing Lakes Erie, Huron and Michigan, the smaller New York lakes,* and the "Poor Valleys" of the Middle and Southern Atlantic States, and ending with the subterranean erosion of the Trenton and Calciferous formations, which, he says, is, in fact, seen to be still going on.

One of the most notable features of the Western States is the PRAIRIES, which are vast natural meadows, sometimes hundreds of miles in extent, bare of trees

*These and other features of Central New York, may have originated from the solution of large beds of rock-salt in the underlying Salina formation, and the consequent subsidence of the strata.

and covered with grass, growing on a deep, rich, comminuted soil of unsurpassed fertility, and with scarcely any exposures of the underlying rock.

The Bluff formation along the Missouri and Mississippi rivers is a very peculiar and interesting one, resting upon and later than the drift. It is of a slightly yellowish ash-color, very fine, not sandy, and yet not adhesive. It makes an excellent soil, is easily excavated by the spade alone, and yet it remains so unchanged by the atmosphere and frost, that wells dug in it require to be walled only to a point above the water-line, while the remainder stands so securely without support that the spade-marks remain upon it for many years. Road embankments and excavations upon the sides of roads stand like a wall. The peculiar outline of the bluffs along the Missouri river valley is very interesting. They are often naked, entirely destitute of trees, and tower up from the river bottom-land, sometimes more than two hundred feet in height, and so steep, in some places, that a man cannot climb them, yet they are not supported by a framework of rocks, as other bluffs are, and not a rock or pebble of any size exists in them, except a few calcareous concretions where lime-water percolates through them. It is a lacustrine deposit, a shallow lake having, after the time of the Glacial epoch, occupied the whole of the basin of the Mississippi before the great rivers had cut their valleys down to their present depths.—White. In Louisiana the Bluff deposit contains three distinct groups of strata, the Port Hudson below, the Loess next and the yellow loam above, over this is the alluvium, and below them all, the drift.—F. V. Hopkins.

Earthy material brought together by the ordinary action of water is said to be alluvial, and the soil or land so formed is called alluvium or alluvion. Diluvium implies the extraordinary action of water. When the drift material covers the surface, of course it forms the soil, but in driftless regions the soil is an admixture of clay, sand, lime, etc., derived from the disintegration of the rocks beneath, with decomposed animal and vegetable substances. Where neither glacial nor alluvial action has taken place—as in some parts of our Southern States—the rocks as described by Dr. T. S. Hunt, are converted into a deep and strong soil, having undergone a process of decay which has rendered them so soft, sometimes to a depth of twenty feet or more, that they may be readily cut by a spade, although retaining all the veins and layers which mark their original stratification. Without having been broken or ground up, even the hardest rocks have quietly mouldered into a soft, clayey mass, which, from its peculiar structure, has a natural drainage and possesses, moreover, great fertility.

The most important of geological formations is the last of all, **the soil.** On this thin, superficial, earthy covering of our planet, depends the growth of all vegetation, and on that depends all terrestrial animal life. But whether the material forming the soil remains unmoved in the same spot where it was once a solid rock, or is transported bodily by a glacier, or carried from the hills into the valleys by running water, and moved from place to place by larger streams and rivers, it was originally derived from the rock formations, therefore the agricultural as well as the mineral resources of the country depends on its geology.

This completes, in brief, the description of all that can be seen of the earth, classified in geological order, from the oldest of the rocks, up to the sands which are now daily washed to our feet, by the currents of the rivers and the waves of the sea.

REMARKS ON THE FOREGOING DESCRIPTIONS.

Paleontologists will be disappointed in this introduction, from which that is omitted which seems to them the most important, and gives the most interest and significance to the subject, namely: the life which they find in the formations, and which serves so important a purpose in their identification and classification. But another book would have been required for that purpose, and it would have been useless without a large number of expensive engravings.* Paleontology is the province of all the text-books on geology, to which this work is a supplement, not a substitute. Its only object is to teach local geology. The descriptions were an after-thought, and they should be regarded as an attempt—to present to the unlearned a first-lesson in geology, in the vernacular tongue, in the hope that it may help on the cause of popular science. They have swollen much beyond the original design, which was definitions, rather than descriptions; but they will serve to show that paleontology is not the whole of geology, and that the formations are more than a mere cabinet of fossils.

There are some things in the descriptions that are not accepted by all geologists. But the scope of the work did not permit any account of the conflicting opinions on disputed points, or discussions of the history of geological nomenclature and classification. Whether the Oriskany sandstone should be placed at the base of the Devonian, or at the top of the Silurian; whether Hudson River, Loraine, Nashville, or Cincinnati, is the best name for that formation; and whether Cambrian should include one, or all, or none of the Lower Silurian formations, and similar questions, seem of less importance to the ordinary reader, for whom the descriptions are intended, than to the professional geologist.

All kinds of geological tables are given, for, in accepting the valuable contributions of others on local geology, it was necessary to let them have their own way, in the chapters on their own States, in regard to the names and the arrangement of the formations. A common number, attached to them throughout the book, serves to identify the formations by whatever name they are called.

The valuable part of the book is the Geological Railway Guide, the design or plan of which is original with the author, as it is believed nothing of the kind has ever appeared, in any language. It is the work of many hands, and the hearty thanks of every lover of the science are due to all those who have contributed to its pages portions of the multitude of facts, forming this index to the geology of all important places in the United States and Canada. The reader will never know the amount of time, patience, labor, and care that it has cost.

* See "THE ANCIENT LIFE HISTORY OF THE EARTH," a comprehensive outline of the principles and leading facts of Paleontological Science. By H. A. Nicholson. Published by D. Appleton & Co., New York. 8vo., 407 pp. $2.00. A very convenient and excellent manual of Paleontology only.

ARRANGEMENT OF THE GEOLOGICAL RAILWAY GUIDE

AND DIRECTIONS FOR USING IT.

1. The railroads are arranged by states, and the states and territories are arranged in geographical order, with reference to the great lines of travel. But to find a railroad, the reader must depend on the index. Branches are placed after the main line, which is generally first given throughout without interruption.

2. When stations are omitted for the sake of brevity, which is seldom the case, the lists being uncommonly full, their geology will be understood to be the same as that given at the stations between which they occur. If the geology of two adjacent stations is different, it is evident enough that there is a transition from one to the other formation, between the stations, but the change is often so gradual that the transition point cannot be precisely given.

3. A few feet of difference in level sometimes carries the railway track to an upper or lower formation. Railroads, too, sometimes run across narrow, projecting tails, and scalloped points of a higher or lower formation, than that given in the Guide, but which it would occupy too much space to specify. Where too, the strata are disturbed and broken-up, all the formations cannot well be specified for want of room. In such cases the Guide serves only to show nearly where you are, the prevalent formation being given.

4. The hills, bluffs and higher ground in view, are often of a different formation from that given on the railroad, but not always higher in the series. Their elevation is often due to the hardness of the strata, the softer rocks forming the valleys, in which railways generally run.

5. Keep in mind the succession of the formations, as shown on the Guide, and whether you are going from older and lower to younger or higher strata, or *vice versa*. Notice the changes in the scenery with the changes in the formations.

6. When you come to a new formation, refer to the description of it, in the beginning of the book. But it is difficult to get a clear idea of the formations from even the best description. The reader must see them for himself, and these descriptions are intended to assist him in identifying them, and to impress their character and appearance upon his mind, or to recall them to his recollection after having seen them.

7. By a little close observation of the formations in traveling, you will find that most of them have peculiarities of their own, by which you can always know them, but which, like the features or appearances of persons, cannot be put into words, so that another who has not seen them could also recognize them. The form of the summits and slopes of the hills, and the general aspect of the country, but especially the rock-cuts on the railways, and other exposures of the formations, in quarries, and in the banks and beds of streams, should be closely observed; and if these are not visible, notice the stone used in buildings, and for the enclosures of fields, the character of the soil, and the fragments of stone mixed through its mass, which betray the nature of the solid rock formation beneath; observe also whether the rocks lie horizontally or in an inclined position.

Prof. J. D. Dana's Table of the Geological Formations (1878).

Systems or Ages.	Groups or Periods.	Formations or Epochs.
Age of Man.	20. Quaternary.	20. Quaternary.
Age of Mammals.	19. Tertiary.	19 c. Pliocene. 19 b. Miocene. 19 a. Eocene.
Reptilian Age.	18. Cretaceous.	18 c. Upper Cretaceous. 18 b. Middle " 18 a. Lower "
	17. Jurassic.	17. Jurassic.
	16. Triassic.	16. Triassic.
Carboniferous.	15. Permian.	15. Permian.
	14. Carboniferous.	14 c. Upper Coal Measures. 14 b. Lower " " 14 a. Millstone Grit.
	13. Subcarboniferous.	13 b. Upper Subcarboniferous. 13 a. Lower "
Devonian, or Age of Fishes.	12. Catskill.	12. Catskill.
	11. Chemung.	11 b. Chemung. 11 a. Portage.
	10. Hamilton.	10 c. Genesee. 10 b. Hamilton. 10 a. Marcellus.
	9. Corniferous.	9 c. Corniferous. 9 b. Schoharie. 9 a. Cauda Galli.
Silurian, or Age of Invertebrates. — Upper Silurian.	8. Oriskany.	8. Oriskany.
	7. Lower Helderberg.	7. Lower Helderberg.
	6. Salina.	6. Salina.
	5. Niagara.	5 c. Niagara. 5 b. Clinton. 5 a. Medina.
Lower Silurian.	4. Trenton.	4 c. Cincinnati. 4 b. Utica. 4 a. Trenton.
	3. Canadian.	3 c. Chazy. 3 b. Quebec. 3 a. Calciferous.
	2. Primordial or Cambrian.	2 b. Potsdam. 2 a. Acadian.
	1. Archæan.	1 b. Huronian. 1 a. Laurentian.

The numbers and letters of this table are attached to the same formations or their equivalents throughout the book.

Table of the Geological Formations.

Arranged for this Work by Prof. T. Sterry Hunt, LL. D., F. R. S.

Ages.	Groups.	American Formations.
Cenozoic.	20. Quaternary.	20. Recent.
	19. Tertiary.	19 c. Pliocene. 19 b. Miocene. 19 a. Eocene.
Meso-zoic.	18. Cretaceous. 17. Jurassic. 16. Triassic.	18. Cretaceous. 17. New Red Sandstone. 16. New Red Sandstone.
Paleozoic.	13–15. Carboniferous.	15. Permo-Carboniferous. 14. Coal Measures. 13 b. Mississippi, (Carb. limestone.) 13 a. Waverley or Bonaventure.
	8–12. Erian or Devonian.	12. Catskill. 11. Chemung and Portage. 10. Hamilton, (including Genesee and Marcellus.) 9. Corniferous or Upper Heldb'rg. 8. Oriskany.
	5–7. Silurian.	7. Lower Helderberg. 6. Onondaga or Salina. 5 c. Niagara, including Guelph. 5 b. Clinton. 5 a. Medina. 5 " Oneida.
	4. Upper Cambrian or Siluro-Cambrian.	4 c. Loraine, 4 b. Utica, 4 a. Trenton,
	3. Middle Cambrian.	3 c. Chazy. 3 b. Levis, (Tremadoc and Arenig.) 3 a. Calciferous.
	2. Lower Cambrian.	2 d. Potsdam. 2 c. Sillery. 2 b. Acadian, (Menevian.) 2 a. Lower Taconic.
Eozoic.	1. Primary or Crystalline.	1 d. Montalban. 1 c. Norian or Labrador.* 1 b. Huronian. 1 a. Laurentian.

* There are many reasons for believing the Norian to be older than the Huronian.—T. S. H.

The Dominion of Canada.[1]

List of the Geological Formations of Canada:

16. Triassic.		
14. Coal Measures.	Carb.	
13 b. Mississippi, Carb. l. s.	Carb.	
13 a. Bonaventure, or Waverley.	Carb.	
12. Catskill, (Old Red Sandstone.)	Devonian.	
11 b. Chemung and Portage.	Devonian.	
10 b. Hamilton, inc. Mar. & Gen.	Devonian.	
9 c. Corniferous, or Up. Held.	Devonian.	
8. Oriskany.	Devonian.	
7. Lower Helderberg.	Silurian.	
6. Salina, or Onondaga.	Silurian.	
5 d. Guelph.	Silurian.	
5 c. Niagara.	Silurian.	
5 b. Clinton.	Silurian.	
5 a. Medina and Oneida.	Silurian.	
4 c. Loraine.		4. Upper Cambrian or Siluro-Cambrian.
4 b. Utica.		4. Upper Cambrian or Siluro-Cambrian.
4 a. Trenton.		4. Upper Cambrian or Siluro-Cambrian.
3 c. Chazy.		3. Middle Cambrian.
3 b. Levis.		3. Middle Cambrian.
3 a. Calciferous.		3. Middle Cambrian.
2 d. Potsdam.		2. Lower Cambrian.
2 c. Sillery.		2. Lower Cambrian.
2 b. Acadian.		2. Lower Cambrian.
2 a. Lower Taconic.		2. Lower Cambrian.
1 d. Montalban.		1. Eozoic or Crystalline.
1 c. Norian or Labrador.[2]		1. Eozoic or Crystalline.
1 b. Huronian.		1. Eozoic or Crystalline.
1 a. Laurentian.		1. Eozoic or Crystalline.

1 The Grand Trunk Railway.

Ms.		
0	Portland, Me.	1 d. Montalban.
11	Yarmouth.	"
27	Danville Junc.	"
36	Mechanics' Fls.	"
47	South Paris.	"
70	Bethel.	"
91	Gorham, N. H.	"
123	Groveton Jun.	1 b. Huronian.
134	N. Stratford.	"
149	Island Pond.	1 d. Montalban.
166	Norton Mills.	"
175	Coaticook.	2. Lower Cambrian.
186	Westerville.	"
193	Lennoxville.	2. Lower Cambrian.
196	Sherbrooke.	1 b. Huronian.
217	- - - -	
221	Richmond.	"
228	Lisgar.	"
235	Durham.	2. Lower Cambrian.
243	Acton.	"
255	Britannia Mills	"
262	St. Hyacinthe.	4 c. Loraine.
275	St. Hilaire.	"
282	St. Bruno.	"
292	St. Lambert.	4 b. Utica, 5 m.
297	Montreal.	4 a. Trenton.

Riviere du Loup Branch.

0	Point Levis.	3. Middle Cambrian.
8	Chaudière.	2. Lower Cambrian.
11	St. J. Chrisost.	"
28	St. Michael.	"
46	St. Thomas.	"
60	L'Islet.	"
76	St. Roch.	"

Riviere du Loup Branch—*Con.*

Ms.		
95	St. Denis.	2. Lower Cambrian.
105	Ste. Helène.	"
125	Riv. du Loup.	"
130	St. Arsène.	"
138	Isle Verte.	"
144	Trois Pistoles.	"

Quebec Branch.

0	Point Levis, opposite Queb.	3. Middle Cambrian.
55	Stanfold.	1 b. Huronian.
64	Arthabaska.	"
96	Richmond.	"

Arthabaska Branch.

0	Arthabaska.	1 b. Huronian.
48	Aston.	"
25	St. Celestin.	4 c. Loraine, 4 miles.
31	St. Gregoire.	5 a. Medina, 6 miles.
35	Three Rivers.	4 c. Loraine, 3 miles.

Montreal to Toronto and Detroit.

0	Montreal.	4 a. Trenton, 14 miles.
8	Lachine Jun.	"
14	Point Claire.	"
21	Ste. Anne.	3 a. Calciferous, 7 miles
24	Vaudreuil.	2 b. Potsdam, 10 miles.
31	St. Dominique.	"
37	Coteau Land'g.	3 a. Calciferous, 3 miles
48	Bainsville.	3 c. Chazy, 33 miles.
54	Lancaster.	"
59	Summertown.	"
67	Cornwall.	3 a. Calciferous, 5 miles
72	Mille Roches.	4 a. Trenton, 2 miles.
77	Dickinson.	3 c. Chazy, 30 miles.
81	Farran's Point.	"
92	Morrisburg.	"

1. Corrected and the nomenclature arranged by Prof. T. Sterry Hunt, LL. D., F. R. S.

2. The Norian or Labrador series (Upper Laurentian of Logan) is found, like the Huronian, to rest unconformably upon the Laurentian, but its true relation to the Huronian being yet undetermined, the position at present assigned to it in the Eozoic succession is only provisional.—T. S. H.

Grand Trunk Railway.

Ms.	(Montreal to Toronto and Detroit—*Con.*)'	
99	Iroquois.	3 c. Chazy.
104	Edwardsburg.	3 a. Calciferous.
112	Prescott Jun.	"
112	Prescott Jun.	3 a. Calciferous- 45 m.
164	Ottowa.	3 c. Chazy, 7 miles.
115	Gladstone.	3 a. Calciferous.
120	Maitland.	"
125	Brockville.	"
129	Lyn.	2 b. Potsdam.
138	Mallorytown.	"
147	Landsdowne.	1 a. Laurentian, 34 m.
155	Gananoque.	"
162	Ballantyne's.	"
169	Rideau.	"
172	Kingston.	"
180	Collins' Bay.	4 a. Trenton, 114 miles.
194	Fredericksb'rg	"
198	Napanee.	"
213	Shannonville.	"
223	Belleville.	"
232	Trenton.	"
241	Brighton.	"
249	Colborne.	"
256	Grafton.	"
264	Cobourg.	"
270	Port Hope.	"
279	Newtonville.	"
286	Pt. Newcastle.	"
290	Bowmanville.	4 b. Utica, 24 miles.
294	Saxony.	"
299	Oshawa.	"
303	Whitby.	"
310	Dunn's Creek.	"
316	Port Union.	4 c. Loraine, 44 miles.
324	Scarboro Jun.	"
333	Toronto.	"
341	Weston.	"
354	Brampton.	5 a. Medina, 11 miles.
362	Georgetown.	"
365	Limehouse.	5 d. Guelph, 26 miles.
368	Acton West.	"
374	Rockwood.	"
381	Guelph.	"
386	Balmoral.	"
391	Breslau.	"
396	Berlin.	6. Onondaga, 14 miles.
403	Doon.	5 a. Guelph.
408	Galt.	"
402	Petersburg.	6. Onondaga.
405	Baden.	7 & 8. Cornif. 16 m. and
421	Stratford.	" [Oriskany
421	Stratford.	" 33 m.
432	St. Mary's.	"
444	Thorndale.	"
454	London.	"
421	Stratford.	" 26 m.
432	St. Mary's.	"
447	Lucan.	"

Grand Trunk Railway.

Ms.	Montreal to Toronto and Detroit—*Con.*	
454	Ailsa Craig.	10 b. Hamilton, 23 m.
461	Park Hill.	"
470	Widder.	"
479	Forrest.	11 b. Chemung, 91 m.
496	Blackwell.	"
501	Sarnia.	"
502	P. Huron,Mich	"
512	Ch. & L. H. Jun	"
557	Milw. Junc.	"
561	Detroit Junc.	"
564	Detroit.	10 b. Hamilton, 3 miles.

Buffalo to Goderich and Detroit.

0	Buffalo.	10. Hamilton, 2 miles.
2	Fort Erie.	9. Corniferous, 30 m.
19	Port Colborne.	"
32	Feeder.	6. Salina, 60 miles.
38	Dunnville.	"
59	Caledonia.	"
68	Onondaga.	"
76	Brantford.	"
84	Paris.	"
82	Drumbo.	"
97	Bright.	9. Corniferous, 68 m.
115	Stratford.	"
128	Mitchell.	"
139	Seaforth.	"
148	Clinton.	"
160	Goderich.	"

Montreal to St. John's and Rouse's Point.

0	Montreal.	4 a. Trenton, 2 miles.
2	St. Lambert.	4 b. Utica, 19 miles.
17	Laprairie Jun.	"
21	Lacadie.	"
27	St. John's.	4 a. Trenton, 29 miles.
40	Stottsville.	"
45	Lacolle.	"
50	Rouse's Point.	"

Montreal to Lachine and Province Line.

0	Montreal.	4 a. Trenton, 10 miles.
8	Lachine.	"
10	Caughnawaga.	4 a. Trenton.
15	St. Isidore.	3 c. Chazy, 18 miles.
21	St. Remi.	"
28	Hughes.	3 a. Calciferous, 12 m.
36	Hemmingford.	"
40	Province Line	"

2 Canada Southern Railway.

0	Buffalo.	9. Corniferous, 2 miles.
6	Victoria.	6. Onondaga. 58 miles.
8	Niagara Junc.	"
23	Welland.	"
32	Perry.	"
47	Canfield.	"
54	Dean's.	"
64	Hagersville.	9. Corniferous, 64 miles.
72	Villa Nova.	"

Ms.	Canada Southern Railway—*Con.*	
83	Windham.	9. Corniferous.
99	Tilsonburg.	"
111	Springfield.	"
124	St. Thomas.	10. Hamilton, 74 miles.
128	St. Claire Jn.	"
137	Iona.	"
150	Bismark.	"
162	Highgate.	"
187	Buxton.	"
198	Tilbury.	"
204	Comber.	9. Corniferous, 48 miles.
213	Woodslee.	"
227	Colchester.	"
235	Amherstburg.	"
236	Grosse Isle.	"
239	Trenton.	"
256	Detroit.	10. Hamilton, 10 miles.
0	Buffalo.	9. Corniferous.
8	Niagara Junc.	6. Onondaga.
19	Black Creek.	5 d. Guelph.
25	Chippewa.	5 c. Niagara.
28	Clifton House.	"
29	Susp. Bridge.	"
35	Queenston.	5 a. Medina.
42	Niagara.	"

3 Great Western Railway.

	Susp. Bridge.	
0	Clifton.	5 c. Niagara, 9 miles.
9	Thorold.	"
11	St. Catharines.	5 a. Medina, 34 miles.
27	Grimsby.	"
43	Hamilton.	"
43	Hamilton.	5 a. Medina, 32 miles.
45	Toronto Junc.	"
56	Bronte.	"
69	Port Credit.	"
75	Mimico.	4 c. Loraine, 7 miles.
82	Toronto.	"
43	Hamilton.	5 b. Clinton.
	Dundas.*	5 c. Niagara. / 5 b. Clinton.
55	Copetown.	5 d. Guelph.
59	Lynden.	"
62	Harrisburg.	"
65	St. George.	"
67	Dumfries.	6. Onondaga.
72	Paris.	" Gravel ridge.
79	Princeton.	" "
84	Governor's.	9. Corniferous.
80	Woodstock.	" Gravel. Heavy Drift.
110	Dorchester.	"
119	London.	"
129	Komoka.	10 b. Hamilton, 26 m.
140	Longwood.	"
145	Appin.	11 b. Chemung, 23 m.
156	Newbury.	"

Ms.	Great Western Railway.—*Con.*	
168	Thamesville.	10 b. Hamilton, 25 m.
183	Chatham.	"
198	Prairie.	9. Corniferous, 36 m.
207	St. Clair.	"
221	Tecumseh.	"
229	Windsor.	"
230	Detroit.	10 b. Hamilton, 1 m.

Great Western Railway Air Line.

00	Buffalo.	9. Corniferous, 75 m.
16	Welland.	"
72	Simcoe.	"
81	Delhi.	10 b. Hamilton, 68 m.
99	Corinth.	"
112	New Sarnia.	"
117	St. Thomas.	"
136	Baird's.	"
130	Lawrence.	"
145	Glencoe.	11 b. Chemung, 2 m.
224	Windsor.	"
225	Detroit.	"

4 Toronto, Grey and Bruce Railway.

0	Toronto.	4 c. Loraine, 33 miles.
9	Western Junc.	"
22	Kleinburg.	"
27	Bolton.	"
33	Mono Road.	5 a. Medina, 5 m.
41	Charleston.	5 c. Niagara, 11 m.
49	Orangeville.	"
64	Shelburne.	5 d. Guelph, 38 m.
81	Proton.	"
87	Flesherton.	5 c. Niagara, 6 m.
93	Markdale.	5 d. Guelph, 16 m.
98	Berkeley.	"
107	Arnot.	"
109	Chatsworth.	5 c. Niagara, 13 m.
114	Rochford.	"
122	Owen Sound.	"

5 Northern Railway of Canada.

0	Toronto.	4 c. Loraine, 24 miles.
14	Thornhill.	"
18	Richmond Hill	"
22	King.	"
30	Aurora.	4 b. Utica, 14 m.
34	Newmarket.	"
38	Holland.	"
49	Gilford.	5 d. Guelph, 34 m.
52	Lefroy.	"
57	Bramley.	"
63	Allendale.	"
74	Angus.	4 b. Utica.
86	Stayner.	"
94	Collingwood.	"
105	Meaford.	4 c. Loraine, 16 miles.

*At Dundas, close to Station, on N. side, a fine section of Niagara and Clinton.

Ms.	6 Intercolonial Railway. Eastern Division.	
0	Halifax.	2. Lower Cambrian.
8	Bedford.	" "
13	Windsor Junc.	" "
28	Enfield.	" "
30	Elmsdale.	" "
35	Milford.	13 a. Bonaventure.
39	Shubenacadie.	"
44	Stewiacke.	"
53	Brookfield.	"
61	Truro.	16. Triassic.
	Central Division,	
61	Truro.	16. Triassic. 13 a. Bonaventure. 14. Coal Measures. 13 a. Bonaventure.
78	Londonderry.	5-7. Upper Silurian. Granite.
90	Wentworth.	14. Coal Measures.
130	Maccan.	13 a. Bonaventure.
138	Amherst.	"
144	Aulac.	14. Coal Measures.
147	Sackville.	"
159	Dorchester.	"
167	Memramcook.	13 a. Bonaventure.
179	Painsec Junc.	14. Coal Measures.
	Western Division.	
179	Painsec Junc.	14. Coal Measures.
185	Humphrey's.	" "
189	Moncton.	" "
197	Boundary Crk.	13 a. Bonaventure.
200	Salaberry.	"
210	Peticodiac.	"
216	Anagance.	"
225	Penobsquis.	"
232	Sussex.	"
237	Apohaqui.	"
243	Norton.	"
250	Passekeag.	"
254	Hampton.	"
259	Nauwigewauk.	"
267	Rothesay.	1 a. Laurentian.
279	St. John.	" (2 b. Acadian.)
	Northern Division.	
187	Moncton.	14. Coal Measures.
224	Welford.	"
310	Bathurst.	2 Lower Cambrian. 13 a. Bonaventure.
329	Belledune.	2. Lower Cambrian.
347	New Mills.	" "
364	Dalhousie.	5-7. Silurian.
372	Campbellton.	"
395	Mill Stream.	9-11. Devonian.
433	Amque.	"
448	Sayabec.	2. Lower Cambrian.

Ms.	Intercolonial Railway.—*Con.* Continuation of Northern Division.	
477	Ste. Flavie.	2. Lower Cambrian.
515	St. Fabien.	"
534	Trois Pistoles.	"
552	Isle Verte.	"
561	Rivière du Lou	p. "
	Pictou Branch.	
61	Truro.	16. Triassic.
70	Union.	13 a. Bonaventure.
74	Riverdale.	"
82	West River.	5-7. Silurian.
89	Glengarry.	13 a. Bonaventure.
96	Hopewell.	14. Coal Measures.
104	New Glasgow.	"
112	Pictou Land'g.	"
113	Pictou.	"
	Shediac Branch.	
179	Painsec Junc.	14. Coal Measures.
184	Dorchester Rd.	"
188	Shediac.	"
190	Pt. du Chene.	"
	7 Windsor and Annapolis Railway.	
0	Halifax.	2. Lower Cambrian.
13	Windsor Junc.	"
30	- - - - -	(Outcrop of Granite.)
39	Newport.	13 a. Bonaventure.
45	Windsor.	"
47	Falmonth.	"
52	Hantsport.	
63	Wolfville.	16. Triassic.
65	Port William.	"
70	Kentville.	"
82	Berwick.	"
87	Aylesford.	"
98	Wilmot.	"
101	Middleton.	"
107	Lawrenceton.	"
115	Bridgetown.	"
121	Round Hill.	"
129	Annapolis.	9-11. Devonian.
	8 European and N. American R. R.	
0	St. John's.	1 a. Laurentian.
4	Fairville.	1 b. Huronian.
16	Westfield.	" Granite.
26	Welsford.	"
36	Enniskillen.	14. Coal Measures.
46	Fredericton J	"
67	Harvey.	"
86	McAdam Jun.	1 d. Montal'n. (Granite.)
91	St. Croix Jun.	
118	Danforth.	1 b. Huronian.
160	Lincoln.	"
183	Oldtown.	"
206	Bangor.	"

Maine. New Hampshire, Vermont, Massachusetts, Rhode Island and Connecticut.[1]

Table of the Geological Formations of the New England States.

Cenozoic.

20. Quaternary.	20 b. Champlain Clays.
"	20 a. Glacial Drift.
19. Tertiary.	19 c. Pliocene.
"	19 b. Miocene.
"	19 a. Eocene.

Mesozoic.

16. Triassic.	16. Triassic.

Paleozoic.

14. Carbonifer's.	14 b. Coal Measures.
"	14 a. Conglomerate.
8–10. Devonian.	10. s. s. pro'bly Hamilton.
"	9. Upper Helderb'g l.s.
"	8. Oriskany Group.
5–7. Silurian.	7. Lower Helderberg.
"	5. Port Daniel (Niag'a)
3–4. Cambro-Silurian.	4 d. Magnesian Slate(Emmons), possibly Cambrian.
"	4 c. Loraine Shales.
"	4 b. Utica Slate.
"	4 a. Trenton l. s.
"	3 c. Chazy l. s. } Stock-
"	3 b. Levis l. s. } bridge.
"	3 a. Calciferous s. s.
"	2 j. Potsdam ss. sl. & qu.
2. Cambrian.[2]	2 i. Clay sl. (Georgian
"	Group.)
"	2 h. St. Johns or Braintree Slate.
"	2 g. Taconic Slate.
"	2 f. Roxbury Conglom'e.
"	2 e. Calciferous Mica
"	Schists.
"	2 d. Staurolite Slate and
"	Schists.
"	2 c. Quartzite.
"	2 b. Andalusite Schists.
"	2 a. Rockingham Mica
"	Schists.

Eozoic.[2]

1 D. Huronian.	1 p. Merrimack qu. & sch.
"	1 o. Hydro Mica (Talcose) Schists and Grits.
"	1 n. Quartzite, Indurated Slate, &c.
"	1 m. Felsite Porphyries.
"	1 l. Hornblende Schists.
"	1 k. Lisbon, Lyman & Swiftwater Series of N. H.
1 C. Labrador.	1 j. Franconia Breccia.
1 B. Montalban.	1 i. Andalusite Gneiss.
"	1 h. Concord & Hallowell Granites.
"	1 g. Lake Winnipiseogee Gneiss.
"	1 f. Green Mount. Gneiss.
1 A. Laurentian.	1 e. Bethlehem "
"	1 d. Porphyritic "
"	1 c. Adirondac "
"	1 b. K 2, K 3 of Percival.
"	1 a. E. Mass. Gneiss, &c.

Eruptive Rocks.[2]

K h.	Mesozoic Dolerites.
J j.	Labradorite Diorites.
I i.	Dolerites.
H h.	Diorites.
G g.	Porphyry of White Mountains.
F f.	Granite, cutting Cambrian Slates.
E e.	Chocorua Sienite and Granite.
D d.	Exeter (Quincy) Sienite.
C c.	Albany Granite.
B b.	Conway Granite.
A a.	Trachyte, &c., of White Mountains.

1. Prepared by Prof. C. H. Hitchcock, State Geologist of New Hampshire.

2. The Eruptive Rocks and the subdivisions of 1 and 2 are not necessarily consecutive. 2 c., 2 d. and 2 e. may yet prove to be Silurian.

Maine.

Maine Central Railroad.

Ms.		
0	Portland.	1 c. Huronian.
8	Falmouth.	1 B. Montalban.
15	Yarmouth.	"
20	Freeport.	"
25	Oak Hill.	"
29	Brunswick.	"
37	Bowdoinham.	"
44	Richmond.	"
56	Gardner.	"
60	Hallowell.	" Granite.
62	Augusta.	" "
70	Riverside.	2. Cambrian.
81	Waterville.	"
89	Clinton.	1 c. Huronian.
94	Burnham.	"
101	Pittsfield.	"
108	Newport.	"
117	Etna.	"
125	Herman Pond.	"
135	Bangor.	"

Skowhegan Division.

0	Waterville.	2. Cambrian.
11	Pishon Ferry.	1 c. Huronian.
19	Skowhegan.	"

Lewiston Division.

0	Portland.	1 c. Huronian.
8	Falmouth.	1 B. Montalban.
19	Gray.	"
29	Danville Junc'n	"
36	Lewiston.	"
46	Leeds Junction.	"
55	Winthrop.	"
61	Readfield.	"
74	North Belgrade.	"
84	Waterville.	2. Cambrian.

Belfast Division.

0	Burnham.	1 c. Huronian.
8	Unity.	"
12	Thorndike.	"
22	Brooks,	1 B. Montalban.
32	City Point.	2. Cambrian.
34	Belfast.	"

Dexter Division.

0	Newport.	1 c. Huronian.
7	Corrinne.	"
14	Dexter.	"

Maine Central Railroad—*Continued.*

Androscoggin Division.

Ms.		
0	Bath.	1 B. Montalban.
9	Brunswick.	"
20	Lisbon.	"
27	Lewiston.	"
34	Leeds Junction.	"
44	North Leeds.	"
54	Livermore Falls	1 c. Huronian.
67	Wilton.	1 g. Lake Gneiss.
74	Farmingham.	2 c. and d. Coos.

Knox and Lincoln Railroad.

0	Bath.	1 B. Montalban.
11	Wicasset.	1 g. Lake Gneiss.
18	New Castle.	"
30	Waterloo.	"
37	Warren.	"
45	Thomaston.	3 b. Levis Limestone.
49	Rockland.	" and Quartzite.

Bangor and Piscataquis Railroad.

0	Bangor.	1 c. Huronian.
12	Old Town.	"
21	Alton.	"
31	Lagrange.	"
40	Milo.	"
53	Dover.	"
61	Guilford.	2. Cambrian.

European and North American Railway.

0	Bangor.	1 c. Huronian.
5	Veazie.	"
12	Old Town.	"
18	Costigan.	"
27	Olamon.	"
36	Enfield.	"
45	Lincoln.	"
56	Winn.	"
66	Kingman.	"
79	Bancroft.	"
88	Danforth.	"
102	Eaton.	"
115	St. Croix.	7–10. Devonian.

☞Railroads of Maine not found under the Maine heading are to be found in the chapters on Massachusetts and New Hampshire.

New Hampshire.[3]

Ms.	Grand Trunk Railway.	
0	Portland, Me.	1 c. Huronian.
5	Falmouth.	"
11	Yarmouth.	1 B. Montalban.
18	Pownal.	"
27	Danville Junc'n	"
36	Mechanic Falls.	"
41	Oxford.	"
47	South Paris.	"
55	West Paris.	"
65	Locke's Mills.	"
70	Bethel.	"
80	Gilead.	"
86	Shelburne.	"
91	Gorham.	"
98	Berlin Falls	1 g. Lake Group.
103	Milan.	"
122	Groveton.	1 c. Huronian.
134	North Stratford	"
142	Wenlock.	Granite.
149	Island Pond.	"
166	Norton Mills.	"
175	Coaticooke.	2 c. Calcife's Mica Schist
	(Continued in Canada.)	

	Portland and Ogdensburg Railroad.	
0	Portland, Me.	1 c. Huronian.
5	Westbrook.	1 B. Montalban.
11	South Windham	"
17	Sebago Lake.	"
24	Steep Falls.	"
32	Baldwin.	"
43	Brownfield.	"
49	Fryeburg.	"
60	North Conway.	B b. Conway Granite.
66	Glen Station.	C c. Albany Granite.
72	Upper Bartlett.	B b. Conway Granite.
78	Bemis.	1 B. Montalban.
87	Crawford.	"
91	Fabyan's.	"
95	Twin Mountain.	1 e. Bethlehem Gneiss.
101	Bethlehem.	"
105	Wing Road.	1 d. Porphyritic Gneiss.
114	Lunenburg.	1 k. Lyman Group.

	Northern New Hampshire Railroad.	
0	Concord.	1 h. Concord Granite.
7	Fisherville.	1 B. Montalban.
14	Nor. Boscowen.	"
17	Franklin.	"
25	East Andover.	"
31	Potter Place.	1 d. Porphyritic Gneiss.
44	Grafton.	"
52	Canaan.	1 l. Hornblende Schist.
59	Enfield.	1 e. Bethlehem Gneiss.
65	Lebanon.	"
69	W.R. Junction.	1 l. Hornblende Schist.

Ms.	Boston, Concord & Montreal Railroad.	
0	Concord.	1 h. Concord Granite.
10	Canterbury.	2 a. Rockingham Schist.
18	Tilton.	1 g. Lake Gneiss.
27	Laconia.	1 B. Montalban.
33	Weirs.	1 d. Porphyritic Gneiss.
48	Ashland.	"
51	Plymouth.	1 B. Montalban.
59	Rumney.	"
67	Wentworth.	1 g. Lake Gneiss.
71	Warren.	"
84	Haverhill.	1 c. Huronian.
93	Wells River.	" & 1 k. Lyman.
103	Lisbon.	" & 1 k. Lisbon.
	North Lisbon.	7. Helderberg.
113	Littleton.	2 c. Coos & 7. Helderbg.
120	Wing Road.	1 d. Porphyritic Gneiss.
124	Bethlehem.	1 e. Bethlehem Gneiss.
129	Twin Mountain.	" (Local Glacier.)
134	Fabyan's.	1 B. Montalban.
120	Wing Road.	1 d. Porphyritic Gneiss.
128	Dalton.	1 c. Huronian.
135	Lancaster.	"
145	Groveton Junc.	"

	Concord Railroad of New Hampshire.	
0	Concord.	1 h. Concord Granite.
5	Suncook.	1 B. Montalban.
9	Hooksett.	"
13	Martin's.	1 g. Lake Gneiss.
18	Manchester.	"
26	Reed's.	"
29	Thornton's.	"
35	Nashua.	1 p. Merrimack Group.

	Suncook Valley Branch.	
	Hooksett.	1 B. Montalban.
	Pittsfield.	2 a. Rockingham Schist.

	Concord and Portsmouth Railroad.	
0	Manchester.	1 g. Lake Gneiss.
8	Auburn.	"
18	Raymond.	1 c. Huronian.
24	Epping.	1 p. Merrimack Group.
31	New Market.	D d. Exeter Sienite.
41	Portsmouth.	1 p. Merrimack Group.

	Manchester and Lawrence Railroad.	
0	Manchester.	1 g. Lake Gneiss.
8	Wilson's.	1 p. Merrimack Group.
14	Windham.	"
22	Messer's.	"
26	Lawrence.	"

	Manchester and North Weare Railroad.	
0	Manchester.	1 g. Lake Gneiss.
11	Oil Mills.	"
19	North Weare.	"

Ms.	Cheshire Railroad.	
0	Bellows Falls.	1 B. Montalban.
4	Walpole.	2 c. & d. Coos sch. & qu.
10	Westmoreland.	1 l. Hornblende Schists.
22	Keene.	1 e. Bethlehem Group.
32	Troy.	4 B. Montalban.
37	Fitzwilliam.	1 a Concord Granite.
43	State Line.	1 B. Montalban.
46	Winchester.	"
54	S. Ashburnham.	"
64	Fitchburg.	"

	Ashuelot Railroad.	
0	Keene.	1 e. Bethlehem Group.
8	Westport.	"
15	Ashuelot.	1 d. Porphyritic Gneiss.
24	South Vernon.	2 c. Coos Quartz.

Ms.	Concord and Claremont Railroad.	
0	Concord.	
8	Mast Yard.	Ferruginous Schists.
12	Contoocook.	1 h. Concord Granite.
18	Warner.	1 g. Lake Gneiss.
23	Roby's Corners.	1 d. Porphyritic Gneiss.
27	Bradford.	"
34	Newbury.	"
43	Newport.	4 g. Lake Gneiss.
48	Kellysville.	"
54	Claremont.	2 c. Calcifer's Mica Sch.
12	Contoocook.	1 h. Concord Granite.
20	Henniker.	1 d. Porphyritic Gneiss.
27	Hillsboro.	1 g. Lake Gneiss.

☞ Railroads not found under New Hampshire heading will be found in Massachusetts.

3. The New Hampshire formations are believed to possess thickness as follows: Helderberg, 500 feet; Calciferous Mica Schists, 4,800 feet; Coos Group, 7,300 feet; Cambrian Slates of Connecticut Valley, 3,000 feet; Kearsarge Group, 1,300 feet; Rockingham Mica Schists, 6,000 feet; Merrimack Group, 4,300 feet; Huronian, 12,000 feet; Montalban, 10,000 feet; Lake Winnepisseoga Gneiss, 18,000 feet; Bethlehem Gneiss, 11,300 feet; Porphyritic Gneiss, 5,000 feet.

Vermont.

Ms.	Central Vermont Railroad. Southern Division.	
127	Brattleboro.	2. Cambrian.
130	Putney.	2 d. Coos Schist.
141	Westminster.	2. Cambrian.
145	Bellows Falls.	1 B. Montalban.
153	Charleston.	2 c. & d. Coos Group.
163	Claremont.	2 c. Calcife's Mica Sch.
171	Windsor.[4]	"
179	North Hartland.	2. Camb. & 1 c. Huro'n.
185	White River Jn.	1 l. Hornbl. Schist. "

	Central Division.	
171	Hartford.	2. Cambrian.
198	Sharon.	2 c. Calcifer's Mica Sch.
205	Roylston.	"
216	Bethel.	1 c. Huro'an Soapstone.
217	Randolph.	"
223	Braintree.	"
232	Roxbury.	"Verde Antique.

Ms.	Central Vermont Railroad. Central Division—*Continued.*	
239	Northfield.	1 c. Huro'an Soapstone.
249	Montpelier.	" and Clay Slate.
258	Waterbury.	"
266	Bolton.[5]	1 f. Green Mt. Gneiss.
272	Richmond.	1 c. Huronian.
281	Essex Junction.	Clay Slate.
286	Winooski.	3 b. Levis Limestone.
289	Burlington.	2 j. Potsdam Sandstone.
292	Milton.	3 b. Levis Limestone.
306	St. Albans.	2 j. Potsdam Slate.

	Rutland Division.	
0	Bellows Falls.	1 B. Montalban.
5	Rockingham.	2 e. Calcifer's Mica Sch.
10	Chester.	1 g. Lake Gneiss.
22	Cavendish.	"
27	Ludlow.	1 c. Huronian.
34	Summit.	1 f. Green Mt. Gneiss.
39	E. Wallingford.	"

4. An interesting area has been traced from Lyme, N. H., to Windsor, Vt., about 30 miles long. Portions of it have been removed by the wearing action of the Connecticut. It appears to have been deposited by a powerful current derived from the melting of the glacial sheet prior to the accumulation of terraces.

5. The centre of the anticlinal axis of the Green Mountains. At least eight of the general sections of the Vermont survey show this feature of structure, proving this formation to be older than the Huronian adjacent upon both sides. This structure was denied by Logan for the continuation of the Vermont rocks in Canada in his generalizations, but the descriptions of the rocks confirm the views of the Vermont geologist.

Central Vermont Railroad.

Ms.	Rutland Division—*Continued.*	
46	East Clarendon.	3 b. Levis Limestone.
52	Rutland.	2 e. Calciferous Sandrock, (Stockbridge.)
59	Sutherland Falls	3 c. Chazy Marble.
69	Brandon.	19 a. Eocene Tertiary.
74	Leicester Junc.	3 c. Chazy Marble.
79	Salisbury.	3 b. Levis Limestone.
85	Middlebury.	"
89	Brooksville.	3 c. Chazy Limestone.
93	New Haven.	4 a. Trenton Limestone.
99	Vergennes.	3 c. Chazy Limestone.
109	Nor. Ferrisburg.	"
113	Shelburne.	2 j. Potsdam Sandstone.
120	Burlington.	"
	Western Division	
0	St. Albans.	2 j. Potsdam Slate.
9	Swanton.	"
	Northern Division.	
0	St. Albans.	2 j. Potsdam Slate.
9	East Swanton.	"
17	Province Line.	3 b. Levis Limestone.
	Eastern Division.	
0	St. Albans.	
10	Sheldon.	1 c. Huronian.
18	Enosburg Falls.	"
28	Richford.	"
	Addison Division.	
0	Leicester Junc.	3 c. Chazy.
3	Whiting.	"
7	Shoreham.	" and 3 a.
9	Orwell.	2 c. Calcife's Sandrock.
15	Larabee's Point	4 a. Trent. & La Motte.
16	Ticonderoga.	3 a. Calciferous s. s.

Harlem Extension Railroad.

0	Rutland.	2 a. Calcifer's Sandrock.
6	Clarendon.	"
9	Wallingford.	"
13	S. Wallingford.	3 c. Chazy Marble.
18	Danby and Mt. Tabor.	3 a. Calcife's Sandstone.
25	East Dorset.	" & Chazy Marble.
30	Manchester.	3 b. Levis Limestone.
39	Arlington.	"
44	Shaftsbury.	"
51	N. Bennington.	"
55	Bennington.	"
61	T. & B. Junc'n.	2. Cambrian Taconic sl.

Portland and Ogdensburg Railroad.

Ms.		
0	Lunenburg.	1 k Lyman Gp. & 1 c Hur
7	Miles Pond.	1 B. Montalban.
13	West Concord.	2 c. and d. Coos Group.
21	St. Johnsbury.	2 e. Calcife's Mica Schs.
33	Danville.	"
41	Walden.	"
49	Greensboro.	"
57	Hardwick.	"
62	Wolcott.	1 c. Huronian.
70	Morrisville.	"
73	Hyde Park.	"
78	Johnson.	"

Connecticut and Passumpsic Railroad.

0	White Riv. Jun.	1 l. Hornblende Schist.
5	Norwich.	"
10	Pompanoosuc.	"
15	Thetford.	2 c. and d. Coos Group.
22	Fairlee.	1 k Lyman Gp. & 1 c Hur
28	Bradford.	"
36	Newbury.	"
40	Wells River.	"
51	Barnet.	2 e. Calcifer's Mich Sch.
58	Passumpsic.	"
61	St. Johnsbury.	"
69	Lyndonville.	"
77	West Burke.	"
90	Barton.	"
100	Coventry.	"
105	Newport.	2. Cambrian.

Saratoga and Champlain Railroad.

0	Rutland.	
11	Castleton.	2. Cambrian Slates.
8	Granville.	"
19	Rupert.	"
26	Salem.	"
34	Eagle Bridge.	"

Massachusetts.

Ms.	Eastern Railroad.	
0	Boston.	20 a. Glacial Drift.
2	Somerville.	2. Cambrian.
3	Everett.	"
5	Chelsea.	20 a. Glacial Drift.
11	Lynn.	1 a. Huronian, (Porp'y)
16	Salem.	D d. Exeter Sienite.
23	Wenham.	"
28	Ipswich.	"
31	Rowley.	"
37	Newburyport.	1 A. Laurentian.
39	Salisbury.	D d. Exeter Sienite.
43	Seabrook.	1 p. Merrimack.
47	Hampton.	"
51	Greenland.	"
56	Portsmouth.	"
58	Kittery.	"
63	Elliott.	"
67	Conway Junc'n.	"
70	So. Berwick J'n	"
75	North Berwick.	"
80	Wells.	D d. Exeter Sienite.
89	Kennebunk.	2. Cambrian.
94	Biddeford.	" and Con'y Gra'te.
95	Saco.	2. Cambrian.
103	Scarboro.	1 c. Huronian.
108	Portland.	"

Boston, Salem and Rockport Division.

	Beverley.	D d. Exeter Sienite.
	Manchester.	"
	Gloucester.	"
	Rockport.	"

Amesbury Branch.

39	Salisbury.	D d. Exeter Sienite.
43	Amesbury.[6]	20 a. Glacial Drift.

Great Falls, Rochester and Conway Branch.

73	Great Falls.	1 p. Merrimack Quartz.
79	Rochester.	2 b. Andalusite Schists.
109	Wolfboro.	1 g. Lake Gneiss.
138	North Conway.	B b. Conway Granite.

Salem and Lawrence Branch.

	Salem.	Sienite and Diorite.
	Middletown.	1 l. Hornblende Schists.
	Lawrence.	1 p. Merrimack Group.

Ms.	Boston and Maine Railroad.	
0	Boston.	20 a. Glacial Drift.
12	Reading.	1 l. Hornblende Schists.
18	Wilmington.	1 A. Laurentian.
23	Andover.	"
26	South Lawrence	1 p. Merrimack Group.
32	Bradford.	"
38	Plaistow.	"
41	Newton.	"
45	East Kingston.	"
51	Exeter.	D d. Exeter Sienite.
58	New Market.	"
68	Dover.	"
72	Salmon Falls.	1 p. Merrimack Group.
78	North Berwick.	"
85	Wells.	D d. Exeter Sienite.
90	Kennebunk.	2. Cambrian.
100	Saco.	"
109	Scarboro Beach.	1 A. Huronian.
116	Portland.	"

Boston, Lowell and Nashua Railroad.

0	Boston.	
8	Winchester.	D d. Exeter Sienite.
15	Wilmington.	1 A. Laurentian.
22	Billerica.	"
26	Lowell.	1 p. Merrimack Group.
29	No. Chelmsford.	"
40	Nashua.	"
45	Merrimack.	"
51	Milford.	1 g. Lake Gneiss.
54	Wilton.	Rockingham Schists.
59	Lyndeboro.	1 g. Quartz Lake Gneiss
66	Greenfield.	1 g. Lake Gneiss.

Danvers and Newburyport Railroad.

0	Boston.	
10	Wakefield.	D d. Exeter Sienite.
13	Lynnfield.	"
19	Danvers.	"
28	Boxford.	1 l. Hornblende Schists.
31	Georgetown.	"
40	Newburyport.	1 A. Laurentian.

Old Colony Railroad.

0	Boston.	
5	Neponset.	2. Cambrian.
10	Braintree.	"
15	Randolph.	D d. Exeter Sienite.
19	Stoughton.	"
25	Easton.	"
31	Raynham.	14. Carboniferous.
34	Taunton.	"
43	Somerset.	Granite.

6. This and the adjoining towns are chiefly occupied by a profusion of lenticular-shaped drift-hills, believed to be moraines of ancient glaciers, and different from the usual *grand moraine* of glacial drift. The hills may be 200 feet high, and their longer axis run southeasterly, being parallel with the course of the striæ in the neighborhood. In the Merrimack and Connecticut Valley a few have been found having a direction to the south and west-of-south, but agreeing with the course of adjoining striæ.

Old Colony Railroad—*Continued.*

Ms.	Division.	
15	Holbrook.	D d. Exeter Sienite.
20	Brockton.	"
27	Bridgewater.	14. Carboniferous.
34	Middleboro.	"
45	Assonet.	Granite.
49	Fall River.	14 a. Conglomerate.
56	Bristol Ferry.	14 b. Coal Measures.
68	Newport.	"

(Continued in Rhode Island.)

South Shore, Duxbury and Cohasset Division.

0	Boston.	
10	Braintree.	2. Cambrian.
11	Weymouth.	20 a. Glacial Drift.
17	Hingham.	D d. Exeter Sienite.
21	Cohasset.	"
39	Egypt.	"
	Sea View.	"
37	Duxbury.	"
	Plymouth.	20 a. Glacial Drift.
45	Fremont.	"
49	Wareham.	"
54	Cohasset Narr's	"
62	Sandwich.	"
69	W. Barnstable.	"
73	Barnstable.	"
75	Yarmouth.	"
84	Harwich.	"
94	Orleans.	"
106	Wellfleet.	"
120	Provincetown.	"
68	Falmouth.	"
71	Wood's Hole.	"

Boston, Clinton and Fitchburg Railroad.

0	Boston.	
22	S. Framingham.	1 A. Laurentian.
28	Fayville.	"
32	Marlboro.	1 l. Hornblende Schists.
41	Berlin.	1 p. Merrimack qu.& sch
48	Clinton.	2. Cambrian.
50	Pratt's Junction	1 p. Merrimack qu.& sch
59	Fitchburg.	Granite.

Fitchburg and Worcester Division.

0	Fitchburg.	
5	Leominster.	1 p. Merrimack qu.& sch
9	Pratt's Junction	"
14	Sterling Junc'n.	"
26	Worcester.	" & Granite.

Mansfield and Framingham Division.

0	Fitchburg.	
40	Sherborn.	D d. Exeter Sienite.
45	Medfield.	"
49	Walpole.	2. Cambrian.
58	Mansfield.	14 b. Coal Measures.
69	Taunton.	"
89	New Bedford.	1 A. Laurentian.

Boston, Clinton and Fitchburg—*Continued.*

Framingham and Lowell Division.

Ms.		
0	Lowell.	1 p. Merrimack qu.& sch
13	Acton.	1 A. Laurentian.
20	Sudbury.	"
26	Framingham.	

Boston and Providence Railroad.

0	Boston.	
5	Forest Hill.	20 a. Drift Moraine.
9	Readville.	1 c. Huronian Porphyry.
14	Canton.	2. Cambrian.
18	Sharon.	D d. Exeter Sienite.
24	Mansfield.	14 b. Coal Measures.
31	Attleboro.	"

New York and New England.

0	Boston.	
9	Readville.	1 c. Huronian Porphyry.
19	Walpole.	2. Cambrian.
23	Norfolk.	D d. Exeter Sienite.
27	Franklin.	"
30	Wadsworth.	1 A. Laurentian.
36	Blackstone.	"
41	Ironstone.	"
48	Douglas.	2 c. Quartzite.
53	E. Thompeon.	1 B. Montalban.

Norwich and Worcester Division.

0	Worcester.	1 p. Merrimack qu.& sch
4	Auburn.	"
11	Oxford.	"
16	Webster.	1 A. Laurentian.

Woonsocket Division.

0	Boston.	
12	Weedham.	2. Cambrian.
19	Medfield.	1 m. Huron'n Porphyry.
25	Medway.	D d. Exeter Sienite.
32	Belllngham.	1 c. Huronian.
38	Woonsocket.	2. Cambrian.

Nashua and Acton Railroad.

0	Nashua.	1 p. Merrimack qu.& sch
5	Dunstable.	1 g. Lake Gneiss.
12	Graniteville.	1 p. Merrimack qu.& sch
22	Acton.	1 A. Laurentian.
24	Concord Junc'n	"

Worcester and Nashua Railroad.

0	Worcester.	1 p. Merrimack qu.& sch
10	Oakdale.	"
17	Clinton.	2. Cambrian.
25	Harvard.	1 p. Merrimack qu.& sch
31	Groton.	"
39	Hollis.	"
46	Nashua.	"
57	Windham.	"
65	Sandown.	"
74	Epping.	"
80	Lee.	"
88	Barrington.	"
95	Rochester.	2 b. Andalusite Schists.
147	Portland.	1 c. Huronian.

Ms.	Providence and Worcester R. R.	
16	Woonsocket.	2. Cambrian.
20	Millville.	"
25	Uxbridge.	1 A. Laurentian.
31	Northbridge.	"
37	Millbury.	"
44	Worcester.	

	Boston, Barre and Gardner Railroad.	
0	Boston.	
44	Worcester.	1 p. Merrimack qu. & sch
52	Holden.	"
60	Princeton.	1 g. Lake Gneiss.
70	Gardner.	"

	Ware River Railroad.	
0	Palmer.	1 d. Porphyritic Gneiss.
3	Thorndike.	"
12	Ware.	"
21	Barre Plaines.	1 g. Lake Gneiss.
27	Templeton.	"
43	Baldwinsville.	"
48	Winchendon.	"

	Springfield, Athol & North-Eastern R. R.	
0	Athol.	1 g. Lake Gneiss.
8	New Salem.	"
16	Greenwich Vil'e	"
21	Enfield.	"
30	Barrett's Junc'n	D d. Sienite.
37	Collins.	"
41	Ludlow.	" & 16. Triassic.
48	Springfield.	16. Triassic.

	New London Northern Railroad.	
50	Stafford.	1 B. Montalban.
60	South Monson.	"
65	Palmer.	1 d. Porphyritic Gneiss.
70	Barrett's.	D d. Sienite.
75	Belchertown.	1 B. Montalban.
80	Dwight's.	20 a. Drift.
85	Amherst.	16. Triassic.
90	Leverett.	1 B. Montalban.
95	South Montague	16. Triassic.
100	Miller's Falls.	1 B. Montalban.
103	Northfield.	16. Triassic.
110	South Vernon.	2 c. Coos Quartzite.
116	Vernon.	1 e. Bethlehem Gneiss.
121	Brattleboro.	2. Cambrian.

Ms.	New Haven and Northampton R. R.	
0	Williamsburg.	Calciferous Mica Schist.
5	Florence.	D d. Sienite.
8	Northampton.	"
13	East Hampton.	16. Triassic.
16	Southampton.	"
23	Westfield.	"
29	Southwick.	"

	Connecticut River Railroad.	
0	Springfield.	16. Triassic.
7	Chicopee Jun'n.	"
8	Holyoke.	"
13	Smith's Ferry.	"
15	Mount Tom.[7]	"
17	Northampton.	D d. Sienite.
21	Hatfield.	16. Triassic.
26	Whately.	"
33	Deerfield.	"
36	Greenfield.[8]	"
40	Bernardstown.[9]	2 c. Quartzite and Coos.
50	South Vernon.	"

	New Haven, Hartford & Springfield R. R.	
0	Springfield.	16. Triassic.
4	Long Meadow.	"

	Housatonic Railroad.	
0	Pittsfield.	3 b. & c. Stockbridge ls.
7	Dewey's.	"
8	Lenox.	"
11	Lee.	"
17	Stockbridge.	"
23	VanDeusenville	"
25	Barrington.	"
31	Sheffield.	"
35	Ashley Falls.	"
37	Canaan.	"

	Fitchburg, Troy and Boston Railroad.	
0	Boston.	
10	Waltham.	1 c. Huronian.
20	Concord.	1 A. Laurentian.
27	West Acton.	"
35	Ayer Junction.	1 p. Merrimack qu. & sch
40	Shirley.	"
46	Leominster.	"
50	Fitchburg.	"
58	Westminster.	Granite.

7. This is the locality furnishing for the Amherst Museum the large rows of tracks of *Brontozoum Giganteum*, the largest of the Triassic birds. Across the river, in South Hadley, is an excellent locality of *Otozoum Moodii*, so named for Pliny Moody, who was the first person in the Connecticut Valley known to have observed any of the footmarks. A specimen is preserved which he dug up in 1800, saying that "the tracks were made by Noah's raven."

8. The noted locality of fossil footmarks is at Turners Falls, on a branch of the F. T. & B. R. R., four miles distant. W. W. Draper was the first person to observe them, in 1835. He suggested that they were "turkey tracks made 2,000 years ago." His impressions were communicated to Col. Wilson, who called the attention of Dexter Marsh to them. Mr. Marsh showed them to Dr. James Deans, who requested Prof. E. Hitchcock to investigate them scientifically. This was done, and the results accumulated in the Hitchcock Ichnological Museum at Amherst, where are over 20,000 separate ichnites, illustrating about 160 species, all from the Connecticut Valley.

9. This is the town where the celebrated Helderberg limestone crops out. It is believed to be a remnant of a once extensive deposit, preserved accidentally from erosion, and resting upon or folded beneath the Coos Quartzite.

Fitchburg, Troy & Boston R. R.—*Continued.*

60	Ashburnham.	1 g. Lake Gneiss.
65	Gardner.	1 B. Montalban.
71	Baldwinsville.	"
77	Royalston.	"
80	Athol.	"
87	Orange.	"
92	Ewing.	"
98	Miller's Falls.	"
102	Montague.	"
106	Greenfield.[8]	16. Triassic.
109	Bardwell's.	"
117	Shelburne Falls.	1 f. Green Mt. Gneiss.
128	Charlemont.	"
132	Zoar.	"
136	Hoosac Tunnel.	[10] "
143	North Adams.	3 b. & c. Stockbridge ls.
148	Williamstown.	"
158	Petersburg.	2 g. Taconic Schists.

Boston and Albany Railroad.

0	Boston.	
5	Brighton.	2. Cambrian.
21	S. Framingham.	1 A. Laurentian.
28	Southville.	"
38	Grafton.	"
49	Worcester.	1 p. Merrimack qu.& sch
52	Rochdale.	1 g. Lake Gneiss.
62	Spencer.	"

Boston and Albany Railroad—*Continued.*

67	Brookfield.	1 g. Lake Gneiss.
73	Warren.	"
83	Palmer.	1 d. Porph. Gneiss.
89	Wilbraham.	16. Triassic.
98	Springfield.	"
108	Westfield.	"
116	Russell.	2 e. Calcifer's Mica Sch.
119	Huntington.	"
126	Chester.	1 c. Huronian.
131	Middlefield.	"
135	Becket.	1 f. Green Mt. Gneiss.
138	Washington.	"
143	Hinsdale.	"
146	Dalton.	2 j. Potsdam.
151	Pittsfield.	3 b. & c. Stockbridge ls.
159	Richmond.	"
162	State Line.	2 g. Taconic Schists.

Milford Branch.

	S. Framingham.	1 A. Laurentian.
	Milford.	"

Pittsfield and North Adams Branch.

0	Pittsfield.	3 b. & c. Stockbridge ls.
6	Berkshire.	"
10	Cheshire.	"
15	South Adams.	"
20	North Adams.	"

10. The monntain is believed to be an inverted and very much crushed anticlinal.

Rhode Island.

Providence and Springfield Railroad.

Ms.		
0	Providence.	14. Carboniferous.
5	Allendale.	1 D. Huronian.
10	Stillwater.	1 A. Laurentian.
17	Tarkiln.	"
23	Pascoag.	"

Providence and Worcester Railroad.

0	Providence.	14. Carboniferous.
6	Valley Falls.	14 b. Coal Measures.
9	Ashton.	2. Cambrian.
16	Woonsocket.	" ?

Boston and Providence Railroad.

0	Providence.	14. Carboniferous.
4	Pawtucket.	14 b. Coal Measures.
5	East Juuction.	

Providence, Warren and Bristol Railroad.

0	Providence.	14. Carboniferous.
7	Nayatt.	"
10	Warren.	"
14	Bristol.	"
16	Fall River.	14 a. Carb. Conglom'te.

Old Colony Railroad.

0	Newport.	14 b. Coal Measures.
12	Bristol Ferry.	"
14	Tiverton.	Granite.
19	Fall River.	14 a. Carb. Conglom'te.

Connecticut.

Ms.	Housatonic Railroad.	
0	Bridgeport.	1 d. Porphyritic Gneiss.
10	Stepney.	1 B. Montalban.
15	Botsford.	"
19	Newtown.	"
23	Hawleyville.	"
27	Brookfield Jun.	"
35	New Milford.	"
42	Merwinsville.	"
48	Kent.[11]	1 A. Laurentian.
57	Cornwall Bridge	"
65	Lime Rock.	3 b. & c. Stockbridge l.s.
73	Canaan.	"

	Shepaug Railroad.	
0	Litchfield.	1 b. Montalban.
6	Morris.	"
13	Washington.	"
20	Roxbury.	"
32	Hawleyville.	"
38	Bethel.	"
59	South Norwalk.	"

	Naugatuck Railroad.	
0	Bridgeport.	1 d. Porphyritic Gneiss.
3	Stratford.	"
13	Derby.	"
15	Ansonia.	"
19	Seymour.	1 B. Montalban.
26	Naugatuck.	"
32	Waterbury.	"
34	Waterville.	"
41	Thomaston.	"
46	Campville.	"
49	Litchfield.	"
52	Wolcottsville.	"
57	Burrville.	1 A. Laurentian.
61	Winsted.	"
32	Waterbury.	1 B. Montalban.
35	Oakville.	"
38	Watertown.	"

	New Haven and Northampton Railroad.	
0	New Haven.	16. Triassic.
9	Mount Carmel.	"
15	Cheshire.	"
22	Southington.	"
27	Plainville.	"
31	Farmington.	"
37	Avon.	"
42	Simsbury.	"
47	Granby.	"

	New Haven & Northampton R. R.—*Con.* Collinsville Branch.	
	Farmington.	16. Triassic.
	Unionville.	"
	Collinsville.	1 B. Montalban.
	New Hartford.	"

	New York, New Haven, Hartford & Springfield Railroad.	
0	New York.	1 B. Montalban.
30	Greenwich.	"
35	Stamford.	"
43	South Norwalk.	"
50	Southport.	"
57	Bridgeport.	1 d. Porphyritic Gneiss.
60	Stratford.	"
65	Milford.	2 c. Calcifer's Mica Sch.
74	New Haven.	16. Triassic.
80	North Haven.	"
86	Wallingford.	"
92	Meriden.	"
99	Berlin.	"
105	Newington.	"
110	Hartford.	"
116	Windsor.	"
122	Windsor Locks.	"
127	Thompsonville.	"
136	Springfield.	"

	Shore Line Division.	
0	New Haven.	16. Triassic.
8	Branford.	1 A. Laurentian.
16	Guilford.	1 B. Montalban.
23	Clinton.	"
28	Westbrook.	"
31	Saybrook.	"
33	Lyme.	1 A. Laurentian.
43	East Lyme.	"
50	New London.	"

	Connecticut Central Railroad.	
	Hartford.	16. Triassic.
	South Windsor.	"
	Melrose.	"
	Hazardville.	"

	Connecticut Valley Railroad.	
0	Hartford.	16. Triassic.
8	Rocky Hill.	"
15	Middletown.	"
24	Higganum.	1 A. Laurentian.
30	Goodspeed.	1 B. Montalban.
38	Essex.	"
44	Saybrook Point	"

11. The oldest formations of New England assume ovoidal shapes, as the area of Laurentian, near Kent, and Winsted, Ct., Vernon, Vt., Winchester, N. H., &c. The later series are grouped concentrically around them, and thus an easy way of determining age and inversion is afforded.

Ms.	New London Northern Railroad.	
0	New London.	1 A. Laurentian.
6	Montville.	"
13	Norwich.	1 B. Montalban.
20	Franklin.	"
26	South Windham	"
30	Willimantic.	"
36	Eagleville.	"
44	Tolland.	"
50	Stafford.	"

	Stonington and Providence Railroad.	
0	New London.	1 A. Laurentian.
9	Mystic.	"
12	Stonington.	"
	(Rhode Island.)	
18	Westerly.	1 A. Laurentian.
26	Wood Riv. Jun.	"
35	Kingston.	"
42	Wickford Junc.	"
48	Greenwich.	14. Carboniferous.
53	Hill Grove.	"
57	Auburn.	"
62	Providence.	"

	Connecticut Western Railroad.	
0	Hartford.	16. Triassic.
6	Bloomfield.	"
12	Tariffville.	"
15	Simsbury.	"
22	Canton.	1 B. Montalban.
24	Collinsville.	"
29	New Hartford.	"
36	Winsted.	1 A. Laurentian.
45	Norfolk.	"
55	Canaan.	3 b. & c. Stockbridge ls.
62	Salisbury.	"
69	Millerton.	"

Ms.	Hartford, Providence & Fishkill R. R.	
0	Waterbury.	1 B. Montalban.
11	Terryville.	"
19	Plainville.	16. Triassic.
24	New Britain.	"
33	Hartford.	"
42	Manchester.	"
49	Vernon.	1 B. Montalban.
56	Andover.	"
65	Willimantic.	"
75	Baltic.	"
88	Plainfield.	"
	(Rhode Island.)	
91	Moosup.	1 A. Laurentian.
96	Oneco.	"
101	Summit.	"
109	Washington.	"
114	Natick.	"
123	Providence.	14. Carboniferous.

	New York and New England R. R.	
0	Willimantic.	1 B. Montalban.
9	Goshen.	"
20	Pomfret.	"
25	Putnam.	"
29	Thomson.	"
33	East Thomson.	"

	Norwich and Worcester Division.	
0	New London.	1 A. Laurentian.
13	Norwich.	1 B. Montalban.
23	Jewett City.	"
29	Plainfield.	"
34	Wauregan.	"
42	Daysville.	"
47	Putnam.	"
52	Grosvenor Dale.	"
57	Webster.	"

New York.[1]

By James Macfarlane.[2]

GEOLOGICAL FORMATIONS OF THE STATE OF NEW YORK.

	FORMATIONS AND SUB-DIVISIONS.		FORMATIONS AND SUB-DIVISIONS.
	20. Quaternary.	Silurian.	8. Oriskany. 7. Lower Helderberg.* 6. Waterlime. 6. Salina or Onondaga Salt group. 5 c. Niagara. 5 b. Clinton. 5 a. Medina, { 2. Medina sandstone. 1. Oneida Conglom.
	16. Triassic.		
Devonian.	12. Catskiil. 11 b. Chemung. 11 a. Portage, { 3. Portage s. s. 2. Gardeau shales. 1. Chasaqua shales. 10 c. Genesee. 10 b. Hamilton, { 3. Tully limestone. 2. Moscow shales. 1. Hamilt'n shales. 10 a. Marcellus. 9 c. U. Helderberg, { 4. Seneca l. s. 3. Cornif's l. s. 2. Onond'a l.s. 1. Schoharie. 9 a. Cauda Galli.	Cambrian.	4 c. Hudson River, { 3. Lor. sha. 2. Fra'kfort sh. & s.s. 4 b. Utica. 4 a. Trenton, { 3. Trenton l. s. 2. Blk. River l.s. 1. Birdseye l. s. } Upper Cambrian. 3 c. Chazy. 3 b. Quebec. 3 a. Calciferous. } Middle Cambrian. 2 b. Potsdam. Lower Cambrian.
		Primary	1 d. Montalban. 1 c. Norian. 1 a. Laurentian.

* Consisting in the ascending order of: 1, the Tentaculite limestone; 2, Pentamerus limestone; 3, Delthyris shaly limestone; 4, Encrinal limestone; and 5, Upper Pentamerus limestone.

☞The right hand marginal figures in the column of formations denote the elevations of the railroad stations in feet above tide water.

1. The State of New York is to the geologist what the Holy Land is to the Christian, and the works of her Palæontologist are the Old Testament Scriptures of the science. It is a Laurentian, Cambrian, Silurian and Devonian State, containing all the groups and all the formations of these long ages, beautifully developed in belts running nearly across the State in an east and west direction, lying undisturbed as originally laid down. Railroads running north and south pass over a number of the formations in short distances, while those running east and west run for long distances on the same formation, as for example the N. Y. C. & H. R. R. on the 6. Salina, and the Erie Railway on the 11 b. Chemung. In the eastern part of the State the formations are more irregularly disposed. New York localities are those to which we must always go back as the standard by which any disputed formation of these ages is to be tested.

2. The author has bestowed more of his own labor and research on the local geology of this State, than on any other, having besides diligent study of all the official reports, made personal observations of the exposures of the formations in traveling for many years on all the railroads. It was from making geological notes on the margin of railroad time tables that he conceived the idea of this geological railway guide book for the State, and by calling in the aid of scientific gentlemen of other States, he has been enabled to extend it over the whole United States and Canada. To Prof. James Hall, of Albany, the State Geologist, he is indebted for much information and important corrections in the table of formations and as to some of the localities in this State.

3. N. Y. C. & H. R. R. R. Grades caused by Geological Structure.—This railroad undoubtedly occupies the finest locality for an east and west railroad in the United States. From New York to Albany the road is level, tide water extending to Troy, the Hudson River being in fact an estuary. From Albany to Schenectady there is an ascent of 200 feet, Little Falls is 368, Rome 439 feet, and Batavia (the highest station) 887 feet above tide. It has no heavy grades on its main line except at Albany and in the trough of the Genesee at Rochester. It owes its advantages to geological structure, the outcrop of the formations running east and west, and the Salina or Onondaga, Utica and Hudson River soft shales are cut into low valleys through which the railroad and Erie Canal are built. If the formations had run north and south, as they do in Pennsylvania, Maryland, &c., and been turned up edgewise, the hard sandstones would have been high ridges and

Ms.	New York Central and Hudson River Railroad.[3]	
0	New York.[4]	1 d. Montalban, 37 ms.
11	Spuyten Duyvil.	"
12	Riverdale.[5]	"
13	Mt. St. Vincent.	"
15	Yonkers.	"
19	Hastings.	"
20	Dobb's Ferry.	"
22	Irvington.	"
25	Tarrytown.	"
29	Scarborough.	"
30	Sing Sing.[5]	"

Ms.	New York Central & Hudson River Railroad—*Continued.*	
34	Croton.	1 d. Montalban.
37	Crugers.	1 a. Lower Laurentian,
38	Montrose.[6]	" 20 miles.
41	Peekskill.	"
45	Ft. Montgomery. Highlands.	"
49	Garrison's. (West Point.)	"
52	Cold Spring.	"
54	Cornwall.[6]	"

The Highlands.

perhaps mountains to be overcome, as they are everywhere from the Mohawk Valley to Alabama. If even the limestone ridge of the Helderberg range, which bounds this valley on the south, had taken a northern direction, as the 2-4. Cambrian formations do, a tunnel would probably have been necessary. In the western part of the State these Helderberg limestones continue, but not as a prominent ridge. The road via Geneva, runs on them at Auburn, Clifton Springs, &c., but with less favorable grades than the direct road, and at Buffalo they are level with the plain. It should be added that the old Laurentian mountains at Little Falls and at Peekskill have been cloven from top to bottom, thus opening the gateways for the traffic and travel of the West. The popular impression that New York is a level plain like the prairies of the West, derived from traveling on the N. Y. C. & H. R. R. R., is altogether erroneous. There is only a narrow trough through the centre of the State, in which the railroad and canal are located, that is of this level character.

4. New York island is 12 miles long and nearly 2 miles wide. The widest point is two and one-quarter miles at 14th St. Below Grand street it gradually becomes narrower as well as at the north end. The lower part of the city, below Wall street, is half a mile wide. The rock of the island is gneiss, except a portion of the north end, which is limestone. The south portion is covered with deep alluvial deposits, which in some places are more than 100 feet in depth. The natural outcropping of the gneiss appeared on the surface about 16th street, on the east side of the city, and run diagonally across to 31st street on 10th Avenue. North of this, much of the surface was naked rock. It contains a large proportion of mica, a small proportion of quartz and still less feldspar, but generally an abundance of iron pyrites in very minute crystals, which, on exposure, are decomposed. In consequence of these ingredients it soon disintegrates on exposure, rendering it unfit for the purposes of building. The erection of a great city, for which this island furnishes a noble site, has very greatly changed its natural condition. The geological age of the New York gneiss is undoubtedly very old, not the 1 a. Laurentian or oldest, nor the 1 b. Huronian, but it belongs to the third or White Mountain series, named by Dr. Hunt the 1 c. Montalban. It is the same range which is the basis rock of nearly all the great cities of the Atlantic coast. It crosses New Jersey where it is turned to clay, until it appears under Trenton, and it extends to Philadelphia, Baltimore, Washington and Richmond, Va., and probably Boston, Massachusetts, is founded on this same formation.

5. On the opposite side of the river may here be seen for many miles the Palisades, a long, rough mountain ridge close to the water's edge. Its upper half is a perpendicular precipice of bare rock of a columnar structure from 100 to 200 feet in height, the whole height of the mountain being generally from 400 to 600 feet, and the highest point in the range opposite Sing Sing 1011 feet above the Hudson, and known as the High Torn. The width of the mountain is from a half mile to a mile and a half, the western slope being quite gentle. In length it extends from Bergen Point below Jersey City to Haverstraw, and then westward in all 48 miles, the middle portion being merely a low ridge. The lower half of the ridge on the river side, is a sloping mound of detritus, of loose stones which has accumulated at the base of the cliff, being derived from its weathered and wasted surface. This talus and the summit of the mountain are covered with trees, with the bare rocky precipice called the Palisades between, and many fine country residences may be seen on the level summit, from which are beautiful views of the river, the harbor and City of New York. Viewed from the railroad or from a steamboat on the river, this lofty mural precipice with its huge weathered masses of upright columns of bare rock, presenting a long, straight unbroken ridge overlooking the beautiful Hudson River, is certainly extremely picturesque. Thousands of travelers gaze at it daily without knowing what it is. This entire ridge consists of no other rock than trap traversing the 16. Triassic formation in a huge vertical dike. The red sandstone formation of New Jersey is intersected by numerous dikes of this kind, but this is much the finest. The materials of this mountain have undoubtedly burst through a great rent or fissure in the strata, overflowing while in a melted or plastic condition the red sandstone, not with the violence of a volcano, for the adjoining strata are but little disturbed in position, although often greatly altered by the heat, but forced up very slowly and gradually, and probably under pressure. Subsequent denudation has laid bare the part of the mountain now exposed along the river. The rock is columnar basalt, sometimes called greenstone, and is solid, not stratified like water formed rocks, but cracked in cooling and of a crystalline structure. (See description of the 16. Triassic formation and its Trap Dikes). Here is a remarkable but not uncommon instance of a great geological blank. On the east side of this river the formations belong to No. 1, the first or oldest series of Primary or Crystalline rocks, while on the west side they are No. 16, all the intermediate Cambrian, Silurian, Devonian and Carboniferous formations being wanting. This state of things continues all along the Atlantic coast to Georgia, the 18. Cretaceous or 17. Jurassic taking the place of the 16. Triassic farther south.

6. 38 Montrose to 54 Cornwall. This celebrated passage of the Hudson through the Highlands, is a gorge nearly 20 miles long from 3 miles south of Peekskill to Fishkill, and is worn out of the 1 a. Laurentian rocks far below mean tide water. The hills on its sides rise in some instances as much

Ms.	New York Central & Hudson River Railroad—*Continued.*	
57	Dutchess and Columbia Junction.	2 Lower and 3 Middle Cambrian or 3 b. Quebec group, 26 miles.
58	Fishkill.[7]	"
62	Low Point.	"
64	New Hamburg.	"
69	Milton Ferry.	"
73	Poughkeepsie.	"
78	Hyde Park.	"
83	Staatsburg.	"
88	Rhinebeck.[8]	4 c. Hudson River, 65 m
94	Barrytown.	"
98	Tivoli.	"
104	Germantown.	"
107	Livingston.	"
109	Catskill.	"
114	Hudson.[9]	"
118	Stockport.	"
121	Coxsackie.	"
123	Stuyvesant.	"
129	Schodack.	"
133	Castleton.	"
142	East Albany.	"
142	Albany.[10]	"
148	Troy.[10]	" 25

Ms.	New York Central & Hudson River Railroad—*Continued.*	
142	Albany.[10]	4 c. Hudson River, 27 m
145	West Albany.[11]	"
160	Schenectady[11,9]	" 237
169	Hoffman's Ferry	4 b. Utica, 7 miles. 258
174	Crane's Village.	" 262
176	Amsterdam.[12]	4 a. Trenton, 10 ms.[271]
182	Tribes Hill.	" quarries, 1 m.
187	Fonda.[13]	4 b. Utica, 5 miles. 291
192	Yost's.[14]	Two bluffs or noses of Calcif. on Laur'n.
195	Sprakers.[14]	3 a. Calciferous hill. Laur'n at R.R. track.
198	Palatine Bridge.[15]	4 a. Trenton, 3 miles. Hills to north Calcif.
200	Fort Plain.[16]	4 a. Trenton, 18 ms. & Hudson River. 305
206	St. Johnsville.	" 311
209	East Creek.	" 326
216	Little Falls.[17]	1 a. Laurentian, 1 m.[368]
223	Herkimer.	4 b. Utica, 28 miles.[390]
225	Ilion.	" 392
227	Frankfort.	" 394
237	Utica.[18]	" 403
241	Whitesboro.[19]	" 407
244	Oriskany.[20]	4 c. Hudson River, 8 m

as 2600 feet, and in many places the walls are very precipitous. The rock is gneiss, of a kind that is not easily disintegrated or eroded, nor is there any evidence of any convulsive movement. It is clearly a case of erosion, but not by the present river, which has no fall, for tide water extends 100 miles up the river beyond the Highlands. This therefore was probably a work mainly performed in some past period when the continent was at a higher level. Most likely it is a valley of great antiquity. Also see notes 17 and 118.

7. Opposite Fishkill is Newburg, which is in the great valley of Lower Silurian or Cambrian limestone and slate. North of that, on the west side of the river, the formations occur in their usual order, their outcrops running northeast and southwest. On the N. Y. C. & H. R. R. R., on the east side, the same valley crosses, and the slates from Fishkill to Rhinebeck are about the same place in the series; but being destitute of fossils and very much faulted, tilted and disturbed, their precise geology is uncertain. See the exposures in the cuts at Poughkeepsie. The high ground to the east is commonly called the Quebec group. See notes 116 and 117.

8. Rhinebeck. A series of great dislocations with upthrows on the east side traverse eastern North America from Canada to Alabama. One of these great faults has been traced from near the mouth of the St. Lawrence River, keeping mostly under the water up to Quebec just north of the fortress, thence by a gently curving line to Lake Champlain or through Western Vermont across Washington County, N.Y., to near Albany. It crosses the river near Rhinebeck 15 miles north of Poughkeepsie and continues on southward into New Jersey and runs into another series of faults probably of a later date, which extend as far as Alabama. It brings up the rocks of the so called 3 b. Quebec group on the east side of the fracture to the level of the 4 c. Hudson River and 4 a. Trenton l. s.

9. Catskill Mountains. For many miles on this railroad are beautiful views of the Catskill Mountains, 3,000 feet high, (12. Catskill,) several miles distant on the opposite or west side of the river, and which furnish the name for the Catskill formation. The wide valley between them and the river is composed of 11 b. Chemung, 10. Hamilton, 7. Lower Helderberg and 4 c. Hudson River. The geology on the east or railroad side is entirely different.

10. Albany. The clay beds at Albany are more than 100 feet thick, and between that city and Schenectady they are underlaid by a bed of sand that is in some places more than 50 feet thick. There is an old glacial clay and boulder drift below the gravel at Albany, but Professor Hall says it is not the estuary stratified clay. At the south end of the city of Troy the gravel and sand beds are subject to dangerous land slides.

11. The distant mountain to the southwest is the Helderberg range. See notes 24 and 41.

12. Amsterdam. Precipice of 4 a. Trenton limestone back of the town, and quarries at the track. For 40 miles to Little Falls the railroad runs on Trenton limestone 3 a. Calciferous, 4 b. Utica and 4 c. Hudson River irregularly alternating.

13. Branch railroad north to Johnstown and Gloversville, in a valley of Utica slate.

14. Between Fonda and Palatine Bridge are fine bluffs of 3 a. Calciferous. The talus of fragments of rock at the foot of the precipice whiten out in weathering like the stones about an old lime-kiln. It is from the cavities of the Calciferous that the beautiful quartz crystals are produced, of which great quantities have been found. A similar bluff on south side of river. No Potsdam here.

15. The railroad skirts along the base of a ridge of Trenton limestone here and at Fort Plain.

16. At Fort Plain village the transition from the Birdseye to the Trenton limestone is to be seen, the first layers of the latter being of a drab color.

17. At Little Falls for one mile is a rare opportunity of seeing the 1 a. Laurentian formation,

Ms.	New York Central & Hudson River Railroad—*Continued.*	
251	Rome.[21]	4 c. Hudson River. 439
255	Green's Cors.[22]	5 a. Medina, 2 miles. 458
259	Verona.[23]	4 b. Clinton, 9 miles. 460
264	Oneida.[24]	4 c. Niagara, 3 ms. 432
267	Wampsville.[25]	"
269	Canastota.[26]	6. Salina or Onondaga Salt group, 23 ms. 429
273	Canaseraga.	6. Salina or Onondaga Salt group. 411
275	Chittenango.	" 410
279	Kirkville.	" 416
282	Manlius.	" 409
289	Syracuse.[27]	" 395

The railroad *via* Auburn is better than the Direct road to Rochester for geological observation.

being a gorge cut by the Mohawk River through a spur of the Adirondack Mountain, which here crosses the railroad. You are now on the bottom rocks of the geological series, for nothing older has ever been found beneath them. The scenery has suddenly changed, and nothing is seen but bare, weatherworn precipices of crystalline rocks, from which all the elements through all the ages, have failed to produce a soil, yet a certain strange interest is attached to them. The oldest picture in the world, the oldest statue or other work of art, would excite the greatest attention, yet what are these in antiquity compared with these grand old Laurentian rocks, the oldest formation and the oldest dry land on the face of the earth, dating far back of the first appearance of either animal or vegetable life of any kind on our planet. The river channel through these rocks is an unequivocal example of river erosion, as pot-holes are found at various heights. See also notes 6 and 56.

18. Utica. The 4 b. Utica slate was named from this city. To study the Trenton, Black River and Birdseye limestones at their original, historical localities, change cars at Utica and go up the Utica and Black River Railroad to Trenton Falls. (See the within guide for that railroad). You can then go on to Watertown on these limestones. Return by the Rome, Watertown &Ogdensburg Railroad to Rome or Syracuse, examining the Loraine shales at Adams and Pulaski.

19. From here to Syracuse there is no lock in the canal. This long level is 427 feet above tide.

20. Oriskany. The formation of this name, is not exposed here, but at Oriskany Falls on the D. L. & W. R. R. from which the name is derived. The best fossils of it are found east of Union Springs in Cayuga County. Along the part of the road east of Oriskany, the Utica shale forms the bottom of the valley. The south wall of the valley consists of the outcrops of the 4 c. Hudson River, 5 a. Oneida Conglomerate, 5 b. Clinton, the 6. Waterlime and 9. Upper Helderberg.

21. Rome. No more 2–4. Cambrian formations west of this in New York. From Rome to Buffalo and from Lake Ontario south to the Pennsylvania line all the formations are 5–11. Silurian and Devonian, and they are finely displayed in numerous gorges, ravines, canons and precipices, very regularly disposed in belts of outcrop running east and west. The typical localities from which most of the formations were named, are situated in this district. It is all historical geological ground, and you can scarcely go amiss in looking for fossils.

22. West of Little Falls the lower formations pass abruptly to the north and cross under Lake Ontario into Canada. The 4 c. Hudson River first crosses the valley, and then the Oneida conglomerate. Other rock formations now appear between Rome and Oneida, which had no existence in the basin east of Little Falls. These are the 5 a. Medina and Clinton, which overlie the Oneida, and form all the south shore of Lake Ontario, and extend across Canada West. Also 5 c. Niagara and the 6. Salina or Onondaga salt group, on which the N. Y. C. & H. R. R. R. runs from Oneida nearly to Rochester. The non-existence of these extensive formations east of Little Falls (the 5 a. Medina, 5 b. Clinton, 5 c. Niagara and 6. Salina), which cover the best part of Western New York, must be owing to the two parts of the State being separated in these early ages by the old Laurentian ridge at Little Falls into separate basins, in which the rock-forming conditions were different.

23. Verona. The Clinton fossil iron ore crops out on the railroad, but not of a good quality.

24. Oneida. The prominent ridge bounding the valley on the south of Utica, Oneida and Syracuse, called Stockbridge Hill, Pompey Hill, Cazenovia Hill and Onondaga Hill, is the Helderberg range, a continuous mountain 800 feet high, forming the back-bone of the State, and composed at its base of the 6. Waterlime, of the Salina group, all the members of the 7. Lower Helderberg being wanting as well as the 8. Oriskany sandstone and other sandstones that separate the Lower and Upper Helderberg, except a mere trace. On the Waterlime rests the Onondaga limestone, the most valuable building stone, and above this the Corniferous. Over these three great limestone formations is always found the 10 a. Marcellus shales, the 10 b. Hamilton and 10 c. Genesee, forming the fine fertile country extending south from this ridge. Still farther south is the 11 a. Portage with its glens, gorges and precipices, and 11 b. Chemung, extending to the Pennsylvania State line. The Oneida conglomerate, which is 30 or more feet thick in Herkimer and Oneida, gradually attenuates in going west, being a grey band, from 4 to 5 ft. thick at Rochester. It was named from Oneida county.

25. Wampsville. Numerous fragments of Niagara limestone are seen mixed with the soil, showing its existence underneath. The Niagara limestone and shales which, at Niagara, Lockport and Rochester are 150 feet thick, thin out in going eastward, being only two or three ft. thick at Saquoit Creek near Utica.

26. Canastota. Stop off and take the branch railroad to Cazenovia, rising 750 feet in 15 miles. Fine geological sections of 6. Salina with gypsum beds, 9. Upper Helderberg and 10 b. Hamilton. Magnificent view across Oneida Lake and a beautiful village and lake at Cazenovia.

27. Syracuse. Onondaga Lake, which is in sight and on the north side of the railroad at the west end of Syracuse City, is 5 miles long, 1 mile wide; its greatest depth is 60 feet, and its surface is 363 feet above tide water. It is excavated in the red shale of the (6.) Salina formation. The lake is what remains of an ancient much more extensive and deeper excavation, all of which has been filled in with sand, gravel and rolled stones, except the part occupied by the lake. The bottom and sides of the lake are covered with lake marl six feet thick. The ancient excavation underneath answers an excellent purpose as a reservoir into which the salt waters are received and retained, and the marl of the bottom of the lake serves an equally good purpose by separating the fresh water of the lake from the salt water stored away in the basin or reservoir of sand and gravel beneath. There could be no better material for the purpose. Into this basin the various borings

New York Central & Hudson River Railroad—*Continued.*		New York Central & Hudson River Railroad.	
Ms.	Old Road, via Auburn.	Ms.	Old Road, via Auburn—*Continued.*
289	Syracuse.[27]	6. Salina, 9 miles. 395	
298	Camillus.	"	
300	Marcellus.[28]	" Gypsum beds.	
303	Half Way.	9 c. Upper Helderberg,	
307	Skaneateles.[29]	or Cornifer. 14 m. 610	
310	Sennett.	"	
316	Auburn.[30]	" Quarries of Corn. l. s. 715	
321	Aurelius.	6. Salina, 10 miles.	
326	Cayuga.[78]	" (Lake 376)	
331	Seneca Falls.	9 c. Corniferous l.s. 8 m	
334	Waterloo.	9 c. Seneca limestone.	
341	Geneva.[31]	Deep drift overlying 6. Salina and 9 c. Corniferous l.s.[452]	
346	Oaks Corners[31]	9 c. Cornifer's l.s., 18 m	
349	Phelps.	"	
353	Clifton Sprgs.[46]	" 618	
358	Shortsville.	"	
364	Canandaigua.	10. Hamilton, 6 ms.[778]	
368	Paddleford.	"	
369	Farmington.	"	
370	W. Farmington.	9 c. Corniferous l. s. and Salina.	
374	Victor.	"	
379	Fisher's.	9 c. Salina, 11 miles.	
384	Pittsford.	"	
388	Brighton.	5 c. Niagara, 4 miles.	
392	Rochester.[36]	" 488	

of the salt wells are made, not through or into rock, but only through the lake marl and other loose material mentioned, to a depth of 150 to 450 ft. No rock salt or bed of salt has ever been discovered in this State, although it has been in Canada; but in this Salina formation are two porous or Vermicular masses of limestone, looking as if perforated by little worms, and hence the name; and between them are certain hopper shaped cavities in the shale in which, as well as in the perforations of these limestones, salt in a crystalline and solid state, it has been conjectured, formerly existed, the saline materials of which have been dissolved in water which percolated through the formation and passed into the basin where it is now found, the bed of marl on which is Onondaga Lake, being afterwards formed over it. But the origin of the salt water may be said to be at present unknown. Forty gallons of the brine produce a bushel of salt, weighing 60 pounds. These are the most productive salt wells in the world in so small a territory—two miles long and one-fourth of a mile wide.

28. Marcellus, from which the formation is named, is three miles south of this station.

29. Skaneateles. From the Junction with the N.Y. C. & H. R. R. the Skaneateles railroad runs south up the outlet of the lake of that name over the Corniferous limestone. The lake outlet with its falls, amounting to 463 feet to Jordan, affording excellent mill sites and many exposures of the rock. Before reaching Skaneateles Village the railroad passes over the Marcellus shales. Skaneateles Lake, where the railroad terminates, is 14 miles long, from a half to a mile and a half wide; its greatest depth south of Borodino is 320 feet and its surface 879 feet above tide. The sides of the northern end of this lake, at the beautiful village of Skaneateles, gradually slope to the water, corresponding in inclination to each other, and adding greatly to the beauty of the lake. The water line, with the exception of the south part, is excavated in the Hamilton group. The south part of the lake is more narrow, and the banks rise abruptly to a considerable height above the water. The Tully limestone, at the top of the Hamilton, and over that the Genesee slate, appear to the south of Borodino, rising, when first seen, 150 feet above the lake, and the south end or head of the lake is surrounded by the Portage group.

30. Auburn. The Corniferous member of the 9. Upper Helderberg limestone and the Onondaga limestone, which is its lower member, are extensively quarried at Auburn. The State Prison and the facings of many of the buildings of this handsome little city are entirely made of this limestone, and several fine churches are built of it. The formation ends at the main street where the 10 a. Marcellus shale begins, and it extends in the stream up to the outlet of the lake. Beginning below the city and following up the stream to the State Prison, the outlet exposes the following section: eight feet of the upper part of 6. the Waterlime of the Salina formation, one foot of 8. Oriskany sandstone, over eight feet of 9 c. Onondaga limestone and twenty-seven feet of the Corniferous exclusive of its upper member the Seneca limestone.

31. Geneva. The Seneca limestone or upper part of the 9. Upper Helderberg disappears near Waterloo and reappears at a distance of six or seven miles west near Oaks Corners. The whole mass of limestone, and all the rocks north of it to Lake Ontario, have been removed from all the intermediate space, and along the shore of that lake the great depth of alluvium conceals the rock if any be present. Near Oaks Corners the limestone suddenly terminates as if broken off and removed, leaving an abrupt descent to the east which bears evidence of the erosive action of water. Seneca Lake and Lake Ontario probably originally communicated by this deep old channel. Ontario is 196 feet lower than Seneca. The same state of things seems to exist north of Cayuga Lake, where the drift material causes the Montezuma marshes and the shallowness of that lake at that end. Seneca Lake is 40 miles long, 3 miles wide, 530 feet deep, and its surface is 441 feet above tide water.

32. Jordan. Between Skaneateles Junction and Elbridge the Oriskany sandstone is over 30 feet thick, being at its maximum. At Auburn it is from six inches to two and a half feet thick.

33. Weedsport. At many points between Syracuse and Rochester, and on the Southern Central and other cross roads, are seen numerous hills or short ridges running from north to south, from fifty to one hundred feet high, with steep slopes and very sharp crests. These are not of drift or alluvium, as they appear to be, but are in reality outliers of the marly deposits of the Salina or Onondaga salt group, with only a thin covering of loose materials. Mount Hope at Rochester, the hills south of Brighton, Fort Hill Cemetery in Auburn, James street hill and University hill in Syracuse, and numerous hog-back ridges about Jordan and other places, are of this character, being Salina shales in place, spared when the adjoining valleys were eroded. There are, however, some hills composed of gravel, or a mixture of gravel and sand, but very little glacial drift on this R. R.

34. Great crops of peppermint are raised here, and this place supplies the world with peppermint oil. There seems to be some peculiarity in the soil which adapts it for the production of this plant.

New York Central & Hudson River Railroad—*Continued.*

Ms.	Direct Road.	
289	Syracuse.[27]	6. Salina or Onondaga Salt group, 71 m.[395]
299	Warner's.	" 419
302	Memphis.	" 402
307	Jordan.[32]	" 393
311	Weedsport.[33]	" 396
314	Port Byron.	" 398
324	Savannah[31 & 78]	" Marshes.
328	Clyde.	" 388
335	Lyons.	" 399
340	Newark.	" 410
348	Palmyra.[34]	" 430
353	Macedon.	" 463
360	Fairport.	" 448
366	Brighton.[35]	5 c. Niagara l.s., 10 ms.
370	Rochester.[36]	" 488

Niagara Falls Division.

370	Rochester.[36]	5 c. Niagara, 10 miles.
380	Spencerport.	5 b. Clinton, 12 miles.
383	Adams Basin.	Railroad runs between Clinton and Medina.
389	Brockport.	" 533
392	Holley.	5 a. Medina, 23 miles.
396	Murray.	"
401	Albion.	" 533
407	Knowlesville.	"
411	Medina.[37]	" 532
415	Middleport.	5 b. Clinton, 4 miles.
420	Gasport.	"
426	Lockport.[38]	5 c. Niagara, 21 ms.[587]
437	Sanborn.	"
446	Suspens. Bridge.	"
447	Niagara Falls.[39]	"

New York Central & Hudson River Railroad.

Ms.	Niagara Falls Division—*Continued.*	
426	Lockport.[38]	5 c. Niagara, 10 miles.
430	Lockport Junc.	"
436	Hall's.	6. Salina, 12 miles.
441	Tonawanda.	"
448	Black Rock.[40]	9 c. Corniferous l.s. 4 m
449	Intern'l Bridge.	"
452	Buffalo.[40]	" 576

Direct Route.

370	Rochester.[36]	5 c. Niagara, 15 miles.
377	Coldwater.	" 488
381	Chili.	"
385	Churchville.	6. Salina, 17 miles. 562
388	Bergen.	" 602
391	West Bergen.	"
395	Byron.	" 687
402	Batavia.[41]	9 c. Cornifer's, 3 m.[887]
408	Crofts.	10 b. Hamilton, 13 ms.
414	Corfu.	" 855
418	Crittenden.	"9 c. Cornif.[840]
421	Wende.	9 c. Corniferous. 20 ms.
423	Town Line.	"
428	Lancaster.	"
438	Buffalo.[40]	" 576

Buffalo and Niagara Falls Division.

0	Buffalo.	9 c. Cornif. l.s. 5 m.[576]
3	Intern'l Bridge.	"
5	Black Rock.[40]	"
11	Tonawanda.	6. Salina, 15 miles.
17	La Salle.	"
22	Niagara Falls.[39]	5 c. Niagara, 4 miles.
24	Suspen. Bridge.	"
30	Lewiston.[42]	5 b. Clinton and 5 a. Medina. Lake, 245.

35. Irondequoit. A few miles east of the mouth of the Genesee River, the Irondequoit Creek empties into the lake, flowing in a deeper channel than the Genesee, but through deposits of sand and gravel. Professor Hall suggests with much probability, that the Genesee run in the channel of the Irondequoit, but when that was filled with gravel and the region elevated, the Genesee was turned westward and compelled to cut its present rocky bed like the Niagara. This phenomenon is not rare, but is many times repeated in this State. See notes 31, 38, 39 and 110.

36. Rochester. See Genesee Falls out of the car windows on north side at the east end of the station house. The gulf of the Genesee River, from Rochester to Charlotte, is remarkable for the striking example of erosion which it exhibits. The distance is seven miles, in which the river forms three cataracts over three distinct formations, the Medina sandstone the lowest, 84 feet fall; the Clinton 25 feet, one and three-fourth miles below, and the Niagara group 96 feet fall, close to the railroad bridge. It is evidently the different hardness of the groups or their varying facility of decomposition that have produced these falls. These three falls at first were but one, and at this time the lower ones are gaining probably on the upper one and the time may come when they will unite again.

37. The 5 a. Medina formation is named after this place.

38. At Lockport is a repetition of the Rochester and Niagara Falls ravine in the Niagara limestone and shales here crossed by the railroad on a high bridge. Here too, a mile west of the city, you can see on the north side of the railroad an old, dry channel from which the stream was diverted by the drift, corresponding to the Irondequoit at Rochester and St. David's at Niagara Falls. There is another of these dry, old channels at Oak Orchard.

39. Niagara Falls are six and a half miles south from lake Ontario at Lewiston, and the whole distance the river runs in a gulf, which, at the falls, is 160 feet, and at Lewiston 300 feet deep and generally about twice as wide at the top as at the bottom. The rocks passed through by the receding falls are the Medina sandstone, the Clinton group of limestone and shale, and the Niagara limestone and shale. These rocks have a slight southerly dip, and all except the Niagara group have disappeared beneath the bed of the river, the falls being now in the Niagara group entirely, the shale lying beneath the limestone. At the whirlpool, a little more than three miles below the falls, on the west bank of the river, the continuity of the rock forming the bank is interrupted by a deep ravine filled with drift material. This ravine may be traced two miles in a northwest direction, and from thence another depression can be followed to Lake Ontario at St. David's four miles west of Queenstown. When the ravine to St. David's was blocked up by drift materials the stream would be forced to

New York Central & Hudson River Railroad—*Continued.*

Ms.	Canandaigua and Tonawanda Division.		
0	Canandaigua.	10 b. Hamil'n, 16 m.	778
8	East Bloomfield.	"	
12	Miller's Corners.	"	
15	West Bloomfield	"	
18	Honeoye Falls.	9 c. Corniferous, 2 ms.	
25	West Rush.	6. Salina, 22 miles.	
26	Erie R. R. Junc.	"	
28	Maxwell's.	"	
33	Caledonia	"	
40	Le Roy.	9 c. Cornif's, 25 m.	864
44	Stafford.	"	
50	Batavia.[41]	10 b. Hamilton.	887
57	East Pembroke.	9 c. Corniferous.	
63	Richville.	"	
65	Falkirk.	"	
67	Akron.	"	
74	Clarence Centre.	6. Salina, 21 miles.	
77	Transit.	"	
80	Gettzville.	"	
86	Tonawanda.	"	

New York Central & Hudson River Railroad—*Continued.*

Ms.	Charlotte Branch.		
370	Rochester.[36]	5 c. Niagara. 5 b. Clinton.	488
379	Charlotte.[35]	5 a. Medina, (Lake, 245)	

Skaneateles Railroad.[39]

	Syracuse.	(As before.)	395
0	Skaneateles Jun	9 c. Corniferous.	610
3	Mottville.	10 a. Marcellus.	
4	Kellogg's Mills.	"	
5	Skaneateles.[39]	10 b. Hamilton.	890

Fonda, Johnstown & Gloversville Railroad.

0	Fonda.[13]	4 b. Utica.	291
6	Johnstown.	"	
8	Gloversville.	4 b. Utica and 4 a. Trenton.	
22	Northfield.	4 b. Utica and 1 a. Laurentian.	

find its present rocky channel. Even though the drift rose only a foot higher than the rocks, it would as effectually force the water over the rocks as if it formed a mountain. Could the river have once surmounted the drift, its work would have been comparatively easy in wearing out a bed through the old ravine, but till it was able to flow over the barrier it would have no power over it, and must commence its slow work of wearing away the solid rock. The present gulf shows us what it has done since the drift period. J. HALL AND SIR CHARLES LYELL.

40. At Black Rock there is only from 6 to 14 inches of the Onondaga limestone which is of a grayish color, crystalline and contains few fossils. The Corniferous limestone above it is 25 to 30 feet containing abundance of hornstone. It is dark colored, fine grained, and in its fresh fracture, and particularly when wet, it presents an almost black appearance, which has given the name of Black Rock to the place. It affords good quarries of excellent building stone. From the occurrence of the Corniferous along the south end of Lake Erie and its dip southward, it seems probable that the bed of this lake has never been excavated below it, and that it now forms the floor beneath the deposit of alluvium. It seems that there are others of the lake bottoms composed of limestone, especially Lake Ontario. See note 71. This is probably for the reason that it received a polish from the action of glaciers which then passed over it, while the resistance of the grit of the sandstones and shales was more favorable for deeper excavation. Lake Erie is 230 miles long, 50 miles wide, 140 feet deep, and and its surface is 569 feet above tide.

41. Batavia is the highest point on the N. Y. C. & H. R. R. R., and one of the highest in Western New York, being 887 feet above tide. This is caused by there crossing the 9 c. Helderberg formation, which maintains its elevation although not observable as a mountain range, being overcome by easy grades. Notice the elevations of the railroad crossings of the Helderberg and Hamilton range, although the railroad seeks the lowest points: Buffalo, 576; Batavia, 887; Le Roy, 864; Canandaigua, 778; Auburn, 715; Skaneateles, 890; Tully, 1249; Cazenovia, 1249; Cooperstown, 1193. When the valleys cut through the limestone, the summit is farther south on the Hamilton or Portage.

42. Lewiston. Tourists should not fail to go down to Lewiston, the terminus of the Buffalo and Niagara Falls division. This railroad ride, although little known, is one of the finest in the United States. It follows the bank of the Niagara River, affording admirable views of the rapids and the formations displayed in the gulf. Nowhere in the State are there better geological sections. On the Canada side, also the Canada Southern Railway, running to the mouth of the Niagara River at Niagara City, affords one good view of the falls, but no such remarkable sections of the rocks as on the American side, where the railroad overhangs the fearful torrent of the river for several miles.

43. Knowersville. The Helderberg mountain shows finely on the left or southwest side of the railroad opposite Guilderland and Knowersville. The railroad passes through it between that place and Duanesburgh. The mountain is capped by the 7. Lower Helderberg limestone forming a steep precipice along its summit, and this rests on the 4 c. Hudson River slates. Back of Knowersville two notches are cut out of the mountain by two streams, leaving a picturesque, fortress-like bluff of the limestone. The Helderberg formations are named from this mountain.

44. At Howe's Cave large quarries on the railroad track. Good place to examine Lower Helderberg limestone and to collect fossils. The cave is an old underground water channel, and is several miles long. Notice that the limestone at Cobleskill is *Upper* Helderberg and that at Howe's Cave *Lower* Helderberg. On no other railroad can you see them both.

45. Cooperstown is seated at the south end of Otsego Lake on a a dike of alluvium. This lake is a handsome sheet of water seven miles long, one and a half wide, 1193 feet above the ocean. It has a high ridge of the Hamilton group on the east side, a low and interrupted range of the same on the west side, and an elevated projection on the northeast end. This lake is one of the head waters of the Susquehanna, the valley spreading out to the southwest.

46. Sharon Springs. All the large sulphur springs of the State, Avon, Clifton, Richfield, &c., and many small ones, rise from the waterlime.

47. Cherry Valley. The railroad is on Corniferous, but the cliffs and gorge are 7. Lower Helderberg. Marcellus and Hamilton form the hills on the south.

Delaware & Hudson Canal Co.'s Railroads.

Ms.	Albany and Susquehanna Railroad.	
0	Albany.[10]	4 c. Hudson River.
6	Adamsville.	"
7	Slingerlands.	"
11	New Scotland.	"
14	Guilderland.	"
17	Knowersville.[48]	"
24	Duanesburg.	" & Utica.
27	Quaker Street.	"
31	Esperance.	"
36	Central Bridge.	7. L. Helderberg.
39	Howe's Cave.[44]	"
		8. Oriskany.
45	Cobleskill.	9 c.U. Helderberg l.s.
		10 a. Marcellus.
50	Richmondville.	" & 10 b. Ham.
57	East Worcester.	10 b. Hamilton.
62	Worcester.	"
67	Schenevus.	11 a. Portage.
70	Maryland.	"
75	Cooperstown Junction.[45]	"
76	Colliers.	11 b. Chemung.
79	Emmons.	"
82	Oneonta.	"
90	Otego.	"
95	Wells Bridge.	"
99	Unadilla.	"
103	Sidney.	12. Catskill, synclinal.
108	Bainbridge.	"
114	Afton.	11 b. Chemung.
119	Nineveh.	"
127	Tunnel.	"
132	Osborn Hollow.	"
135	Port Crane.	"
142	Binghamton.	" 868

Portage hills.

	Saratoga.	3 a. Calciferous and 4 a. Trenton.
0	Ballston.	4 c. Hudson River.
15	Schenectady.	" 237
29	Quaker Street.	"

45	Cobleskill.	9 c. Upper Helderberg.
50	Hyndsville.	"
54	Seward.	"
59	Sharon Sprgs.[46]	7. Lower Helderberg.
68	Cherry Valley[47]	9 c. Cornif. & Marcellus.

Cooperstown and Susquehannah Valley R.R.

75	Junction.	11 a. Portage.
91	Cooperstown[45]	10 b. Hamilton. 1193

Delaware and Hudson Canal Company's Railroads—*Continued.*

Ms.	Middleburg & Schoharie, and Schoharie Valley Railroads.	
0	Central Bridge or Schoharie Junction.	4 c. Hudson River.
3	Vromans.[48]	"
6	Schoh'e C. H.[49]	9 b. Schoharie grit.
9	Borst's.	7. Lower Helderberg.
12	Middleburg.	10 a. Marcellus.

Nineveh Branch.

119	Nineveh.	11 b. Chemung.
122	Centre Village.	"
127	Ouaquaga.	"
130	Windsor.	"
133	Comstock.	"
140	Jefferson Junc.	"

Saratoga and Champlain Division.

0	Albany.[10]	4 c. Hudson River.
6	West Troy.	"
9	Cohoes.[50]	" Falls,70 ft.
12	Albany Junc.	"
0	Troy.	"
6	Albany Junc.	"
12	Mechanicsville.	"
25	Ballston.	"
32	Saratoga.	4 a. Trenton and Calcif.
43	Gansevoorts.	"
49	Fort Edward.	"
57	Smith's Basin.	" quarries.
60	Fort Ann.	"
64	Comstock's.	2 b. Potsdam. Fine surface exposures for 4 miles.
71	White Hall.	2 b. Potsdam. Fine exposures on 1 a. Laurentian gneiss.
0	White Hall.[51]	" Lake, 96.
		3 a. Calciferous.
7	Chubb's Dock.	"& 1 a. Laur. back.
10	Dresden.[52]	1 a. Laurentian.
14	Putnam.	"
		3 a. Calciferous bluff.
		4 a. Trenton. Valley.
20	Pattuiwa.	1 a. Laurentian.
	(Mt. Defiance.)	"
22	Ft. Ticonderoga.	"
	(Ticon'ga Creek,	outlet of Lake George.)
	(Tunnel.)	4 a. Trenton.
24	Addison Junc.	" large valley.

48. On either side of the valley, according to Prof. Hall, is the following section: Pyritiferous shales, (Clinton group); Coralline limestone, (Niagara); Waterlime, (Salina); Tentaculite; Pentamerus; Delthyris shaly limestone; Upper Pentamerus, (Lower Helderberg); Oriskany; Cauda Galli; Schoharie grit; Onondaga limestone, (Upper Helderberg). At Vromans are cliffs of Hamilton, "Vroman's Nose."

49. The Schoharie grit formation was named from this place. The fossils peculiar to it are found in the mountain one and a half miles northwest and northeast of Schoharie.

50. See from car windows the great falls of Mohawk, 70 feet high, over Hudson River slate.

51. Whitehall is usually called the head of Lake Champlain, but the lake for 15 miles is rarely more than 100 to 150 yards wide. It is in fact a mere channel between mud flats and clayey alluvium. Lake Champlain is 112 miles long, 600 feet deep, and the surface being only 96 feet above tide, it

Delaware and Hudson Canal Company's Railroads.

Ms.	Saratoga and Champlain Division—*Cont.*	
		1 a. Laurentian bluff
		4 a. Trenton.
32	Crown Point.	1 a. Laurentian bluff.
		4 a. Trenton, 7 miles.
		Valley chiefly 1 a. Laur.
40	Port Henry.[53]	1 a. Laurentian.
	(Tunnel.)	"
51	Westport.[54]	"
54	Wadham's Mills	"
57	Whallonsburgh.[55]	For 13 miles deep cuts through bluffs, 1 a. Laurentian. Beautiful sections.
64	Willsborough[55]	
77	Port Kent.[56]	1 a. Laurentian ends.
	(Ausable R.)[57]	2 b. Potsdam.
84	Valcour.	2 b. Potsdam. Heavy beds of sand & clay.
90	Plattsburg.[57]	"
95	Beekmantown.	4 a. Trenton and 3 c. Chazy.
99	West Chazy.	"
100	Chazy.[58]	"
105	Sciota.	"
111	Mooer's Junc.	"
118	Champlain.	3 a. Calciferous & 3 c. Chazy.
99	West Chazy.	"
122	Rouse's Point.	"
	(Con. in Canada,	see Grand Trk. R'y.)

No rock exposures.

Delaware and Hudson Canal Company's Railroads—*Continued.*

Ms.	Ausable Branch.	
0	Plattsburg.	2 b. Potsdam.
5	Salmon River.	3 a. Calciferous.
8	Lapham's Mills.	1 a. Laurentian.
10	Peru.	"
14	Harkness.	"
17	Ferronia.	"
20	Ausable.[57]	"
	Glens Falls Branch.	
49	Fort Edward.	4 a. Trenton.
53	Sandy Hill.	"
55	Glens Falls.	"Utica slate above.
	Lake George Branch.	
22	Ticonderoga.	1 a. Laurentian.
26	Baldwin on Lake George.[59]	"
	Adirondack Railroad.	
0	Saratoga.	4 a. Trenton & 3 a. Cal.
6	Greenfield.	2 b. Potsdam.
10	King's.[60]	"
13	South Corinth.	"
17	Jessup's Land'g	"
22	Hadley.[60]	1 a. Laurentian.
30	Stony Creek.	"
36	Thurman.	"
44	The Glen.	"
47	Washburn's Ed dy.	"
50	Riverside.	"
58	North Creek.	"

extends 500 feet below the level of the ocean. Its bed is a deep chasm in the Laurentian or Primitive rocks. On the west side, where the mountain ranges reach it, the slope is abrupt, but on the east side it is longer and more gradual. At many places the lake is bordered by steep banks of blue and yellowish brown clay and yellowish brown sand, rarely over 15 feet thick, but its greatest height is 100 feet at Burlington. It contains marine fossils in the mixture of clay and sand, but none in the clay beneath. This drift formation extends north to the mouth of the St. Lawrence River. In Albany County it is an immense mass and is known as the Albany clay.

52. From Dresden to Port Kent, 67 miles, the Laurentian hills are the western boundary of the valley of Lake Champlain. But at many points this mountain ridge recedes from the lake, leaving nooks and valleys, in which are patches of 3 c. Chazy and 4 a. Trenton limestone along the railroad.

53. The magnetic iron ore mines back of Port Henry are worth a visit, the bed of the ore being more than 100 feet thick. The mining of these heavy beds is on a grand scale.

54. From 51 Westport to 77 Port Kent, the formation, according to Dr. Hunt, is 1 c. Norian or Upper Laurentian.

55. At the village of Essex, on the lake and between Wallonsburg and Willsboro stations, is a bold bluff, 100 to 200 feet high above the lake, of 3 c. Chazy limestone.

56. The Adirondack Mountains commence at Little Falls, rising suddenly from the Mohawk Valley, and run northeast to Port Kent on Lake Champlain. The most elevated peak, Mount Marcy, is 5,467 feet high, the summit being just upon the region of perpetual frost. There are four other peaks 5,000 feet high, each distant about 6 miles from the other. This group of Adirondack Mountains is the culminating point of the State around the sources of the Hudson, Ausable, Racket and Black Rivers, and dividing the north half of the State into two separate geological basins. They are directly west of Westport, several miles to the west of the railroad. Only a glimpse of one of them can be had from the railroad. In the Adirondack pass in Essex County, is a perpendicular precipice or naked wall of rock 1,000 feet high and more than half a mile long. There is not probably in the Eastern States an object of the kind so vast and imposing as this. Emmons, 218.

57. Stop at Plattsburg and visit the Ausable valley, which is interesting for the Ausable chasm, where for at least two miles the Ausable River, a large and rapid stream, is compelled to flow through a rocky gorge in the 2 b. Potsdam sandstone with perpendicular walls of 100 feet with a width only varying from 20 to 40 feet. Here the *linqula antiqua* is found in great abundance, and there is here a better development of the Lower Silurian or Cambrian rocks than in any other part of the State. Emmons, 267.

58. The 3 c. Chazy formation was named from this locality. See Note 55. Also as to Isle La Motte see Note 67.

59. The rock which forms Diamond Island in Lake George is a good example of 3 a. Calciferous. Lake George is 30 miles long, 1¼ miles wide, and its surface is about 80 feet above tide water.

Central Vermont Railroad.

Ms.	Ogdensburg & Lake Champlain Railroad.	
0	Ogdensburg.	3 a. Calciferous, 20 ms.
9	Lisbon.	"
17	Madrid.	"
25	Norwood.	"
28	Knapps.	2 b. Potsdam, 53 miles.
36	Brasher Falls.	"
41	Lawrence.	"
47	Moira.	"
55	Bangor.	"
61	Malone.	"
73	Chateaugay.	1 a. Laurentian, 5 ms.
81	Cherubusco.	2 b. Potsdam, 36 miles.
89	Ellenburgh.	"
90	Dannemora.	"
97	Altona.	"
103	Mooer's Forks.	"
106	Mooer's Junc'n.	3 c. Chazy.
114	Champlain.	3 a. Cal. & 3 c. Chazy, 4
118	Rouse's Point.	3 c. Chazy, 2 ms. [ms
122	Alburgh.	4 b. Utica, 13 miles.
126	Alburgh Springs	"
133	Swanton.	4 c. Hudson River.
136	Swanton Junc.	"
142	St. Albans, Vt.	2 b. Potsdam, 6 miles.

Utica and Black River Railroad.

0	Utica.	4 b. Utica, 12 miles.[60]
6	Marcy.	"
10	Stittville.	"
12	Holland Patent.	4 a. Trenton, 32 miles.
16	Trenton.	"
18	Trenton Falls[62]	"
19	Prospect.[62]	"
21	Remsen.	"

Ms.	Utica and Black River Railroad—*Con.*	
25	East Steuben.	4 a. Trenton.
28	Alder Creek.	"
35	Boonville.[63]	" 1120
38	Leyden.	"
42	Port Leyden.	"
45	Lyons Falls.[64]	1 a. Laurentian, 1 mile.
51	Glendale.	4 a. Trenton, 28 miles.
54	Martinsburg.[65]	"
58	Lowville.	"
66	Castor Land.	"
70	Deer River.	"
74	Carthage.[66]	1 a. Laurentian.
81	Great Bend.	4 a. Trenton, 18 miles.
83	Felt's Mills.	"
85	Black River.	" 897[River.
92	Watertown.[67]	Tren., Birdseye & Black
104	Sacket's Harbor	"
74	Carthage.[66]	1 a. Laure'n, 6 ms. 721
92	Theresa Junc.	2 b. Potsdam.
98	Orleans Corners	3 a. Calciferous.
101	Lafargeville.	"
108	Clayton.	2 b. Potsdam.
74	Carthage.[66]	1 a. Laurentian, 1 mile.
83	Sterlingsville.	3 a. Calciferous, 1 mile.
87	Philadelphia.	2 b. Potsdam, 8 miles.
90	Shurtliff's.	" Iron ore.
93	Theresa Junc'n.	"
95	Theresa.	1 a. Laurentian and 2 b. Potsdam, 18 ms.
101	Redwood.	"
108	Rossie.	" Lead mine.
113	Hammond.	2 b. Potsdam, 10 miles.
118	Brier Hill.	"
123	Morristown.	" & 1 a. Laur'n.

60. This railroad cuts through Trenton, Calciferous and Potsdam within less than 10 miles of Saratoga. Fine sections of ripple marked Potsdam in railroad cut in Greenfield. The Ausable chasm is repeated at the High Falls of the Hudson at Luzerne or Hadley station on the Adirondack Railroad, in Warren County, where the river flows for a mile through a gorge at the junction of the Potsdam sandstone and the gneiss. The walls rise in some places to a height of one hundred feet.

61. Potsdam. This is the locality which gave the name to the Potsdam sandstone. See the description of that formation in another part of this volume.

62. Trenton Falls. For about three miles between Trenton Falls station and Prospect station and a mile or two east of the railroad, the East Canada Creek has cut a passage through the Trenton limestone, the sides of the excavation rising vertically with an average height of over 100 feet. In this passage are the Trenton Falls or Cascades which have given so much celebrity to the place, justly meriting by their number, beauty and position, the admiration they receive. Including the one at Prospect Village there are six falls, five of which are placed at intervals somewhat regular and occupy the middle part of the excavation. The rock is in thin layers of from 6 to 10 inches in thickness, separated by thin layers of shale, and contains trilobites in prodigious numbers. The formation derives its name from this place. It is 500 feet thick and about seven miles in breadth. Going east or south it grows thinner and is about 30 feet thick in the Mohawk Valley. The stone quarried at Prospect and used at Utica, is the upper part of the Trenton, which is here of a gray color and of a more solid and crystalline structure and appearance. Going on north by this railroad you travel for many miles on a terrace of the limestones of this group, forming the banks of Black River, which has its rocky channel in this formation all the way to Watertown, with three important falls at Lyons, Carthage and Watertown and many cascades. Very picturesque scenery and interesting geology, with an abundance of fossils.

63. Boonville. The first range or cliff of limestone on Black River, extending by the side of the river from opposite Boonville to Watertown, is the Birdseye limestone. It is of a light dove color which by long exposure to the weather becomes of a light ash gray or white. It is in thick, straight layers, with straight, vertical joints, giving the rock when quarried the appearance of a wall, and it has a compact grain and smooth fracture.

64. At Lyons Falls, Black river falls 63½ feet over gneiss or 1 a. Laurentian rock. Thence to Carthage it falls but 9 feet and there is another fall over gneiss rock.

65. The high hills west of Martinsburg are of the Hudson River group.

Rome, Watertown and Ogdensburg Railroad.

Ms.		
0	Rome.	4 c. Hudson River. 439
11	Taberg.	" 11 miles.
14	McConnellsville	5 a. Medina and Oneida Conglomerate, 31 miles.
18	Camden.	"
23	West Camden.	"
28	Williamstown.	"
31	Kasoag.	" 636
37	Albion.	"
42	Richland.[68]	"
47	Sandy Creek.	4 c. Hudson River, 12 m
52	Mannsville.	" Lora.shales,
54	Pierrep't Manor.	" deep gulfs.
59	Adams.[69]	4 a. Trenton limestone.
63	Adams Centre.	"
72	Watertown Jun	Tren., Birdseye & Black River. 397
73	Watertown.[67]	
78	Sanford's Corn's	" Sandy drift.
83	Evans' Mills.	3 a. Calciferous.
90	Philadelphia.	2 b. Potsdam.
96	Antwerp.	1 a. Laure'n, Iron ore.
101	Keene's.	" "
108	Gouverneur.	2 b. Potsdam.
115	Richville.	1 a. Laurentian.
123	De Kalb Junc'n	" Iron ore.
129	Rensselaer Falls	2 b. Potsdam.
134	Heuvelton.	"
142	Ogdensburg.	3 a. Calciferous.

42	Richland.[68]	5 a. Medina.
47	Pulaski.[70]	4 c. Hudson River.
50	Sandhill.	5 a. Medina.
55	Mexico.	"
60	New Haven.	"
63	Scriba.	"
71	Oswego.[71]	" Lake, 245

73	Watertown.[67]	4 a. Trenton. 397
72	Watertown Jun.	"
76	Brownville.[72]	"
86	Chaumont.	"
89	Three-Mile Bay.	"
93	Rosiere.	"
97	Cape Vincent.	" 250

123	De Kalb Junc'n.	1 a. Laurentian.
131	Canton.	2 b. Potsdam.
142	Potsdam.[61]	"
148	Potsdam Junc'n	3 a. Calciferous.

Rome, Watertown & Ogdensburg R.R.—*Con.*

Ms.		Syracuse Division.
0	Syracuse.[27]	6. Salina or Onondaga Salt group. 395
5	Liverpool.	"
8	Woodward.	5 c. Niagara.
11	Clay.	5 b. Clinton.
15	Brewerton.[102]	"
18	Central Square.	5 a. Medina.
22	Mallory.	"
24	Hastings.	"
27	Parish.	"
31	Union Square	4 c. Hudson River.
34	Holmesville.	"
39	Pulaski.[70]	"
45	Sandy Creek Ju.	"

Lake Ontario Division, West.

0	Oswego.[71]	5 a. Medina. Lake, 245.
4	Furniss.	"
7	Wheeler's.	"
10	Hannibal.	5 b. Clinton.
13	Sterling Valley.	"
16	Sterling.	"
20	Red Creek.	"
26	Wolcott.	" Fossil iron ore.
31	Rose.	"
36	Alton.	"
38	Wallington.	"
41	Sodus.	"
47	Williamson.	"
52	Ontario.	" Fossil iron ore.
56	Union Hill.	" "
59	Webster.	"
64	Pierce's.	"
66	Sea Breeze.[35]	5 a. Medina.
70	Charlotte.[35]	"
76	Greece.	"
80	North Parma.	"
83	East Hamlin.	"
86	Hamlin.	"
90	East Kendall.	"
92	Kendall.	"
97	East Carlton.	"
100	Carlton.	"
103	Waterport.	"
106	Carlyon.	"
110	Lyndonville.	"
114	County Line.	"
118	Somerset.	"
123	Hess Road.	"
127	Newfane.	"
128	Coomer Road.	"
132	Wilson.	"
147	Rawsonville.	"
156	Lewiston.[42]	" Lake, 245.

66. The Laurentian rocks cover the whole of the country east of the Black River and the later formations west of the river, the opposite sides forming the strongest contrast imaginable as to rocks, soil, vegetation and population.

67. At Watertown the banks of the Black River present fine sections of the limestone visible from the car windows, showing the Trenton limestone, Black River limestone and the Birdseye limestone. There is a mass forming the Black River sub-division, known to quarrymen as the seven feet tier, lying between the Birdseye and Trenton limestone. At the Isle LaMotte, near Chazy, in Lake Champlain, it is a black marble, but at Watertown it is only suitable for ordinary purposes.

Delaware, Lackawanna and Western Railroad.

Ms.			
0	Binghamton.	11 b. Chemung.	868
7	Chenango.	"	
11	Chenango Forks	"	
21	Whitney's Point	"	
23	Lisle.	"	
30	Marathon.	"	
35	State Bridge.	"	
44	Cortland.	11 a. Portage.	1111
47	Homer.	"	
54	Preble.	10 a. Genesee.	
59	Tully.[73]	10 b. Hamilton.	1249
61	Apulia.	"	1221
66	Onativia.	10 c. Marcellus.	
73	Jamesville.[74]	9 c. Corniferous.	585
80	Syracuse.[27]	6. Salina.	395
80	Syracuse.[27]	6. Salina.	395
		5 c. Niagara.	
92	Baldwinsville.	5 b. Clinton.	
98	Lamson's.	5 a. Medina.	
104	Fulton.[75]	"	
115	Oswego.[71]	" Lake, 245.	

Cayuga Division.

0	Owego.	11 b. Chemung.	822
4	Cattatonk.	"	
10	Candor.	"	
14	Wilseyville.	11 a. Portage.	913
33	Ithaca on the hill.	"	945
33	Ithaca on the Lake.	"	876
0	Binghamton.	11 b. Chemung.	868
11	Chenango Forks	"	
19	Greene.	"	
25	Brisbin.	"	
29	Coventry.	"	
33	Oxford.	10 a. Portage.	956
41	Norwich.	10 b. Hamilton.	1000
47	North Norwich.	"	
52	Sherburne.	"	1042
57	Earlville.[94]	"	1077

Heavy drift.

Delaware, Lackawanna and Western Railroad—*Continued.*

Ms.			
60	Poolville.	10 b. Hamilton.	
64	Hubbardsville.	"	
68	Nor. Brookfield.	"	
72	Sangerfield Cen.	"	
73	Waterville.	"	
78	Paris.	9 c. Corniferous.	
81	Richfield Junc.	6. Salina.	
84	Clayville.	5 b. Clinton.	
86	Sauquoit.	"	
87	Chadwick's.	"	
89	Washing'n Mills	"	
91	New Hartford.	"	
95	Utica.[18]	4 b. Utica.	403
81	Richfield Junc'n	6. Salina.	
85	Bridgewater.	10 b. Hamilton.	
86	Unadilla Forks.	11 b. Chemung.	
88	West Winfield.	12. Catskill, synclinal	
90	Cedarville.	10 b. Hamilton.	
92	Miller's Mills.	"	
99	South Columbia.	"	
102	Richfield Spgs[46]	9 c. Upper Helderberg.	
0	Utica.[18]	4 b. Utica.	403
4	New Hartford.	5 b. Clinton.	
9	Clinton.[76]	"	
11	Franklin I. W.	5 c. Niagara.	
14	Deansville.	6. Salina.	
18	OriskanyFalls[20]	8. Oriskany s.s. on 7. L.	
21	Solsville.	10 b. Hamilton. [H'g.	
24	Bouckville.	"	
26	Peaksport.	"	
29	Hamilton.	"	
31	Smith's Valley.	"	
0	Clinton.[76]	5 b. Clinton.	
2	Kirkland.	"	
3	Clark's Mills.	"	
5	Westmoreland.	"	
7	Bartlett.	"	
13	Rome.	4 c. Hudson River.	439

Few exposures of rock on the railroad.

The Falls of Black River in Watertown are 35 feet perpendicular over the limestones at the Suspension Bridge, and 112 feet within the city limits in six separate falls.

68. There are two miles of rapids in Salmon River, which terminate in a fall of 107 feet. At high water the sheet of water is 250 feet wide, and at low water about half that extent. The fall is over the grey sandstone of the 5 a. Medina, and is seven miles northeast from Richland.

69. Adams. The Gulf of Loraine, on South Sandy Creek, is a genuine canon upon a small stream flowing through the Loraine or Hudson River slates, Utica slate and Trenton limestone in the town of Loraine, from which some geologists prefer that name for the formation. The walls are perpendicular and vary in height from 100 to 300 feet, and the gulf varies in width up to 16 rods. There are several of these gulfs in Jefferson County, some of them 12 miles in length, reaching to the starting points of the streams. A convenient place to stop to study the Loraine shales, a huge mass of mud rock, is the pleasant village of Adams. There are two of these gulfs within two miles southeast in the town of Loraine, but not on the stream in the village, which is on Trenton limestone. On the way observe a remarkable moraine of naked Laurentian boulders, some of them very large. This ridge crosses the railroad just south of Adams, where are many boulders in the fields, and is said to extend from Lake Ontario south of Woodford northeast into Canada. The ridge road, which runs all along Lake Ontario, also occurs here a little nearer the lake than the ridge of boulders.

70. The shales and sandstones at Pulaski are the upper part of the 4 c. Hudson River, which were at first called Pulaski Shales, or the Shales of Salmon River, and Loraine Shales. It is the only rock at Pulaski village, and is full of fossils, while the lower or Frankfort division has very few.

71. Oswego. Lake Ontario, like all other New York lakes, is a lake of excavation. Along its northeast shore, in Canada, is the 4 a. Trenton limestone. On its south or New York shore we find the 5 a. Medina sandstone extending from Oswego, the whole length of the lake, to Hamilton in Canada. The lake is excavated 50 feet in the red and 100 feet in the gray 5 a. Medina formation, 230 feet in the Hudson River and 120 feet in the 4 b. Utica slate, the whole making a thickness of

Ms.	Geneva, Ithaca and Sayre Railroad.		
0	Sayre.[109]	11 b. Chemung.	774
2	West Waverly.	"	
9	Bingham's.	"	
16	Van Ettenville.	"	
19	Spencer.	"	Hills of Portage.
23	North Spencer.	"	
27	West Danby.	"	
31	Newfield.	"	
38	Ithaca.[84]	11 a. Portage.	376
44	Willow Creek.	"	
46	Taghanic Falls.	" Gulf.	
48	Trumansburg.	"	
51	Covert.	" Tully limestone.	
54	Farmer.	10 b. Hamilton.	
57	Ovid Centre.	"	
61	Hayt's Corners.	"	
65	Romulus.	"	
70	West Fayette.	"	
77	Geneva[31]	9. c. Corniferous. An ancient deep channel northward, filled with gravel drift.[452]	

	Ontario Southern Railroad.		
0	Sodus Point.	5 a. Medina. Lake, 245.	
4	Wallington.	"	
6	Sodus Centre.	5 b. Clinton.	
10	Zurich.	"	
13	Fairville.	5 c. Niagara.	
16	Newark.	6. Salina.	
20	Marbleton.	"	
22	Outlet.	"	
23	Phelps.	9 c. Corniferous.	
27	Orleans.	"	
31	Flint.	"	
34	Stanley.	10 b. Hamilton.	885

Ms.	Cayuga Southern.[77]		
0	Cayuga.[78]	6. Salina. Lake, 376.	
6	UnionSprings[79]	6. Salina, with Gypsum beds. 9 c. Corniferous quarries.	
10	Levanna.[80]	10 a. Marcellus. 10 b. Hamilton.	
13	Aurora.[81]	"	
16	Willett's.	"	
20	King's Ferry.	" Bluffs 100 ft.	
22	Atwater's.	"	
25	Lake Ridge.[82]	" Tully limes.	
27	Taughannock.	" "	
32	Ludlowville.[83]	10 c. Genesee and Portage.	
38	Ithaca.[84]	11 b. Portage.	376

	Northern Central Railroad.		
0	Elmira.[108]	11 b. Chemung.	862
6	Horse Heads.	"	897
10	Pine Valley.	"	891
13	Millport.	11 a. Portage.	
19	Havana.[85]	"	453
22	Watkins.[86]	" Lake,[441]	447
29	Rock Stream.	"	
31	Big Stream.	10 c. Genesee, gulf.	
33	Starkey.	"	804
37	Himrod's.	"	793
41	Milo.	"	851
45	Penn Yan.[87]	" & Portage.	750
49	Benton.	" "	
51	Bellona.	10 b. Hamilton.	857
55	Hall's.	"	
58	Stanley.	"	898
61	Lewis.	"	
63	Hopewell.	"	844
69	Canandaigua.[88]	Lake, 668"	734

500 feet or the real depth of the lake, the surface of the 4 a. Trenton limestone being its bottom. It is 180 miles long, 40 miles wide, 492 feet deep and its surface is 245 feet above tide water.

72. Midway between Watertown and Brownville the whole river falls 60 feet in less than half a mile, running in a gorge with high banks.

73. Tully. The Tully limestone, separating the Hamilton from the Genesee, which is named from this place, is not seen on the railroad, but is found further to the west. The swamp near Preble is supposed to be underlaid by the Tully limestone.

74. Between Syracuse and Jamesville are good natural sections of the 6. Waterlime and 9. Onondaga and Corniferous limestones, many quarries and natural cliffs. Beyond Jamesville observe the transition into the Hamilton group where the high hills begin, the Marcellus shales being deeply excavated. Visit Green Lake, near Jamesville.

75. The red sandstone of the 5 a. Medina formation is well displayed at Fulton, in Oswego County, where it causes the Oswego Falls and forms the banks and bed of the river above and for half a mile below. The upper layers are covered with *Fucoides Harlani*, some of them of gigantic size.

76. The 5 b. Clinton formation is named from this place.

77. This is one of the best railroads in the State for geological observations. There are many points on the Cayuga Railroad where the junction of the Hamilton with the Tully limestone and of the latter rock with the Genesee shale, and of the Genesee with the Portage group are perfectly seen in juxtaposition. The lake affords every evidence and facility for geological sections.

78. Cayuga Lake is 40 miles long, 3¼ miles wide, 390 ft. deep, and its surface is 376 ft. above tide.

79. The gypsum beds are finely displayed just north of Union Springs, and large quantities are produced for market. South of the town the 9. Upper Helderberg range crosses, and causes an islet in the lake. Its lower layers, the Onondaga limestone, make beautiful quarries.

80. The low clayey land extending nearly to Levanna is on the 10 a. Marcellus shale. The first rock south of this is the dividing line between the Marcellus and Hamilton.

81. The 10 b. Hamilton presents its first bluff south of Aurora, 20 to 50 feet high, containing numerous fossils. Further south are many others, some of them 100 feet high, extending for miles. Nothing could be finer than these geological sections of the Hamilton.

82. The Tully limestone first appears at Lake Ridge, from which the station is named. It is the dividing line between the 10 b. Hamilton and the 10 c. Genesee. It dips as you go south and rises again. This looks like a flexure of the formations, but it is caused by the change in the course of

Ms. | Syracuse, Geneva & Corning Railroad.

Ms.			
0	Geneva.[31]	9 c. Corniferous.	452
9	Earle.[32]	10 a. Marcellus.	
14	Dresden.[87]	522" Tully limestone, 1 mile south.	
21	Himrod's.	10. Hamilton.	854
26	Dundee.	"	968
30	Rock Stream.	11 a. Portage.	
33	Reading Centre.	"	1043
36	Watkins Glen.	"	1015
37	Glen Bridge.[86]	1021 "View of Glen. Bridge 150 feet high.	
45	Beaver Dam.	11 a. Portage.	1267
49	Post Creek.	11 b. Chemung.	1175
52	Ferrenburg.	"	
58	Corning.	"	943

Gulfs.

Corning, Cowanesque & Antrim Railroad.

0	Corning.	11 b. Chemung.	943
15	Lawrenceville, Penn.	"	
22	Tioga Village.	"	1008
39	Wellsboro.	"	1330
51	Antrim.	14 b. Semi-bituminous Coal Measures.	1673
15	Lawrenceville.	11 b. Chemung.	1008
23	Nelson.	"	
27	Elkland.	"	1143
48	Fall Brook.	"	1794

Tioga, Elmira and State Line Railroad.

0	Elmira.[108]	11 b. Chemung.	862
1	Erie Junction.	"	
3	State Line Junc.	"	
7	Wells.	"	
9	Seeley Creek.	"	1041
10	State Line.	"	
12	Millerton, Penn.	"	1246
15	Trowbridge.	12. Catskill.	1440
17	Summit.	"	1594
23	Tioga Junction.	11 b. Chemung.	1021
24	Mitchell's.	"	
25	Old Station.	"	
26	Tioga.	"	1042
27	Berry's Bridge.	"	
35	Mansfield.	1140" Iron ore.	
40	Covington.[1208]	12. Cats'll, Fish beds.[90]	
45	Blossburg.[1348]	14 b. Coal Measures.	
49	Arnot.	1683" coal mines.	
45	Morris Run.	"	"1655

Ms. | Syracuse, Chenango and N. Y. R.R.

Ms.			
0	Syracuse.[27]	6. Salina.	395
8	Manlius Cen.[91]	7. L. Held., Waterlime.	
10	Fayetteville.	" & 9. Onon. l.s.[560]	
12	Manlius.	9. Onondaga limest. Heavy beds.	720
15	Oran.[92]	9. Onondaga l. s.	897
	Tunnel.	10 a. Marcellus.	1218
		10 b. Tunnel in Hamilton sandstone.	
20	Cazenovia.[93]	10. Hamilton.	1190
23	Webster's.	"	
29	Erieville.	"	1596
32	Georgetown.	"	1637
38	Lebanon.[94]	10 c. Genesee.	1364
		11 a. Portage, cliffs.	
45	Earlville.	10 c. Genesee.	1077

Cazenovia, Canastota & De Ruyter R.R.[26]

0	Canastota.	6. Salina.	429
3	Clockville.	"	637
4	Colton.	"	
5	Oak Hill.	" Gypsum in cuts.	
6	Quarries.[95]	9. Onondaga limestone.	
8	Perryville.[96]	"	1041
9	Hyatt's.	"	
11	Chitt'go Falls[97]	10 c. Marcellus.	
12	Bingley.	"	1041
13	Shelter Valley.	"	
14	Firndell.	10 a. Hamilton.	
15	Cazenovia.[93]	"	1177
17	Syr. & Chen. Jun	"	1248
22	New Woodstock	"	1293
25	Shedd's Corners.	"	1386
30	De Ruyter.	10 c. Genesee.	1276

Southern Central Railroad.

0	Sayre.[109]	11 b. Chemung.	774
7	Barton.	"	
10	Smithboro.	"	
14	Tioga.	"	
20	Owego.	"	811
24	Flemingville.	"	
29	Newark Valley.	"	959
35	Berkshire.	"	1038
39	Richford.	"	1090
43	Harford Mills.	"	
45	Harford.	"	1179
51	Dryden.	1072 "Summit, 1215.	

the lake. After rising again it forms a beautiful coping of the Hamilton group for miles above Taughannock. See the description of the 10 b. Tully limestone.

83. This is one of the best localities of the Hamilton group which we know. South of Ludlowville the 10 c. Genesee shale appears above the Tully limestone. It is uniformly black, of a slaty structure, fine grained, a hard and brittle mud rock, its edges resisting the weather, but its surface when exposed falling into pieces. You get a good section of the base of the Portage here. There is a well marked dividing line here between the Genesee and Portage, being a sandstone 2 or 3 feet thick, very compact and solid, with its under surface filled with fucoids raised in relief, one or two inches long, with their ends depressed. The eye readily follows it as it dips toward the water.

84. Every part of the Portage group can be inspected in the ravines and water falls in the vicinity of Ithaca.

85. There is a glen here, one mile southeast from the station, quite equal to that at Watkins. It is also in the Portage. See Note 86.

86. Watkins Glen is in the 11 a. Portage. It is a great wonder and very beautiful. There is a grand view of the chasm in crossing the bridge over it at Glen Bridge on the Syracuse, Geneva & Corning Railroad. The gulfs on that road are perfectly characteristic of the Portage group.

Southern Central Railroad—*Continued.*

Ms.			
54	Freeville.	11 a. Portage.	1042
56	Peruville.	"	
59	Groton.	"	990
65	Locke.	792" on 10 c. Gen.	
69	Moravia.[98]	"	725
73	Cascade.[99]	10 b. Hamilton.	717
76	Scipio.	" (Glen.)	
79	Wyckoff's.[99] (Foot of Lake.)	"	719
86	Auburn.[30]	9 c. Cornifer.	644
90	Throop.	6. Salina, 13 miles.	
95	Weedsport.[33]	"	417
99	Brick Church.	"	
104	Cato.	"	416
108	Ira.	5 c. Niagara.	
112	Martville.	5 c. Clinton.	
115	Sterling.	"	
116	Fair Haven.	5 a. Medina, 3 miles.	
118	N. Fair Haven[71]	" Lake, 245.	

Owasco Lake.

Utica, Ithaca and Elmira Railroad.

0	Elmira.	11 b. Chemung.	862
5	Horse Heads.	"	817
10	Breesport.	"	
14	Erin.	"	
17	Park.	"	
21	Swartwood.	"	
25	Van Etten.	"	
28	Spencer.	"	
32	West Candor.	"	
34	North Candor.	"	
37	Wilseyville.	" 913	
42	White Church.	"	
44	Mott's Corners.	11 a. Portage.	
46	Besemer's.	"	
50	Ithaca.[84]	"	
53	Varna.	"	
54	Snyder's.	"	
57	Etna.	"	
60	Freeville.	"	
62	Malloryville.	"	
63	McLean.	"	
67	South Cortland.	100 "	
70	Cortland.	"	
71	D. L. &W. Depot	"	1111

Hills of Portage.

0	Cortland.	11 a. Portage.	
12	Truxton.	"	
16	Cuyler.	"	
20	De Ruyter.	10 c. Genesee.	1276

0	De Ruyter.	10 c. Genesee.	1276
10	Otselic.	11 a. Portage.	
20	Plymouth.	11 b. Chemung.	
28	Norwich.	"	

Utica, Ithaca & Elmira Railroad—*Continued.*

Ms.	Scipio Branch.	
0	Freeville.	11 a. Portage.
4	West Dryden.	"
7	Asbury Road.	"
10	South Lansing.	"
14	North Lansing.	"
17	Genoa.	"
23	Venice Centre.	"
27	Scipio.	"

New York & Oswego Midland Railroad.

	New York, (Erie	Railroad), N. W.	
0	Middletown.	4 c. Hudson River.	550
5	Fair Oaks.	"	
10	Bloomingburg.	5 a. Oneida.	757
12	Wurtsboro.	Tunnel, 3,840 feet.	101
15	Summitville.	10. Hamilton, 11 a. Portage & Chemung.	545
30	Fallsburg.	12. Catskill. Tunnel,	
39	Liberty Falls.	" 1,017 ft.	
40	Liberty.	"	
46	Parkesville.	"	1798
51	Morseton.	11. Chemung.	
63	Cook's Falls.	"	
73	East Branch.	"	
82	Hancock.	12. Cats'll. Tun'l, 1,100	954
89	Codosia Summit	" 1462 ft.	
93	Rock Rift.	"	1152
101	Walton.	Junct'n of the 11.	1220
108	Zig Zag.	Chem. & 12. Catsk.	1685
117	Sidney Centre.	12. Catskill, synclinal.	
125	Sidney Plains.	11 b. Chemung.	967
127	New Berlin Jun	"	
134	Guilford.	"	1399
143	Oxford.	"	
148	Norwich.	11 a. Portage.	763
163	Earlville.	10 c. Genesee.	
167	Smith's Valley.	10 b. Hamilton.	
172	Eaton.	10 a. Marcellus.	
174	Morrisville.	9 c. Corniferous l. s. in	
181	Munnsville.	" hills.	
183	Cook's Corners.	6. Salina.	
187	Oneida Comm'ty	5 c. Niagara.	
190	Oneida.	5 b. Clinton.	412
192	Durhamville.	"	
200	North Bay.[102]	"	
209	Cleveland.	" Lake, 367	
216	Constantia.[102]	"	
223	Central Square.	"	
230	Pennellville.	"	
238	Fulton.[75]	5 a. Medina.	335
250	Oswego.[71]	" Lake, 245.	

Deep drift, glass sand.

87. The outlet of Crooked Lake from Penn Yan to Dresden is through the Genesee slate, Tully limestone, and the upper part of the Hamilton—all finely displayed. Crooked Lake is 20 miles long, one mile wide, 100 feet deep, and its surface is 718 feet above tide water. Its northern half is divided by a bluff of Portage (800 feet high) into two branches—one of them 12 and the other 8 miles long.

88. Canandaigua Lake is 14 miles long, from one to two miles wide, its surface is 668 feet above tide, and its greatest depth is 100 feet, but it is very shallow at both ends. It is excavated from the Hamilton and Portage groups.

89. The drift described in note 31 extends nearly to Dresden.

90. The fish beds are midway between Blossburg and Covington, in a cut called "Red Rock," where the formation is exposed for about 200 feet in thickness.

New York & Oswego Midland Railroad— *Continued.*

Ms.		
101	Walton.	(As before.)
105	Colchester.	12. Catskill.
109	Hawley's.	"
112	De Lancey's.	"
118	Delhi.	"
127	New Berlin Jun	11 b. Chemung.
134	Mount Upton.	"
140	Holmesville.	"
145	New Berlin Cen.	10. Hamilton.
149	New Berlin.	"
0	Middletown.	4 c. Hudson River.
15	Summitville.	"
17	Phillipsport.	"
19	Homowack.	"
23	Ellenville.	"and Trenton.

New York, Lake Erie & Western Railroad.
(Late Erie Railway).

	New York.[4]	1 c. Montalban.
0	Jersey City.[103] (Tide Marshes.)[104]	16. Triassic. Tunnel in Basalt, through Bergen Hill.
9	RutherfordPark	16. Triassic, 31 miles.
11	Passaic.	" Passaic Falls
16	Paterson.	" over Basalt.
21	Ridgewood.	" 137
23	Hohokus.	"
25	Allendale.	"
27	Ramsey's.	"
31	Suffern, N.J.[105]	1 a. Laurentian. 298
33	Ramapo, N.Y.	"
34	Sterling Junc'n	"
35	Sloatsburg.	"
41	Southfield.	"
43	Greenwood.[105]	" 520

Ms.	New York, Lake Erie & Western—*Con.*	
47	Turner's.	4 a. Trenton limestone.
49	Monroe.	4 c. Hudson River.
50	Schunemunk Mt	2 b. Potsdam.
51	Oxford.	4 a. Trenton.
53	Greycourt.	4 c. Hudson River, 25 m
59	Goshen.	" 430
66	Middletown.	" 559
70	Howell's.	" 689
75	Otisville.[106]	" 836
	Kittatiny, Blue, or Shawangunk Mountain.	5 a. Oneida, or Shawangunk and Medina.
87	Port Jervis.[101]	7. Lower Helderberg. 8. Oriskany. 441 9. Cauda Galli & Up. Heldg. & 10. Ham'n.
	Sparrowbush.	11 a. Portage.
99	Pond Eddy.	11 b. Chemung. 571
106	Shohola.	"
110	Lackawaxen[107]	" 648
116	Pine Grove.	"
122	Narrowsb'rg[107]	" 714
131	Cochecton.	12. Catskill ridge.
		11 b. Chemung.
135	Callicoon.	" 781
136		12. Catskill, (bluffs).
143	Hawkins.	"
147	Basket.	"
154	Lordville.	"
159	Stockport.	11 b. Chemung.
163	Hancock.	12. Catskill. 926
172	Hale's Eddy.	11 b. Chemung.
176	Deposit.	" 1008
184	Summit.	1373 "Mt. to N. Cats.
192	Susquehan'a[108]	" 911
200	Great Bend.	" 884

91. Just south of the Erie Canal there is a deep cut in a bluff of Waterlime group.

92. Picturesque view of Pompey Valley.

93. Cazenovia Lake is a beautiful lake, 4½ miles long, ¾ mile wide, and 70 feet deep, 1,189 feet above tide water, and is excavated in the Hamilton group. It discharges its waters into Chittenango Creek, which runs southward.

94. Lebanon and Earlville are both good localities for Hamilton fossils.

95. Extensive and beautiful view extending over Oneida Lake.

96. Canaseraga Falls similar to Chittenango Falls. Note 97.

97. The Falls are in sight in the valley to the west. Here Chittenango Creek falls 120 feet perpendicularly into a canon over the 9. Onondaga limestone, with the Corniferous bed over it, which forms the sides of the creek at the top of or above the Falls. Under the Onondaga limestone is the Oriskany sandstone, only six inches thick. Above the Falls the creek flows through a small, handsome valley, its lower sides formed of Marcellus, and the tops of the hills Hamilton.

98. Moravia is an excellent locality for Hamilton fossils. The Tully limestone, the dividing line between the Hamilton and Genesee, is half way up the hill sides, and appears to dip below the valley north of Locke. It is met with at the falls of Dry Creek, south of Moravia.

99. Owasco Lake is 10 miles long, a mile and a half wide at the north at Auburn, and a half mile at the south end, and 750 feet above tide water. The whole of the lake is in the Hamilton group.

100. Marl is here taken from the bottom of ponds; dried like bricks, and burnt into lime.

101. From Bloomingburg tunnel to Sidney, the geology is the same as from Port Jervis to Susquehanna on the Erie Railway.

102. Oneida Lake is 19 miles long, 6 miles wide, its greatest depth not over 40 feet, and in general it is quite shoal. Its surface is 367 feet above tide water. It is excavated in the 5 b. Clinton group the rocks of which appear on its south shore and west end. Its north shore is covered with sandy alluvium which is 100 feet deep at the east end and furnishes glass sand used in the glass factories in this vicinity.

103. The Erie railway tunnel at Jersey City is through Bergen Hill, which is the southern end of the mountain ridge of basalt or trap rock of the 16. Triassic age, 48 miles long, known farther north as the Palisade Mountain. See note 5.

104. The railroads out of New York through New Jersey pass over very extensive tide marshes, covered with reeds and coarse sedge grass, growing in soft mud, which is in some places forty feet deep, and all overflowed in high tide. These vast salt marshes so near New York City, which excite the wonder of strangers, contain from 250,000 to 300,000 acres or from 400 to 470 square miles.

Ms.	New York, Lake Erie & Western—*Con.*	
205	Kirkwood.	11 b. Chemung.
214	Binghamton [108]	" 868
223	Union.	"
229	Campville.	"
236	Owego.	" 822
246	Smithboro.	"
248	Barton.	"
255	Waverly. [109]	" 826
260	Chemung.	"
266	Wellsburg.	"
273	Elmira. [108]	" 862
290	Corning.	" 943
301	Addison.	"
331	Hornellsville.	" 1161
343	Canaseraga.	"
355	Nunda.	11 a. Portage.
361	Portage. [110]	" 1314
365	Castile.	"
374	Warsaw.	" 1326
380	Dale.	"
391	Attica.	" 998
395	Griswold's.	10 b. Hamilton. 1044
397	Darien.	"
403	Alden.	868 " & 9 c. Corn.
408	Town Line.	9 c. Corniferous. 683
412	Lancaster.	"
420	East Buffalo.	" 611
422	Buffalo. [40]	588 " Lake, 569.

0	Corning.	11 b. Chemung. 943
1	Painted Post.	"
5	Coopers'.	"
7	Curtis'.	"
9	Campbell's.	"
14	Savona.	"
20	Bath.	"
23	Kanona.	"
27	Avoca.	"
30	Wallace's.	"
35	Liberty.	"
39	Blood's.	"
45	Wayland.	"
50	Springwater.	11 a. Portage.
53	Webster.	"
57	Conesus.	"
60	South Livonia.	11 b. Hamilton.
64	Livonia.	"
67	Hamilton.	"
76	Avon. [111]	9 c. Cornif. and Water-
80	Rush.	6. Salina. lime.
82	Scottsville.	"
86	Henrietta.	"
90	Red Creek.	"
94	Rochester. [32]	5 c. Niagara, 3 miles. [527]

Ms.	New York, Lake Erie & Western—*Con.*	
331	Hornellsville.	11 b. Chemung. 1161
340	Alfred.	"Summit, 1793.
349	Andover.	"
357	Genesee.	" 1511
365	Phillipsville.	"
369	Belvidere.	" 1384
373	Friendship.	" 1539
382	Cuba.	1542 "Summit, 1698.
389	Hindsdale.	"
394	Olean.	" 1488
398	Allegany.	"
407	Carrollton.	" 1399
410	Great Valley.	"
413	Salamanca.	" 1384
421	Little Valley.	"
428	Cattaraugus.	"
437	Dayton.	" 1346
440	Perrysburg.	"
447	Smith's Mills.	"
451	Forestville.	" 883
454	Sheridan.	11 a. Portage.
459	Dunkirk.	" 607

76	Avon. [111]	9 c. Cor. & 6. Water Li.
83	Caledonia.	"
90	Le Roy.	" Good exposures of the rocks.
94	Stafford.	"
100	Batavia. [41]	889 "
107	Alexander.	10 b. Hamilton.
110	Attica.	11 a. Portage.

76	Avon. [111]	9 c. Corniferous.
80	South Avon.	" and Marcellus.
85	Geneseo.	10 b. Hamilton.
89	Cuylerville.	"
90	Shaker's.	11 a. Chasaqua shale.
91	Mt. Morris. [112]	10 c. Genesee.
94	Sonyea.	"
98	McNair.	"
102	West Sparta.	11 a. Portage.
106	Dansville. [113]	"

Newburg Branch.

0	New York.	4 c. Hudson River.
43	Greenwood.	"
45	Junction.	"
48	Highland Mills.	"
50	Woodbury.	"
56	Cornwall.	"
58	Vail's Gate Jun.	"
60	New Windsor.	"
63	Newburg.	"

Future generations may build dikes and reclaim them, but at present they are dismal swamps without a single tree or shrub, and wholly impassable to either man or beast. The two hills which rise abruptly in the salt meadow south of the Erie Railway and north of the Pennsylvania Railroad, are called Big Snake Hill and Little Snake Hill. The large one is half a mile long and 200 feet high. Both of these hills are outbursts of trap from between the underlying sandstone strata, similar to the Palisade Mountain.

105. Suffern to Greenwood. Here is a long natural gap through the Laurentian Highland range or Ramapo Mountains. Going west you go through a 2–4. Cambrian valley to Otisville. There is some Trenton limestone at Greenwood furnace and Turner's, but nearly all the surface for 30 miles is covered with Hudson River slates, the softer portions about Goshen forming a beautiful country.

Ms.	Middletown and Crawford Railroad.	
0	Middletown.	4 c. Hudson River.
3	Crawford Junc.	"
5	Circlesville.	"
8	Bellville.	"
10	Thompson Rdge	"
13	Pine Bush.	"

	Bath and Hammondsport Railroad.	
0	Bath.	11 b. Chemung.
3	County House.	"
5	Cold Spring.	"
7	Pleasant Valley.	"
9	Hammondsport.	"

	Branches of N. Y. L. E & W. Piermont Branch.	
0	Suffern.	16. Triassic.
9	Nanuet.	"
17	Piermont.	"

	Northern Railroad of New Jersey.		
0	Jersey City.	16. Triassic.	Trap dike
6	New Durham.	"	to Gran-
7	Granton.	"	ton.
9	Ridgefield.	"	
12	Leonia.	"	
14	Englewood.	"	
15	Highland.	"	
16	Tenafly.	"	
17	Cresskill.	"	
19	Closter.	"	
21	Norwood.	"	
23	Tappan.	"	
24	Sparkill.	"	
25	Piermont.	"	
29	Nyack.	"	

Palisade Mountain. See Note 5.

Ms.	Branches of N. Y. L. E. & W.—*Continued.* Walkill Valley Railroad.	
0	Jersey City.	(See Main Line Erie R.)
59	Goshen.[105]	4 c. Hudson River.
61	Ripp's.	"
64	Campbell Hall.	"
66	Neely Town.	"
68	Beaver Dam.	"
69	Montgomery.	"
73	Walden.	"
76	Shawangunk.	5 a. Oneida or Shaw'k Grit and Medina.
79	New Hurley.	7. Lower Helderberg and 9. Upper Held'g, mainly Upper.
82	Gardner.	"
85	Forest Glen.	"
87	New Platz.	"
91	Springtown.	"
94	Rosendale.[114]	4 c. Hudson River.
96	Katson's Cave.	"
98	Whiteport.	"
102	Kingston.[114]	" & Water Li.

	Monticello and Port Jervis Railroad.		
0	Port Jervis.[10]	10. Hamilton.	441
6	Huguenot.	"	
8	Rose Point.	11 b. Chemung.	
12	Paradise.	"	
13	Oakland.	"	
16	Hartwood.	"	
18	Gillman's.	"	
20	Barnum's.	"	
24	Monticello.	12. Catskill.	

106. Otisville. One mile west of Otisville in the Erie Railway cut the 4 c. Hudson River shales are seen running under the 5 a. Oneida conglomerate. This is the dividing line between two of the great geological groups or periods, the Lower Silurian and Upper Silurian. In a moment the whole character of the country is changed from cultivated grazing land on the Hudson River slates, the Orange County milk country to the east of this line, to a poor, barren, rocky region on the Oneida or Shawangunk and Medina formations, showing in a striking manner how the character of the country depends on its geology. In descending the Shawangunk Mountain towards Port Jervis there is an alternation of beds of the Oneida conglomerate, which is of a light gray color, and the Medina sandstone, which is of a high red color. Some pockets of galena were discovered and mined here, but were soon exhausted. At Port Jervis we are in the Hamilton, a formation producing a country capable of supporting a population. The intermediate formations are very thin and compressed together.

107. Lackawaxen. From Port Jervis to Narrowsburg, the Delaware River and Erie Railway pass through a deep and crooked gorge about 25 miles long, exhibiting some of the wildest scenery in the country. The railroad is cut out of rock in many places and overhung as it were by ragged precipices.

108. Binghampton. West of Susquehanna the Erie Railway and its branches run for more than 300 miles on the 11 b. Chemung formation. Most of it is a fine fertile country with some handsome towns, the largest of which are Elmira and Binghampton, in valleys filled with gravel alluvium, and the higher country formed of the calcareous Chemung shales, is quite productive, much of it being a good grazing country; but there is no variety in its geology. East of Susquehanna the Chemung formation is composed of harder sandstone. It contains less calcareous shale, and the soil is poor. The country improves rapidly going westward from Susquehanna.

109. Just west of Waverly are the Chemung Narrows, where 100 feet of rock are exposed. The quarries have produced an abundance of characteristic fossils of the Chemung group in their greatest beauty and perfection, the formation having been named from this locality. Five miles south of Waverly the opening of the Susquehanna Valley may be seen, where the Chemung River from the west and the Susquehanna from the east unite and traverse the State of Pennsylvania to Chesapeake Bay. At the west end of Waverly Village is a curious flat-topped hill, about 60 feet high, called "Spanish Hill." It is an eddy hill of gravel formed in the drift period; but it can be seen to better advantage on the south side, at Sayre on the Pa. & N.Y. R. R. and the G. I. & S. R. R. There is a similar eddy hill in the village of Union.

Branches of N. Y. L. E. & W.—*Continued.*

Ms.	Buffalo, Bradford & Pittsburg Railroad.		
0	Carrollton.	11 b. Chemung.	Bradford oil region.
6	Limestone.	"	
11	Bradford's, Pa.	"	
14	De Golias, "	"	
19	Big Shanty, "	"	
22	Crawford's, "	"	
26	Gilesville, "	14. Coal Measures.	

	Warwick Branch, S. W.	
54	Greycourt.	4 c. Hudson River.
55	East Chester.	"
57	Sugar Loaf.	"
58	Lake.	4 a. Trenton.
63	Warwick.	"

	Suspension Bridge and Niagara Falls Branch.	
420	Buffalo.	9 c. Corniferous.
420	East Buffalo.	"
425	Main Street.	"
431	Tonawanda.	6. Salina.
437	La Salle.	"
442	Niagara Falls.[39]	5 c. Niagara.
443	Susp. Bridge.[42]	"
444	Clifton, Ont.	"

Honesdale Branch.
(See Pennsylvania.)

Jefferson Branch.
(See Pennsylvania).

Ulster and Delaware Railroad.

0	Rondout.[114]	4 c. Hudson River. 6. Water Lime.	This R. R. runs into the heart of the Catskill Mts.
4	Kingston.	7. Lower Helderberg.	
9	West Hurley.	10. Hamilton.	
12	Olive Branch.	11 b. Chemuag.	
15	Brooks' Cross'g	11 a. Portage.	
17	Broadhead Bra.	"	
18	Shokan.	11. Chem. & 12. Cats.	
21	Boiceville.	12. Catskill.	
24	Mount Pleasant.	"	
27	Phœnicia.	"	
32	Fox Hollow.	"	
33	Shandaken.	"	
36	Big Indian.	"	
39	Pine Hill.	" Lowest pass of the Catskill Mts.	
44	Griffin's Corners	12. Catskill.	
48	Dean's Corners.	11. Chemung.	
51	Kelly's Corners.	"	
53	Halcottville.	"	
57	Stratton's Falls.	12. Catskill.	
59	Roxbury.	"	
65	Moresville.	"and Chemung.	
74	Stamford.	"	

Ms.	Buffalo and Southwestern Railroad.		
0	Buffalo.[40]	9 c. Corniferous.	578
3	Junction.	"	
5	LimestoneRidge	"	
10	Abbott Road.	"	
13	Hamburg.	10. Hamilton.	
16	Eden Valley.	11 a. Portage.	
19	Eden Center.	"	
23	North Collins.	"	
27	Lawton's.	11 b. Chemung.	
30	Collins.	"	
33	Gowanda.	"	
39	Dayton.	"	
43	Pine Valley.	"	
48	Cherry Creek.	"	
53	Clear Creek.	"	
56	Randolph.	"	
60	Kennedy.	"	
69	Jamestown.[115]	"	

Buffalo, Allegany Valley & Pittsburg R. R.

From Dunkirk to Pennsylvania State line on 11 a. Portage and 11 b. Chemung.

Buffalo, Corry and Pittsburg Railroad.

From Brockton, 11 b. Chemung.

Atlantic and Great Western Railroad.

Part in New York, 11 b. Chemung.[115]

Rochester and State Line Railroad.

0	Rochester.	5 c. Niagara.	488
5	Maplewood.	"	
7	Brookdale.	6. Salina.	
11	Scottsville.	"	555
14	Garbuttsville.	6. Waterlime.	
15	Wheatland.	"	
17	Mumford.	"	611
21	Lime Rock.	9 c. U. Helderberg.	770
25	Le Roy.	"	864
30	Pavilion Center.	10. Hamilton.	
33	Pavilion.	"	933
38	Wyoming.	10 c. Genesee.	957
43	Warsaw.	11 a. Portage.	1110
48	Rock Glen.	"	
54	Gainesville.	"	1673
62	Bliss Corners.	"	
65	Eagle Village.	" Summit, 1909.	
83	Machias.	1639 " & 11 b. Chem.	
93	Ashford.	" "	
97	Ellicottsville.	"	1541
102	Great Valley.	"	
108	Salamanca.	"	1390

110. Portage. Here the railroad crosses the very deep gorge of the Genesee River on a high iron bridge 820 feet long and 235 feet high. There are three falls within a distance of two miles which are 60, 90 and 110 feet high, besides the intervening rapids. Two of them are visible from the car windows on the north side. The bridge crosses the upper falls. The river pursues a meandering course through this deep gorge and over these three successive cascades, descending more than 500 feet, and passes out into the Valley of the Genesee at Mount Morris. The gorge is 20 miles long by the river, or 14 by the public road, and its depth in some places is not less than 350 feet, its width only about 600 feet, and the banks nearly perpendicular. The place is well worth a visit. It is cut out of the 11 a. Portage group, except the lower end, which is in the 10 c. Genesee shale. The Portage group was named from this place. See note 112, Mount Morris. There is an ancient channel

, New York and Philadelphia Railroad.

Ms.		
).[40]	9 c. Corniferous.	578
15	Elma.	10. Hamilton.
17	Aurora.	" & 11 a. Portg.
22	Wales.	"
26	Holland.	"
29	Protection.	"
36	Arcade.	11 a. Por. & 11 b. Chem.
39	Yorkshire.	"
43	Machias.	"
50	Franklinville.	11 b. Chemung.
57	Ischua.	"
63	Hindsdale.	"
69	Olean.	"
76	Portville.	"
84	Eldred, Pa.	12. Catskill.
89	Larabees.	"
97	Port Allegeny.	"
107	Keating Summit	"
121	Emporium.	14 a. Carboniferous, summit of hills.

Lake Shore and Michigan Southern R.R.

0	Buffalo.[40]	9 c. Corniferous.	578
10	Hamburg.	10. Hamilton.	
21	Angola.	"	
26	Farnham.	"	
29	Irving.	"	
31	Silver Creek.	10 c. Genesee.	
40	Dunkirk.	11 a. Port. & Chemung.	
49	Brocton Junc'n.	" "	Portage along the lake. Chemung to the E. in the hills.
57	Westfield.	" "	
65	Ripley, Pa.	" "	
73	North-East.	"	
80	Harbor Creek.	"	
84	Wesleyville.	"	
88	Erie.	"	
98	Fairview.	"	
103	Girard, Pa.	"	
115	Conneaut, Ohio.	11. Erie Shale.	
123	Kingsville.	"	
128	Ashtabula.	"	
	(Continued	in Ohio).	

Ms.	**Harlem Extension Railroad.**	
0	Chatham 4 cor.	3 b. Quebec.
5	Chatham.	"
11	Rider's Mill.	"
18	New Lebanon.	"
27	Lebanon Spr'gs.	"
31	N. Stephentown	"
34	Centre Berlin.	"
39	Berlin.	"
44	Petersburg.	"
45	N. Petersburg.	"
47	T. & B. Junction.	"
53	Bennington, Vt.	"

Poughkeepsie, Hartford & Boston Railroad.

0	Poughkeepsie.	3 b. Quebec.[116]
8	Russell's.	"
18	Standfordville.	"
26	Pine Plains.	"
30	Ancram Lead Mines.	"
34	Tanner's.	"
37	Boston Corners.	"
43	C. W. R.R. Jun.	"
	Millerton.	"

Troy and Boston Railroad.

0	Troy.	4 c. Hudson River & 3 b. Quebec.[116]
4	Lansingburgh.	"
9	Melrose.	3 b. Quebec.
13	Schaghticoke.	"
14	Valley Falls.	"
17	Johnsonville.	"
21	Buskirks.	"
24	Eagle Bridge.	"
26	Hoosac Junc'n.	"
	State Line.	3 b. Quebec.
27	Hoosac Falls.	"
30	Hoosac.	3 b. & c. Stockbr'ge l.s.
32	Petersburgh.	2. Cambrian.
36	North Pownal.	"
43	Williamstown.	"
45	Blackinton.	"
48	North Adams.	1 f. Green Mt. gneiss.

from Portage to Nunda, filled up by drift, compelling the river to cut its present deep, tortuous channel. For other examples of this see notes 31, 35, 38 and 39.

111. Avon. You have 6. Waterlime, 9. Upper Helderberg, and 10 a. Marcellus shale in the creek.

112. To study the Genesee shales stop at Mount Morris. Go through the village one mile northwest to the mouth of the gorge, where the Genesee River, after running 20 miles through the deep canon from Portage, breaks out into the beautiful, broad and fertile Genesee Valley. There is a good section close to the bridge over the river. Get a boat and row one mile up the pool of the State dam, which flows to the foot of the precipices all that distance. This is the finest exposure of the 10 c. Genesee in the State, the typical locality from which it was named, and the scenery is in itself remarkably good. The cliffs are 100 to 200 feet perpendicular, full of *septaria*, like flattened cannon balls sticking in the walls. It is curious that so soft a shale rock should stand the weather so well and not form sloping banks when the edges only are exposed. See note No. 110, Portage.

113. Dansville is in a beautiful amphitheatre of Portage hills with very picturesque views from the Water Cure and other elevated points.

114. The Rosendale Cement, manufactured near Rondout, is from the 6. Waterlime rock, which is here between the Medina sandstone and the Lower Helderberg limestone, the intermediate formations being wanting. It is a light blue, fine grained limestone, with smooth conchoidal fracture. The same formation furnishes the Hydraulic Cement, made at Syracuse, N.Y., and elsewhere.

115. Jamestown. Chatauqua Lake is 18 miles long, 2 miles wide, 1291 feet above tide water and 726 above Lake Erie. Its northern extremity is only 8 miles from Lake Erie, and yet it empties its waters by the Conewango, Alleghany, Ohio and Mississippi into the Atlantic. It is a beautiful sheet of water, bounded on its eastern side by gravelly sloping banks, and on the west by more level and in some places marshy shores. It is excavated in the Chemung group, the Portage being along its outlet and on the shores of Lake Erie below, but of much less thickness than further east.

Ms.	New York & Harlem R.R.[116, 117, 118]	
0	New York.	1 d. Montalban.
9	Fordham.	"
11	Williams Bridge	"
14	W. Mt. Vernon.	"
16	Bronxville.	"
17	Tuckahoe.	" Marble.
20	Scarsdale.	"
22	White Plains.	"
31	Pleasantville.	" Marble.
33	Chappaqua.	1 a. Laurentian.
37	Mount Kisco.	"
40	Bedford.	" Feldspar pro-
45	Golden's Bridge	" duced for pot-
47	Purdy's.	" teries.
48	Croton Falls.	"
53	Brewster's.	" Iron ore W.
56	Dykeman's.	" on summit.
61	Patterson.	"
64	Pawling.	3 b. Quebec.
71	South Dover.	" Iron ore W.
76	Dover Plains.	" Limest'e on E.
82	Wassaic.	"
84	Amenia.[119]	" Iron ore W.
87	Sharon.	" Burden's gun
93	Millerton.	"bar'l iro. ore W.
97	Mount Riga.	" (Summit).
100	Boston Corners.	" Iron ore W.
106	Copake.	" Iron Works.
109	Hillsdale.	"
116	Martinsdale.	"
120	Philmont.	"
126	Ghent.	"
127	Chatham.	"

Highlands.

All the iron ore is produced on the west side—none on east side of railroad.

Newburg, Dutchess & Connecticut R. R.		
	New York.	
0	Dutchess Junc.	3 b. Quebec group.
2	Matteawan.	"See note 116
4	Glenham.	"
6	Fishkill.	"
12	Hopewell.	"
13	Clove Branch Ju	"
17	Sylvan Lake.	"
19	Billings.	"
25	Verbank.	"
30	Millbrook.	"
37	Bangall.	"
40	Stissing Junc'n.	"
45	Pine Plains.	"
47	Bethel.	"
50	Shekomeko.	"
54	Winchell's.	" [Quebec.
59	Millerton.	"Hills W. are

Ms.	New York and New Haven Railroad.	
0	New York.	1 d. Montalban.
12	Williams Bridge	"
15	Mount Vernon.	20. Quaternary, underlaid by 1 c. Montalban, probably.
18	New Rochelle.	"
22	Mamaroneck.	"
25	Rye.	"
27	Port Chester.	"
30	Greenwich.	"
31	Cos Cob Bridge.	"
35	Stamford, Conn.	"

Greenwich and Johnsonville Railroad. Washington Co.		
	Troy.	
0	Johnsonville.	3 b. Quebec.[116 & 117]
5	Lee's.	"
6	S. Cambridge.	"
8	W. Cambridge.	"
10	Summit.	"
13	Easton.	"
16	Greenwich.	"

Long Island Railroad.		
0	Hunter's Point.	20. Quaternary.
10	Jamaica.	"
19	Mineola.	"
25	Hicksville.	"
29	Syosset.	"
34	Huntington.	"
40	Northport.	"
59	Port Jefferson.	"
30	Farmingdale.	"
65	Manor.	"
94	Greenport.	"

Flushing, North Shore & Central Railroad.		
0	Hunter's Point.	20. Quaternary.
3	Woodside.	"
4	Winfield.	"
5	Newtown.	"
8	Flushing.	"
9	College Point.	"
11	Whitestone.	"
14	Brookdale.	"

Staten Island Railroad.		
	Stapleton.	18 c. Cretaceous. (Plastic clay formation).
	Richmond.	"
	Pleasant Plains.	"
	Tottenville.	"

116. Quebec Group. The geology of the country between the Hudson River and the Connecticut and Massachusetts state line is yet involved in considerable doubt, and while the name Quebec group is here given, it should be understood that the precise geological horizon of the places is much less certain than in the portion of the State west of the river, where all the formations can be identified by characteristic fossils, as well as by their superposition and well marked lithological appearances. When the State geological survey was made, forty years ago, these extensive deposits of slate rocks were called Hudson River slates. Afterwards, in accordance with the Canada survey, they were called the Quebec group, by which they are yet designated as a general title, for

Ms.	South Side Railroad of Long Island.	
0	Brooklyn.	20. Quaternary.
8	Richmond Hill.	"
10	Jamaica.	"
16	Valley Stream.	"
19	Ocean Point.	"
21	Far Rockaway.	"
25	Sea Side House.	"
22	Freeport.	"
36	Babylon.	"
47	Oakdale.	"
54	Patcnogue.	"

Geneva and Lyons

Division of N. Y. C. & H. R. R. R.

0	Geneva.[31]	Deep drift, overlying 6. Salina and Corniferous. 9 c. 452
14	Lyons.	6. Salina. 399

Troy and Schenectady

Division of N. Y. C. & H. R. R. R.

148	Troy.	4 c. Hudson River.
151	Cohoes.	" Falls, 70 ft.
154	Crescent.	"
160	Niskayuna.	"
166	Aqueduct.	"
170	Schenectady.	"

Ms.	Boston and Albany Railroad.	
0	Albany.	4 c. Hudson River.
1	Greenbush.	"
9	Schodack.	"
17	Kinderhook.	" 116 & 117
20	Chatham Centre	3 b. Quebec.
24	Chatham.	"
29	East Chatham.	"
34	Canaan.	"
39	State Line.	"
	(Continued	in Massachusetts).

Hudson and Chatham Branch.

0	Hudson.	4 c. Hudson River.
4	Claverack.	3 b. Quebec.
9	Millerville.	" 116 & 117
11	Pulver's.	"
15	Ghent.	"
17	Chatham.	"

Rhinebeck and Connecticut Railroad.

0	Rhinecliff.	4 c. Hudson River.
3	Rhinebeck.	"
7	Red Hook.	3 b. Quebec.
11	Spring Lake.	" 116 & 117
17	JacksonCorners	"
25	Ancram.	"
35	Boston Corners.	"
42	State Line.	"
	Connecticut We	stern R. R. Junction.

the want of a more definite term. They are probably composed of several formations which have not been minutely studied, and are so metamorphosed, contorted, broken and wrinkled in almost every conceivable manner, and so disturbed, inverted and involved with each other, that at present their precise geology cannot be stated. See note 117 on this subject, by Prof. T. S. Hunt.

117. Geology of Eastern New York.—To the east of the Hudson River in New York we find besides the Laurentian rocks of the Highlands, and small portions of Huronian, a great development of the gneiss and mica-schists of the Montalban and of two other and very unlike series. The first of these is the Lower Taconic, consisting of the Stockbridge limestone with quartzite and peculiar slates. This series, together with the Primary crystalline schists, stretches up northward, passing along the southeast side of the Highlands, and occupying portions of Eastern New York and Western New England. On the northwest side of the Highlands, extending northward along the valley of the Hudson, and as far as Lake Champlain, is found another series, variously designated as the Hudson River group of Mather, the Taconic Slates or Upper Taconic series of Emmons, and the Quebec group of Logan. These rocks have been supposed to be Upper Cambrian or Silurian, (Utica, Loraine and Oneida) but are now believed to be chiefly of Lower and Middle Cambrian ages (including Sillery and Levis). They are generally disturbed and often inverted, and include small outliers and involved portions of Upper Cambrian and occasionally of Silurian strata. This Hudson River and Upper Taconic group is distinct from and superior to the Lower Taconic. It is impossible in the present state of our knowledge of their distribution to define the limits of these various groups of strata to the east of the Hudson, or to say at what stations the Upper Taconic, the Lower Taconic or the Primary rocks are met with. T. S. Hunt.

118. Geology of the Harlem Railroad.—The Laurentian mountains forming the Highlands on the Hudson River, from Peekskill nearly to Fishkill, (see note 6), extend as mountains only about sixteen miles east of that river. The Harlem Railroad runs through valleys, and the Highlands are not observable as a prominent ridge. But the series of formations is the same as on the river, consisting first of the Laurentian foundation rocks; then, south of these, the later crystalline series to New York City. North of the Laurentian, is the *Great Valley*, a thousand miles long, made up of the groups variously called Taconic, Quebec, Cambrian or Lower Silurian. This valley, geographically at least, runs across the River Hudson at Newburg and Fishkill, (see note 7), and then runs through the Taconic or Quebec belt to the City of Quebec in Canada. This district has been for a long time the great battle-field of geologists. Its geology can perhaps safely be inferred to be the same as in other portions of the same valley, where, from its fossils and the rocks above and below, its place in the series can be fixed beyond question.

119. The limestones and sandstones used for flagging and building in the various cities along the line of the N. Y. C. & H. R. R. R., are as follows: At Albany, Schenectady, Utica and Rome, 4 a. Trenton limestone, generally of the Birdseye portion, which produces the thickest stone; at Syracuse, Auburn and Geneva, the 9. Upper Helderberg, generally the Onondaga or lower portion of it; from Rochester to Buffalo the 5 a. Medina sandstone is the favorite for these purposes. Some 5. Niagara limestone are used at Rochester and 9. Upper Helderberg or Corniferous at Buffalo, especially for lime burning. But the best flagstones are from the Hamilton and Chemung formations, and generally come from the shores of Cayuga Lake. Large quantities of flagstones are also brought from the upper part of the Hamilton group in the higher parts of the Helderberg, and from the same geological position along the west side of the River Hudson from below Catskill as far as Kingston.

New Jersey.[1]

List of the Geological Formations on the New Jersey Railroads.

20. Quaternary, or Recent.
19. Tertiary (Southern New Jersey.)
18. Cretaceous.
- g. Upper Marl.[2]
- f. Yellow Sand.
- e. Middle Marl.[2]
- d. Red Sand.
- c. Lower Marl.[2]
- b. Clay Marls.
- a. Plastic Clays.

16. Triassic, or New Red Sandstone.
5 a. Medina s.s. and Oneida Conglom.
4 c. Cincinnati, or Hudson River.
4 a. Trenton Limestone.
2 b. Potsdam (Green Pond Mt.)
1 b. Huronian (at Trenton.)
1 a. Laurentian. Gneiss, Crystalline Limestone, &c. (The Highland Range.)

2 Producing the green sand marl used in agriculture.

1 Pennsylvania Railroad.
(United Railways of New Jersey.)

Ms.		
0	New York.	1 b. Huronian.[3]
1	Jersey City.	16. Triassic.
9	Newark.	"
14	Elizabeth.	"
19	Rahway.	"
23	Uniontown.	"
26	Metuchen.	"
31	N. Brunswick.	"
41	Monmouth J.	18. Cret's, a. plastic clay
46	Plainsboro.	" "
47	Princeton Jun.	" "
57	Trenton.	1 b. Huronian.[3]
67	Bristol, Pa.	"
85	Germant'wn J.	"
88	Mantua.	"
90	W. Philad'a.	"
47	Princeton Jun.	11. Cret's, a. plastic clay
49	Princeton.	16. Triassic. (E. edge.)
57	Trenton.	1 b. Huronian.[3]
63	Bordentown.	18. Cretaceous (a. and b.)

2 Amboy Division.

0	South Amboy.	18. Cret's. a. plastic clay
8	Old Bridge.	" "
14	Jamesburg.	" "
18	Cranberry.	" b. clay marl.
21	Hightstown.	" "
24	Windsor.	" "
27	Newtown.	" "
31	Yardleyville.	" "
34	Bordentown.	" "
39	Florence.	" a. plastic clay.
43	Burlington.	" "
47	Beverly.	" "
50	Riverside.	" "
54	Palmyra.	" "
61	Camden.	" "
62	Philadelphia.	1 b. Huronian.[3]

3 Perth, Amboy and Woodbridge R.R.

Ms.		
0	New York.	
19	Rahway.	16. Triassic.
21	Junction.	
24	Woodbridge.	18. Cret's. a. plastic clay
27	Perth Amboy.	" "

4 Millstone and New Brunswick R. R.

0	New York.	
31	N. Brunswick.	16. Triassic.
34	Millstone Junc.	"
46	Middlebush.	"
39	E. Millstone.	"

5 Rocky Hill Branch.

0	New York.	
41	Monmouth Jn.	18. Cret's. a. plastic clay
46	Kingston.	16. Triassic.
48	Rocky Hill.	" Trap Dike.

6 Freehold, Jamesburg and Squankum.

41	Monmouth J.	18. Cret's a. plastic clay.
43	Dayton.	" "
47	Jamesburg.	" "
52	Englishtown.	" b. clay marl
57	Freehold.	18 Cretaceous. " d. red sand. " e. mid. marl. " f. yel'w sand.
65	Farmingdale.[4]	" g. upper marl
74	Sea Girt.	19. Tertiary.

7 Belvidere Division.

0	Philadelphia.	
30	Trenton.	1 b. Huronian.[3]
36	Greensburg.	16. Triassic.
38	Somerset Jun.	"
40	Wash. Cross'g.	"
41	Titusville.	" Trap Dike.
43	Moore's.	"
46	Lambertville.	" " (Goat Hill)

4. Green sand marl grits.

1. The excellent Reports on the Geology of New Jersey, by Prof's H. D. Rogers, Wm. Kitchell and Geo. H. Cook, with the large and beautiful Geological Map by Prof. Cook, and the author's own observations, are the authorities for the geology of the Railway Guide of this State. It has also been revised and corrected by Prof. John C. Smock, the Assistant State Geologist.

3. New York, Trenton and Philadelphia are on Dr. T. S. Hunt's 1 d. Montalban. (See Canada.)

Ms.	Belvidere Division—*Continued.*	
50	Stockton.	16. Triassic.
56	Pt. Pleasant.	" Trap Dike.
62	Frenchtown.	"
68	Holland.	" Trias. congl.
	(Muscone'g M.)	1 a. Laurentian.
72	Riegelsville.	4 a. Trenton.
	(Pohatcong M.)	1 a. Laurentian.
75	Carpenterville.	4 a. Trenton.
80	Lehigh Junc.	"
81	Phillipsburg.	"
	(Marble Mt.)	1 a. Laurentian.
88	Martin's Creek.	4 a. Trenton.
95	Belvidere.	" & 4 c. Hudson.
46	Lambertville.	16. Triassic.
56	Flemington.	"

8 Mercer and Somerset R. R.

	Trenton.	
0	Somerset Jun.	16. Triassic.
5	Pennington.	"
10	Hopewell.	"
16	Harbinger.	"
23	E. Millstone.	"
30	N. Brunswick.	"

9 Delaware and Boundbrook.

(New Route, New York to Philadelphia)

0	New York.		To Boundbrook over N. J. Central R. R.
1	Jersey City.	16. Triassic.	
8	Bergen Point.	"	
12	Elizabeth.	"	
24	Plainfield.	"	
31	Bound Brook.	"	
35	Weston.	"	
37	Hamilton.	"	
41	Vanaken.	"	
42	Harlingen.	"	
45	Skillman.	"	
48	Hopewell.	"	
53	Pennington.	"	
58	Trenton Junc.	"	
60	Yardley, Pa.	"	Yardley to Phila. by N. Pa. R. R.
65	Woodbourne.	"	
67	Langhorne.	"	
73	Somerton.	1 b. Huronian.	
76	Bethayres.	"	
80	Jenkintown.	"	
88	Philadelphia.	"	

10 Camden and Burlington County R. R.

0	Philadelphia.	
1	Camden.	18. Cret's, a. plastic clay.
9	Moorestown.	" b. clay marl.
19	Mt. Holly.	" c. lower marl.
25	Pemberton.	" e. middle marl
26	New Egypt.	" f. yel'w sand. g. upper marl
44	Imlaystown.	" c. lower marl.
51	Hightstown.	" b. clay marl.

Ms.	11 Camden and Atlantic R. R.	
0	Camden.	18. Cret's. a. plastic clay.
7	Haddonfield.	" b. clay marl. d. red sand.
10	Ashland.	" e. middle marl g. upper marl.
16	Berlin.	19. Tertiary.
19	Atco.	"
23	Waterford.	"
25	Ancora.	"
27	Winslow.	"
30	Hammontown.	"
32	De Costa.	"
37	Elwood.	"
42	Egg Harb. City	"
48	May's Landing.	"
46	Pomona.	"
52	Atsecon.	"
59	Atlantic City.	20. Quaternary.
19	Atco.	19. Tertiary.
28	Atsion.	"

12 West Jersey R. R.

0	Philadelphia.	1 b. Huronian.
2	Camden.	18. Cretaceous. " a. Plastic clay
4	Gloucester.	" b. Clay marl. " c. Lower marl
8	Woodbury.	" d. Red sand. " e. Middle marl " f. yellow sand.
18	Glassboro.	19. Tertiary.
24	Franklinville.	"
35	Vineland.	"
39	Millville.	"
59	Mt. Pleasant.	"
81	Cape May.	"
18	Glassboro.	"
26	Elmer.	"
37	Bridgeton.	"
26	Elmer.	"
34	Yorkstown.	"
38	Alloway.	"
39	Middletown.	"
43	Salem.	"

13 New Jerscy Southern.

	New York.	
0	Sandy Hook.	20. Quaternary.
7	Seabright.	"
11	Long Branch.	" e. middle marl
16	Eatontown.	" "
22	Shark River.	" f. yel'w sand.
26	Farmingdale.	" g. upper marl.
27	Squankum.	" "
33	Bricksburg.	19. Tertiary.
41	Manchester.	"
47	Whiting's.	"
47	Whiting's.	"

Ms.	New Jersey Southern—*Continued.*	
59	Shamony.	19. Tertiary.
71	Atsion.	"
79	Winslow Junc.	"
85	Cedar Lake.	"
95	Vineland.	"
107	Bridgeport.	"
114	Greenwich.	"
117	Bay Side.	"
47	Whitings.	"
55	Hanover.	"
61	New Lisbon.	"
65	Pemberton Jn.	"
	Camden.	18. Cretaceous.
	Philadelphia.	

(Tom's River Branch.)

0	Sandy Hook.	20. Quaternary.
41	Manchester.	19. Tertiary.
49	Tom's River.	"
54	Cedar Creek.	"
60	Waretown.	"
61	Barnegat Jun.	"

Port Monmouth Branch (N.)

0	Sandy Hook.	20. Quaternary.
16	Eatontown.	19. Cret's, e. midl. marl.
17	Shrewsbury.	"
19	Red Bank.	" { d. red sand. c. lower marl.
25	Pt. Monmouth.	" b. clay marl.

14 Central R. R. of New Jersey.

0	New York.	
1	Jersey City.	16. Triassic.
8	Bergen Point.	"
12	Elizabeth.	"
24	Plainfield.	"
31	Bound Brook.	"
36	Somerville.	"
45	White House.	"
	Pickels Mt. on S.	" Trap Dike.
50	Lebanon.	"
52	Annandale.	1 a. Laurentian.
54	High Bridge.	"
58	Glen Garden.	"
59	N. Hampton J.	"
61	Asbury.	4 a. Trenton.
64	Valley.	"
66	Bloomsbury.	"
	(Pohatc'g Mt.)	1 a. Laurentian.
69	Springtown.	4 a. Trenton.
74	Phillipsburg.	"
75	Easton.	"
	(Con tin'd in Pa.)	

Musconetcong Mt. on S.

(High Bridge and Chester Branch.)

54	High Bridge.	1 a. Laurentian.
59	California.	"
62	(Germ. Valley)	4 a. Trenton.
67	Chester.	1 a. Laurentian.

15 Lehigh Valley R. R.

Ms.	(Easton and Amboy Division.)	
0	New York.	
1	Jersey City. Bergen Hill.	16. Triassic. Deep rock-cut in Trap-dike.
9	Newark.	"
14	Elizabeth.	"
19	Rahway.	"
20	Metuchen.	"
0	Perth Amboy.	18. Cret's. a. plastic clay.
6	Ford's.	" "
7	Metuchen.	16. Triassic.
20	Metuchen.	"
23	S. Plainfield.	"
26	Newmarket.	"
30	Bound Brook.	"
35	S. Somerville.	"
38	Flagtown.	"
41	Neshamic.	"
45	Three Bridges.	"
51	Flemington J.	"
54	Lansdown.	"
57	Midvale.	"
61	Pattenburg.	1 a. Laurentian.
	(Tunnel 1 mile in Musconetcong Mt.)	"
62	West End.	"
65	Bloomsbury. (Pohatcong Mt.	4 a. Trenton. on N.)
69	Kennedy.	1 a. Laurentian.
73	Phillipsburg.	4 a. Trenton.
74	Easton.	"
	(Cont'd. in Pa.)	

Over Pa. R.

16 Delaware, Lackawana and Western.

(Morris and Essex Division, or Main Line.)

0	New York.	
2	Hoboken. Tun'l. in Trap.	16. Triassic.
10	Newark.	"
13	Orange.	"
15	South Orange.	"
19	Millburn.	" Trap 1st Mt.
22	Summit.	" " 2d Mt.
25	Chatham.	" Long Hill, S.
31	Morristown.	"
34	Morris Plains.	"
38	Denville.	1 a. Laurentian.
40	Rockaway.	"
43	Dover.	"
48	Drakesville.	" Iron ore District.
53	Stanhope.	"
56	Waterloo.	"
62	Hackettstown.	4 a. Trenton.
68	Port Murray.	" & 4 c. Hudson.
71	Washington.	1 a. Laur. & 2 c. Potsdam.
80	Stewartsville.	4 a. Trenton.
85	Phillipsburg.	"
86	Easton.	"

Ms.	16 Main Line—*Continued.*	
71	Washington.	1 a. Laurentian. (Pohatcong Mt.)
75	Oxt'rd Furnace	Tunnel(Scott's Mt.W.) 2 b. Pots. & 4 a. Trent.
80	Bridgeville.	" "
82	Manunka Ch'h. (Tunnel.)	4 c. Hudson River. (Jenny Jump Mt.on E. 1 a. Laurentian.)
84	Delaware.	4. c. Hudson River.
87	Portland, Pa.	"
90	Columbia, Pa.	4 a. Trenton. 4 c. Hudson Riv. 2 ms
92	Water Gap, Pa. (Contin'd in Pa.)	5 a. Oneida conglom. and Medina s. s. (Blue Mountain.)

17 Boonton Branch.

0	New York.	1 b. Huronian.
2	Hoboken.	16. Triassic.
9	Rutherford Pk.	"
12	Passaic.	"
17	Paterson.	" Trap 1st Mt.
	Little Falls.	" "
25	Lincoln Park.	"
27	Whitehall.	"
29	Montville.	" Trias. congl.
32	Boonton.	1 a. Laur. Ramapo Mt.
37	Denville.	" "
70	Washington.	By main line above.
86	Easton.	"

Branches to Iron Ore Mines, from Morris and Essex Division.

18 Hibernia Mine R. R

40	Rockaway.	1 a. Laurentian.
42	Beach Glen.	"
44	Hibernia.	"

19 Mount Hope Mine R. R.

40	Rockaway.	1 a. Laurentian.
42	Mt. Hope.	"

20 Port Oran and Mt. Hope R. R.

43	Dover.	1 a. Laurentian.
44	Port Oran Jun.	"
47	Mt. Hope.	"

21 Chester Railroad.

43	Dover.	1 a. Laurentian.
46	Chester Jun.	"
49	Suckasunny.	"
55	Chester.	"
	(Schooley's Mt.	to the West.)

22 Ogden Mine R. R.

10 miles R. R. Ogden Mine to Morris Canal.

53	Stanhope.	1 a. Laurentian.
56	Morris Canal.	"
60	Hopatc'ng lake	"
64	4 miles by lake	
70	Ogden Mine.	"

22 Sussex Railroad.

Ms.	(Branch of Morris and Essex.)	
	Waterloo.	1 a. Laurentian. Gneiss.
5	Whitehall.	"
6	Andover.	4 a. Trenton. 4 c. Hudson River.
10	Newton.	4 a. Trenton.
13	Branchville J.	"
14	Lafayette.	"
15	Augusta.	4 c. Hudson River. 4 a Trenton.
19	Branchville.	4 c. Hudson.
13	Branchville J.	4 a. Trenton. 4 c. Hudson, 1 m.
18	Sparta.	4 c. Trenton.
	(German Flats)	"
21	Franklin.	" (Zinc mine.)

24 Montclair and Greenwood Lake R. R.

9	Jersey City.	16 Triassic.
9	N. Newark.	"
11	Bloomfield.	"
12	Montclair.	"
14	Montcl. H'ghts.	" Trap Dike.
15	Great Notch.	" " (1st Mt.)
16	Cedar Grove.	" "
17	Little Falls.	" " (2d Mt.)
19	Mountain View	"
23	Pequannock.	"
24	Pompton Pl'ns.	"
28	Pompton.	1 a. Laurent. Ramapo Mt
32	Medvale.	" "
36	Ringwood Jun.	"
37	" Park	"
38	Monk's.	"
40	Hewitt.	"
43	Cooper.	"
45	Lake Side.	"
50	Greenw'd Lake	"

25 New Jersey Midland R. R.

0	Jersey City.	16. Triassic.
13	Hackensack.	"
20	Paterson.	"
22	Hawthorne.	"
26	Wortendyke.	"
35	Pompton Jun.	1 a. Laurentian.
36	Bloomingdale.	"
37	W. Bloomingd.	2 b. Potsdam and congl.
47	Newfoundland.	" (Green Pond Mt.)
56	Ogdensburg.	1 a. Laurentian.
57	Sterling Hill.[5]	" cryst. l. s.
58	Franklin.[5]	" "
	(German Flats)	4 a. Magnesian l. s.
66	Deckertown.	4 c. Hudson River.
74	Unionville.	"
88	Middlet'n, N.Y.	"

5 Zinc ore mines at these places in the crystalline limestone; also Franklinite.

26 Erie Railway.

(The New Jersey portion of this R. R. is given with those of the State of New York.)

Pennsylvania.

By Professor J. P. Lesley, the State Geologist.

List of the Geological Formations of Pennsylvania.

Prof. Dana's Table of the Formations.	Names Provisionally adopted in the Second Geological Survey of Pennsylvania, by Prof. J. P. Lesley.		Old Penn. Nos. of 1st Geo. Sur.
20. Quaternary.	20. Quaternary.		
16. Triassic.	16. Triassic.		
14 c. Upper Coal Measures.	14 c. Upper Barren Measures.		XIII.
" "	" Monongahela Riv. Coal Series.		"
14 b. Lower Coal Measures.	14 b. Lower Barren Measures.		"
" "	" Allegheny River Coal Series.		"
14 a. Millstone Grit.	14 a. Pottsville Conglomerate.		XII.
13 b. Upper Subcarboniferous.	13 b. Mauch Chunk Red Shale, (Umbral.)	Bernician	XI.
13 a. Lower Subcarboniferous.	13 a. Pocono Grey Sandstone, (Vespertine.)	Bernician	X.
12. Catskill.	12. Catskill Red s. s.	(Ponent.)	IX.
11 b. Chemung.	11 b. Chemung.	Devonian.	VIII.
11 a. Portage.	11 a. Portage.	Devonian.	"
10. Hamilton, { Genesee. Hamilton. Marcellus.	10 c. Genesee. 10 b. Hamilton. 10 a. Marcellus.	Devonian.	"
9. Corniferous.	9. Upper Helderberg.	Devonian.	"
8. Oriskany.	8. Oriskany.	Devonian.	VII.
7. Lower Helderberg.	7. Lower Helderberg, (Lewistown Limestone.)	Silurian.	VI. "
5 b. Clinton.	5 b. Clinton.	Silurian.	V.
5 a. Medina and Oneida.	5 a. Medina.	Silurian.	IV.
" "	" Oneida.	Silurian.	"
4 c. Cincinnati.	4 c. Hudson River.	Silurian.	III.
4 b. Utica.	4 b. Utica.	Silurian.	"
4 a. Trenton.	4 a. Trenton.	Silurian.	II.
3. Canadian.	3 a. Calciferous.	Silurian.	"
2. Primordial or Cambrian.	2 b. Potsdam.	Silurian.	I.
1. Archæan.	1. Azoic.		

Notes on the Table of Formations.—All beneath the Potsdam is styled Azoic, because no survey has yet sufficiently differentiated the mass into its several systems. The term Eozoic is rejected partly because both too vague and too shifting, and partly because it would suit the Cambrian system better than the Huronian and Laurentian, both of which remain to all intents and purposes Azoic. The terms Huronian and Laurentian are known to apply lithologically to rock masses in Pennsylvania, but their geographical relationships in the State are but imperfectly made out.

Much uncertainty still exists about the lines of demarcation between some of the formations in Pennsylvania, such as between the Catskill and Chemung; the Lower Helderberg and Clinton; the Hudson River and Utica; the Calciferous and Potsdam.

Niagara, Onondaga or Salina, Corniferous and other names are omitted because of their uncertain presence in many districts of the State; and because of the narrowness of their upturned outcrops where they do exist.

Some of the places named in the following lists occupy positions covering the width of two or more steeply outcropping formations, to any one of which therefore they might be assigned.

In the northern and western counties it is often impossible to say precisely whether places stand upon Chemung, Catskill, Pocono or Mauch Chunk rocks. In such cases, Chemung has been preferred, because the others might be studied in the surrounding hills on account of the general horizontality of the bedding. J. P. L.

Pennsylvania.

Pennsylvania Railroad. New York Division. Ms.		
0	W. Philadelphia.	1. Azoic.
6	Kensington.[1]	20. Quaternary.
13	Holmesburg.	"
23	Bristol.	"
26	Tullytown.	"
32	Morrisville.	1. Azoic.
33	Trenton, N.J.	(See New Jersey.)

Pennsylvania Division—Main Line.		
0	W. Philadelphia.	1. Azoic.
5	Merion.	"
9	Bryn Mawr.	"
20	Paoli.	"
22	Malvern.	"
28	Oakland.[2]	2-4. Siluro-Cambrian. (Calciferous ?)
33	Downingtown.	3 a. & 4 a. Magnesian Limesto's & Marbles.
39	Coatesville.	"
44	Parkersburg.	2 b. Potsdam s. s.
47	Penningtonville	"
51	Gap.[3]	1. Azoic.
57	Lemon Place.[4]	2–4. Siluro-Cambrian Limestones.

Pennsylvania Railroad. Pennsylvania Division—Main Line—*Con.* Ms.		
61	Bird-in-Hand.	2–4. Siluro-Cambrian Limestones.
69	Lancaster.	"
76	Landisville.[5]	"
81	Mount Joy.	"
87	Elizabethtown.[6]	16. Triassic.
95	Branch Inter.[7]	"
96	Middletown.	"
106	Harrisburg.	4 a. Trenton Limestone and edge of 4 b. Utica Slate.
111	Rockville.[8]	4 c. Hudson Riv. Slate.
113	Marysville.	5 a. Oneida Conglom'e.
120	Duncannon.[9]	12. Catskill s. s.
133	Newport.	11 b. Chemung.
138	Millerstown.[10]	5 b. Clinton and fossil iron ore beds.
143	Thompsontown.	7. Lower Helderberg.
148	Tuscarora.	10. Hamilton.
152	Perrysville.[11]	"
155	Mifflin.	5 b. Clinton.
162	Narrows.[12]	"
167	Lewistown.	7. Lower Helderberg.
178	McVeytown.[13]	"

1. This line runs along the Delaware river over alluvion and modified glacial drift, based upon Azoic rocks, upon which lie the bottom layers of the Cretaceous of New Jersey.
2. Here the line finally leaves the Azoic rocks, across a fault, and passes white marble quarries to the Westchester Valley, rocks vertical, and probably identical with those of western Vermont, (Taconic ?)
3. Beds of quicksand. Wharton's famous nickel mine not far off.
4. From here to Elizabethtown, over the garden of Pennsylvania, the great limestone plain of Lancaster; steep dips; plications and faults innumerable; geology wholly unknown.
5. Zinc mines recently opened and worked one mile to the east.
6. Road runs for a mile or two along the back of a greenstone trap dike, twenty miles long, extending from the Cornwall iron mines near Lebanon, to the Susquehanna river at Falmouth, and over it into the great greenstone trap region of York County. Good place to study the action of the trap rock in metamorphosing the beds of New Red.
7. Commencement of the great cross section of the Paleozoic Rocks, and south edge of the limestones of the Great Valley.
8. Finest section in the State here. Seven miles thickness of rock, nearly vertical but slightly overturned, so that the upper formations seem to plunge beneath the lower — may here be measured, viz: From the Hudson River slates (Lower Silurian, or Siluro-Cambrian), up to the Coal Measures on the summit of the Third Mountain.
9. Here a greenstone trap dike, only 4 feet thick, 35 miles long, crosses the road and river. It carries iron ore. One mile west a coal bed is opened in the Pocono Sandstone, the representative of the New River Coal System of Montgomery County in Virginia. Five miles east, in the notch in the summit of Peter's (Fourth) Mountain, where the Dauphin-Halifax turnpike crosses its crest, is a vertical wall scored horizontally with *glacial striæ*. Notice the terrace which the Catskill makes on the north flank of Peter's Mountain opposite Duncannon; it is the finest exhibition of Catskill terrace erosion in the State. See Notes 77 and 170.
10. Clinton fossil ore bed extensively worked here and at Mifflin.
11. Best place to study the Juniata River coal system. (Hamilton; Lower Devonian).
12. Long Narrows. River flows in a narrow synclinal between anticlinals of Medina and Oneida.
13. Best place to study Oriskany glass sand quarries, one mile back of McVeytown on the opposite (north) side of river.

Pennsylvania Railroad.

Ms.	Pennsylvania Division—Main Line—*Con.*	
188	Newton Hamil'n	10. Hamilton.
191	Mount Union.	5 b. Clinton.
195	Mapleton.[14]	7. Lower Helderberg.
203	Huntingdon.[15]	11 a. Portage.
210	Petersburg.	5 b. Clinton Red Shale.
216	Spruce Creek.[16]	4 a. Trenton Limestone.
220	Birmingham.[17]	3 a. Calciferous.
233	Tyrone.	5 b. Clinton.
227	Tipton.	10. Hamilton.
231	Bell's Mills.[18]	"
237	Altoona.	"
242	Kittaning Pt.[19]	12. Catskill.
249	Gallitzin.	14 b. Coal Measures of the Allegheny River Series.
252	Cresson.	"
255	Lilly.[20]	"
262	Wilmore.	"
265	South Fork.[21]	"
269	Mineral Point.	"
274	Conemaugh.	"
266	Johnstown.	"
285	Ninevah.	"
290	New Florence.	"
295	Bolivar.[22]	"
301	Blairsville Int[23]	"

Pennsylvania Railroad.

Ms.	Pennsylvania Division—Main Line—*Con.*	
		14 b.L. Barren Measu's.
308	Derry.	14 c. Monongahela Riv. Series of C. M.
313	Latrobe.[24]	"
323	Greensburg.	"
328	Penn.	"
333	Irwin's.	"
343	Brinton's.	"
347	Wilkinsburg.	14 b. L. Barren Measur.
354	Pittsburg.[25]	"

Philadelphia and Erie Division.

0	Sunbury.[26]	11 b. Chemung.
2	Northumberla'd	"
9	Montandon.	5 b. Clinton.
13	Milton.[27]	"
17	Watsontown.	"
19	Dewart.	10. Hamilt. & 7 Lew. l.s.
24	Montgomery.	"
28	Muncy.[28]	5 b. Clinton.
40	Williamsport.[29]	10. Hamilton.
45	Linden.	11 a. Portage.
52	Jersey Shore.[30]	11 b. Chemung.
57	Pine.	"
60	Wayne.	"
65	Lock Haven.[31]	"

14. Vertical Oriskany and glass sand quarry on the opposite (east) bluff.

15. Plenty of middle Devonian fossils to the south of the town, across the flat, which was once a deep lake, now probably filled with glacial moraine matter. One mile further on, high and picturesque pulpit rocks of Oriskany crown the bluffs on both sides of the river. Best view to be got by crossing the turnpike bridge at Huntingdon and riding a mile towards Petersburg. Fine pulpit rocks stud the crest of Warrior's Ridge to the north and far to the north-east.

16. To the south are the Springfield Furnace mines. Up Spruce Creek a dozen miles are the largest Limonite mines of the interior of the State.

17. Here Potsdam comes up in the centre of the overturned anticlinal.

18. Blair's mine, between Bell's Mills and Altoona. An open quarry in limonite on Oriskany and Helderberg outcrops; very curious. Unique exposure of *celestine* in the bank of the creek below Bell's Mills.

19. Horseshoe Bend, on 1° gradient, cuts off the point of a spur of Catskill and Pocono, and makes high cliffs.

20. Coal mines and coke ovens for miles.

21. The anticlinal at the Viaduct brings the Mauch Chunk Red Shale 20 feet above grade, and produces the 3 mile loop in the river. A very curious place. Notice the false bedded boulders of Pocono sand stone lying in the bed of the valley below, under the viaduct.

22. A vast bed of fire-brick clay half a mile back.

23. Notice the arch of Pocono and Catskill opposite. On the opposite mountain top lies a small patch of the lowest coal bed of the Alleghany River series.

24. Here the Pittsburg Coal Bed is first met—the lowest bed of the upper productive (Monongahela River) Coal series. Down the Loyalhanna, left bank, 6 miles, the hill slope is covered with cubic blocks of sand rock 20 feet high and 100 feet on a side, moved from their original sites.

25. The Pittsburg Coal Bed is seen mined at the hill tops south of the city, 350 feet above the Monongahela River level. At the south end of the hill behind the city, stands an oil well derrick 70 feet high, 100 feet above the streets. It has been bored to a depth of 2,300 feet, through the Butler Oil Rocks, but yields nothing but a stream of strong brine.

26. Fine cliffs opposite, west side of the river. Superb landscape from hill ¼ mile back of station.

27. In the centre of a rolling plain of Clinton anticlinals and synclinals crossing the river from east to west, bounded on the west by anticlinal Oneida and Medina Mountains called the "Buffalo," "Seven Mountains," Jacks," &c., around the bases of which run the outcrops of the fossil ore.

28. Plenty of fossils; fine cliffs of Chemung and Portage facing the river on the east side. Last appearance of Silurian Mountains of Middle Pennsylvania in the progress towards the north east—the end of the Bald Eagle Mountain (5 a. Medina) close along the railroad. Facing, to the north, appears the wall of the Alleghany Mountains with patches of the lowest coal on the broken forest plateau above.

29. Five miles south, through a gap, lies the little secluded Musquito Valley of Siluro-Cambrian limestone, with black marble quarries of Utica or Trenton.

30. Gap into secluded Nippenose or Oval Valley (anticlinal S.-C. limestone; fossils), 4 miles south and across the river, has *in it* a remarkable conical glacial (?) hill.

31. Five miles south enter Nippenose Valley; limestone; limonite mines; Trenton fossils, &c.

Pennsylvania Railroad.

Ms.	Philadelphia and Erie Division—*Con.*	
69	Queen's Run.[32]	11 b. Chemung.
75	Ferney.	"
80	Whitham.	"
86	Hyner.	"
89	North Point.	"
92	Renovo.[33]	"
98	Westport.	"
102	Cook's Run.	"
105	Keating.	"
110	Round Island.	"
117	Sinnemahoning.	"
120	Driftwood.[34]	12. Catskill.
129	Sterling.	"
133	Cameron.[35]	"
139	Emporium.[36]	"
148	Beechwood.	"
160	St. Mary's.[37]	14 b. Allegheny Riv. Series of Coal Meas.
165	Daguscahonda.	12. Catskill.
170	Ridgeway.[38]	11 b. Chemung.
178	Wilmarth.	12. Catskill.
184	Wilcox.[39]	"
189	Sergeant.	"
193	Kane.[40]	14 a. Pottsville Conglo.
199	Wetmore.	"
202	Ludlow.	"
209	Sheffield.[41]	"
212	Tiona.	13 a. Pocono ?
217	Stoneham.	12. Catskill.
222	Warren.[42]	11 b. Chemung.
228	Irvineton.	"

Pennsylvania Railroad.

Ms.	Philadelphia and Erie Division—*Con.*	
234	Pittsfield.	11 b. Chemung.
238	Garland.[43]	"
244	Spring Creek.	"
249	Columbus.	"
251	Corry.[44]	"
256	Concord.	"
262	Union.	"
269	Waterford.	"
275	Jackson.	"
281	Belle Valley.[45]	11 a. Portage.
288	Erie.[148]	"

	Columbia Branch.	
0	Lancaster.	2-4. Siluro-Cambrian ls.
7	Mountville.	"
12	Columbia.[46]	"
16	Marietta.	"
23	Bainbridge.[47]	"
27	Falmouth.	16. Triassic.
30	Highspire.	"
33	Baldwin.	2–4. Siluro-Cambrian.
37	Harrisburg.	4 b. Utica Slate.

	Pennsylvania and Delaware Branch.	
0	Pomeroy.	2–4. Siluro-Cambrian.
3	Newlin.	1. Azoic.
6	Doe Run.	"
12	Chatham.	" Serpentine.
15	Avondale.[48]	"
18	Landenberg.	"
22	Thompson.	"
38	Delaware City,	Del.

32. Here the road enters the gate of the long gorge of the West Branch, and continues in it 51 miles to Driftwood; the floor of the gorge being sometimes Chemung and sometimes Catskill. Steep walls of Catskill and Pocono rocks, a thousand feet high, hem in the river, with its innumerable horseshoe bends. Side gorges of the same nature open on both sides. On the hogback mountain tops between, covered with broken rocks and forest, lie patches of coal measures. The strata gently rise and fall in successive undulations, crossing the river at right angles. Old iron furnace of cut stone, at Farrandsville.

33. Good hotel; machine shops of the company; coal mined on the top of the mountain, back of the town.

34. Low grade road to the great Jefferson county coal field, up Bennett's Branch.

35. Coal mines on top of the mountain.

36. Valley of erosion in Chemung rocks straight north into New York State. From here, the road (and river) rises fast, and reaches the general level of the upland at St. Mary's.

37. The lowest coal beds are mined all about here, and south of Daguscahonda. The road descends rapidly into the winding gorge or trench of the Clarion River to Ridgeway.

38. Down the Clarion are coal mines and salt and oil borings, (no oil.)

39. Deep oil wells, (no oil.) The Bishop Summit coal mines, 10 miles to the north-east; Johnson's Run coal basin to the east.

40. Summit of the country. Lowest coal bed. Road north-east, through forest, 15 miles, to Alton coal mines; thence railroad down Tuniangwant to the Bradford oil wells.

41. Here the Garland conglomerate may be well studied in connection with the disputed subconglomerate coal beds.

42. Capital centre point for the geological student. Fossils in the hills around. (Private cabinet of Dr. Randall.) Fine cliffs of Garland conglomerate crown the hill tops. Butler-Venango oil sands crop out in the foot-hills. Oil wells sunk in the valley bottom reach Warren oil sand group at 500 to 600 feet. Railroads down the river; and across to Titusville. Good hill-roads to Pleasantville and Oil City, along the great original oil belt; many derricks standing and new ones rigging.

43. The quarries are on the peak of the hill, one mile north-west.

44. Oil refineries; very high land.

45. Descends rapidly through a ravine, in Chemung and Portage rocks, to the lake shore.

46. Five miles back towards Lancaster; famous limonite iron mines. Road runs up the east bank of the river, six miles, under cliffs, to Chicques. Chicques rock, 300 feet high, Potsdam ? Geology still obscure and very interesting.

47. One mile after passing this, enter Trias (dipping N. W.) and continue on it to Highspire.

48. Serpentine belt crossed here, and before reaching here.

Pennsylvania Railroad—*Continued.*

Ms.	Frederick Division.	
0	Columbia.[46]	2–4. Siluro-Cambrian.
5	Stoner.	"
14	York.[49]	"
19	Graybill.	"
25	Minges Mill.	"
32	Hanover.	"
39	Littlestown.	"
47	Taneytown, Md.	"
70	Frederick, "	4 a. Trenton.

	Waynesboro Branch.	
0	Downingtown.	4 a. Trenton.
6	Brooklyn.	1. Azoic.
12	Barneston.	"
18	Honeybrook.	"

	Williamsburg and Springfield Branch.	
0	Williamsburg[50]	4 a. Trenton.
6	Reese's.	10. Hamilton.
11	Frankstown.[51]	"
14	Hollidaysburg.	5 b. Clinton.

	Ebensburg and Cresson Branch.	
0	Cresson.	14 b. Coal Measures, Allegheny River Ser.
6	Kaylor's.	"
11	Ebensburg.	"

Bedford Division.
(See Huntingdon and Broad Top Railroad.)

0	Mount Dallas.[52]	5 b. Clinton.
8	Bedford.[53]	7. Lower Helderberg.
13	Napier.	5 b. Clinton.
18	Sulphur Springs	"
22	Bard's.	"
31	Bridgeport.[54]	"
36	Cook's Mills.	"
39	State Line, Md.	"
41	Mt. Savage Jn."	"
45	Cumberland, "	7. Lower Helderberg.

Pennsylvania Railroad—*Continued.*

Ms.	Bald Eagle Valley Division.	
0	Tyrone.	5 b. Clinton.
5	Bald Eagle.[55]	10. Hamilton.
10	Hannah.	"
14	Port Mathilde.	"
21	Julian.	"
26	Unionville.	"
29	Snow Shoe Jun.	"
31	Milesburg.[56]	"
34	Curtin.	"
40	Howard.	"
44	Eagleville.	"
51	Mill Hall.	"
55	Lock Haven.	"
31	Milesburg.[56]	"
33	Bellefont.[57]	4 a. Trenton.

	Tyrone and Clearfield Division.	
0	Tyrone.	5 b. Clinton.
6	Vanscoyoc.	12. Catskill.
13	Summit.[58]	14 a. Pottsville Conglo.
19	Osceola.[59]	14 b. Coal Measures.
24	Phillipsburg.	"
29	Wallaceton.	"
34	Woodland.	"
41	Clearfield.	"
47	Curwinsville.	"

	Phillipsburg and Moshannon Branch.	
0	Morrisdale.[59]	14 b. Coal Measures.
8	Osceola.	"
13	Sterling.	"
17	Ramey.	"

	Hollidaysburg and Morrison's Cove Branch.	
0	Altoona.	10. Hamilton.
4	Canaan.	"
8	Hollidaysburg.	5 b. Clinton.
11	Reservoir.	"
17	Roaring Spr's[60]	4 a. Trenton.
22	Martinsburg.	"
28	Henrietta.[61]	"

49. This road follows the York county belt of the Cadorus (S.-C.) limestones, with the south-east edge of the Trias, not far off on the right, and the north-west edge of the Azoic country on the left. Pigeon Hills (Azoic or perhaps Potsdam?) to the right before reaching Hanover. Trap dikes just west of Hanover; and at Littlestown.

50. The great Springfield furnace limonite mines are (by Mine Railroad) 5 miles to the south.

51. Old and extensive Clinton (fossil) ore mines here.

52. Extensive fossil ore mines at Bloody Run, east of Mount Dallas; and in the gap of the mountain approaching Bedford.

53. Mineral waters. Abundance of Helderberg and Oriskany fossils; interesting and varied geology; iron mines around.

54. At north end of, but outside of the Cumberland coal basin.

55. This and the following stations are at old iron furnaces, not able to use their fossil ore close by, and therefore hauling Sil.-Cambrian limonites from the Warrior Mark Valley, over the Bald Eagle Mountain.

56. Entrance gap to the Nittany Limestone Valley full of iron ore banks.

57. Trenton fossils abundant here. To the south-east, seven miles, Nittany Mountain, in the centre of the valley; fine views; curious geology; synclinal ships-keel mountain; turnpike road.

58. Summit of Allegheny Mountain and east edge of the bituminous coal fields. Here Powell's semi-bituminous coal mines.

59. Many coal mines along the Moshannon above and below this in the 1st subdivision of First Basin. Road gets into 2d subdivision, over a low anticlinal. All the mines along this road are on beds of the Allegheny River series.

60. Here enter Morrison's Cove by a gap in the nearly vertical Medina and Oneida rocks of Dunning's Ridge. Fossil ore outside (W.); Bloomfield limonite mines (very famous) inside (E.) U. S. cannon made at Pittsburg from pig metal made at the furnace in the gap. Sinking springs up the run.

Pennsylvania Railroad—*Continued.*

Ms.	Southwest Pennsylvania Branch.	
0	Uniontown.	14 b. L. Coal Measures.
4	Lamont Furn.[62]	"
9	Dunbar.[63]	"
13	Connellsville.[64]	14 b. Barren Measures.
18	Pennville.	"
25	Tarr's.	"
32	Youngwood.	"
38	Greensburg.	14 c. U. Coal Measures.

Western Pennsylvania Division.

0	Blairsville Int[65]	14 b. L. Coal Measures.
8	Livermore.	14 b. Barren Measures.
17	Saltsburg.[66]	"
24	Roaring Run.	"
32	Leechburg.[67]	14 b. L. Coal Measures.
37	Allegheny Junc.	"
38	Freeport.	"
45	Tarentum.	"
51	Springdale.	14 b. Barren Measures.
57	Montrose.	"
62	Sharpsburg.[68]	"
67	Allegh'y City[69]	"
0	Butler.[70]	14 b. L. Coal Measures.
10	Delano.	"
21	Butler Junction.	"

Lewistown Branch.

1	Lewistown.	7. Lower Helderberg.
6	Mann's.[71]	4 a. Trenton.
13	Milroy.	4 and 3 a. Calciferous.

Pennsylvania Railroad—*Continued.*

Ms.	Indiana Branch.	
0	Blairsville Int[72]	14 b. L. Coal Measures.
3	Blairsville.	14 c. U. Coal Measures.
13	Homer.	14 b. Barren Measures.
19	Indiana.[72]	"

Sunbury and Lewistown Branch.

0	Sunbury.[26]	12. Catskill.	
5	Selinsgrove.	10. Hamilton.	All iron ore So. of R.R.
17	Middleburg.	5 b. Clinton.	
25	Beavertown.	"	
50	Lewistown.	7. Lower Helderberg.	

Lewisburg Centre and Spruce Creek Branch.

0	Montandon.	5 b. Clinton.
1	Lewisburg.	"
	Vicksburg.	"
10	Mifflinburg.	"
18	Laurelton.	"

Northern Central Railway.

0	Baltimore, Md.	(See Maryland.)
47	Hanover Jun.[73]	2–4. Siluro-Cambrian.
57	York.	"
67	Conewago.[74]	16. Triassic.
73	Goldsboro.[75]	"
79	Red Bank.	"
84	Bridgeport.[76]	4 a. Trenton.
88	Harrisburg.	4 b. Utica.
91	Marysville.	5 a. Oneida.
93	Dauphin.[8]	13 b. Mh. Ck. Red shale.
99	Clark's Ferry.	12. Catskill.

61. Old limonite mines (very rich), Schoenberger's. A few miles further on are the new and curious Leathercracker Cove limonite mines of the Cambria Company.

62. Important outcrop of the iron ore beds underlying the Pittsburg coal bed.

63. Mauch Chunk red shale iron ore beds in the ravines of the mountain.

64. Centre of the coke trade. Miles of coke ovens all along the road from here towards Greensburg and towards Mount Pleasant. (See Coke Report, L. 1877, Second Geological Survey of Pa.)

65. Occupies the same position on the Kiskaminitas that Connellsville (64) does on the Youghioghany, in the centre of the narrow first gas coal basin west of Chestnut ridge. Pittsburg coal bed on the hills opposite, south side river.

66. Two miles further the Pittsburg bed occupies the central hills of the third gas coal basin. Old salt wells along the river bringing up brine from the Pocono sandstone.

67. Famous gas well 1,250 feet deep, on south side of river. Gas from first (?) oil sand (of Butler and Venango) brought across the river on bridge, to rolling mill. Gas furnaces for puddling iron here first successfully used. See Report L. Geological Survey.

68. Iron works fired by natural gas brought in a pipe, 40 miles long, from the great gas wells in northern Butler County.

69. Remark the typical Eddy Hill in the centre of plain, on which the College formerly stood.

70. To get to the first productive deep oil wells one must go several miles northeast from Butler towards St. Jo, Petrolia, &c. The road descends to the Alleghany River level over lower productive coal measures.

71. In the gap of Jack's Mountain is the spring and former residence of "Logan the Indian." Trenton rocks form cliffs. The Kishacoquillas Valley is shut in east of Milroy by two very remarkable "ships keel" (synclinal) mountains of Medina and Oneida. The hull is Oneida, the keel Medina. The valley and its three arms are all surrounded by terraces *of erosion*. Taylor thought it was a terrace of deposit and that the valley had been a lake. A turnpike drive across the valley from Logan's Gap, northwest, by the old iron mines, and over the Standing Stone mountain, to Greenwood furnace, with its fossil ore mines and fine scenery, will repay. A fault cuts the S. S. Mountain. The Clinton shales are curiously crumpled in the cuttings descending to the furnace.

72. The barren coal measures cover most of Indiana County.

73. Magnetic and limonite iron ores from one to five miles west of this and in the ridges to the north and south.

74. Cliffs of greenstone trap overhang the road and river.

75. More trap cliffs from here to Red Bank. Magnetic iron ore bed above, back from the river.

76. Fine long cuttings through the Siluro-Cambrian limestone opposite Harrisburg.

Ms.	Northern Central Railway—*Continued.*	
106	Halifax.	12. Catskill.
111	Millersburg.[77]	13 b. Mh.Ck. Red shale.
118	Mahantango.	12. Catskill.
127	Trevorton.[78]	"
133	Selinsgrove.[79]	10. Hamilt. & 7 Lew. l.s.
138	Sunbury.[26]	12. Cats'l or 11 b. Che'g.
	(Philadelphia and Erie to Williamsport.)	
178	Williamsport[29]	10. Hamilton.
187	Cogan Valley.	12. Catskill.
192	Trout Run.[80]	"
198	Bodine's.	"
202	Ralston.	14 b. Coal Measures.
203	McIntyre.[81]	"
207	Roaring Run.	12. Catskill.
212	Carpenter's.	11 b. Chemung.
218	Canton.	"
220	Minnequa Sprs.	"
222	Alba.[82]	12. Catskill.
231	Troy.	"
236	Columbia X Rds	11 b. Chemung.
241	Snediker's.	"
247	State Line.	"
256	Elmira, N. Y.	"

	Shamokin Division.	
138	Sunbury.[26]	12. Catskill.
156	Shamokin.[121]	14 b. Anthracite Coal Measures.
164	Mt Carmel.[105]	"

Erie Railway.

Jefferson Branch.

0	Susquehanna.	11 b. Chemung.
11	Starrucca.	12. Catskill.
14	Thompson's.	"
25	Herrick Centre.	"
33	Forest City.	13 a. Pocono.
38	Carbondale.	14 b. Anthracite Coal Measures.

Ms.	Erie Railway—*Continued.* Honesdale Branch.	
0	Lackawaxen.	12. Catskill.
4	Rowland's.	"
8	Millville.	"
12	Kimble's.	"
16	Hawley.	11 b. Chemung.
20	White Mills.	"
25	Honesdale.[83]	"

Delaware and Hudson Railroad.

0	Carbondale.	14 b. Anthracite Coal Measures.
7	Jermyn.	"
13	Dickson.	"
16	Scranton.	"

Delaware, Lackawanna & Western R.R.

0	New York.	(Cont'd from N. Jersey.)
84	Delaware.	4 c. Hudson River.
92	Water Gap.[84]	5 a. Oneida.
96	Stroudsburg.[85]	10. Hamilton.
100	Spragueville.	12. Catskill.
104	Henryville.	11 b. Chemung.
109	Oakland.	13 a. Pocono Sandstone.
115	Forks.	"
122	Tobyhanna.	"
128	Goldsboro.[86]	"
136	Moscow.	"
139	Dunning's.[87]	"
149	Scranton.	14 b. & c. Anthracite Coal Measures.
159	Abington.	12. Catskill.
164	Factoryville.[88]	"
174	Nicholson.	"
176	Foster.	11 b. Chemung.
183	Montrose.	"
190	New Milford.	"
196	Great Bend.	"
210	Binghamton.	(Continued in N.Y.)

77. End of the Carlisle-Duncannon long trap dike is just back of this. See Notes 9 and 170.

78. West end of the anthracite coal field. No anthracite west of this Fine study of the lowest beds in the gap of the Conglomerate mountain.

79. Easternmost limit of the fossil ore outcrops of the Lewistown belt. Good anticlinal sections of 10. Genesee, Hamilton, Marcellus and 7. Lewistown l. s. between here and Sunbury.

80. Entrance to the long gorge of the Lycoming Creek through the Alleghany Mountain platean; similarly situated to Queen's Run (32). Gorge exactly like that of the West Branch Susquehanna (32). Coal patches 1000 feet above road level, up Trout Run.

81. Old iron mines under the cliffs of Pottsville conglomerate forming the cornice of the mountain walls. Great incline plane up mountain to McIntyre coal mines.

82. The Armenia Mountain of Catskill and Pocono dominates this on the west. On its top is the east end of the Blossburg-Antrim semi-bituminous coal basin.

83. Head of the Delaware and Hudson Canal supplied with Carbonale and Scranton anthracite coal of the third great basin by railroads coming out of the basin over the Wyoming mountains.

84. Celebrated for its scenery. Large hotels. Indian staircase in the gap made by massive north dipping outcrops of Medina and Oneida. One mile before reaching these rocks are quarries of Hudson River roofing slate on both sides of the Delaware River.

85. Excellent geological headquarters. Fine exposures of Oriskany, Waterlime, &c., &c., in the ravine of Broadhead's Creek between the gap and Stroudsburg. Fossils abundant around Stroudsburg. Buttermilk and other cascades to the right of the road, (east). Noble carriage drive and exquisite scenery, for 30 miles from Stroudsburg to Milford. Lake on top of the Blue (Kittatinny) Mountain, 10 miles east of S. Fine drive southwest through Red Valley (Clinton) and over outcrops of Helderberg to the Wind Gap. Ascent of the Pocono Knob (Catskill) to the northwest.

86. Head waters of Lehigh, on the extreme highland, "shades of death," "beach woods," a plate of Pocono rocks covered here and there by synclinal outstretches of Mauch Chunk red shale.

87. Commence descent into third anthracite coal field by a ravine through the Pottsville conglomerate. Under it the iron ore of XI. has been opened.

88. Now over the Elk Mountain range and synclinal of Pocono in the first bituminous coal basin; but no coal.

Delaware, Lackawanna & Western—*Cont.*

Ms.	Bloomsburg Division.	
0	Scranton.	14 b. and c. Anth'e Coal Measures. (Over the great Lack'na & Wyoming coal basin.)
6	Lackawanna.	"
12	Wyoming.	"
20	Plymouth.	"
24	Nanticoke.[89]	"
33	Shickshinny.[90]	14 a. Pottsville Conglo.
41	Beach Haven.	11 b. Chemung.
47	Briar Creek.	10. Hamilton.
54	Espy.[91]	8. Oriskany.
58	Rupert.	11 b. Chemung.
68	Danville.[92]	5 b. Clinton.
80	Northumberla'd	11 b. Chemung.

Lehigh Valley Railroad.

0	Perth Amboy.	(See New Jersey.)
61	Easton.[93]	3 a. Calciferous.
73	Bethlehem.[94]	"
88	Allentown.	"
81	Catasauqua.[95]	4 a. Trenton.
87	Laury's.	4 c. Hudson Riv. Shales.
94	Slatington.[96]	"
103	Lehighton.[97]	11 b. Chemung.

Lehigh Valley Railroad—*Continued.*

Ms.		
107	Mauch Chunk[98]	13 b. Mauch Chunk r.s.
114	Penn Haven.	"
120	Drake's Creek.	12. Catskill.
130	Tannery.	"
132	Whitehaven.	13 b. Mauch Chunk.
142	Summit Siding.	13 a. Pocono.
146	Fair View.[99]	"
152	Newport.	13 b. Mah. Ck. r. s. (Wyoming Valley.)
		14 a. Potts. Cong. (Wyoming Valley.)
158	Sugar Notch.	14 b. An. Cl. Mers. (Wyoming Valley.)
162	Wilkesbarre.	" (Wyoming Valley.)
168	Fort Blanchard. (Pa. & N. Y. R. R.)	" (Wyoming Valley.)
170	Pittston.	" (Wyoming Valley.)
172	L. & B. Junc'n.	" (Wyoming Valley.)
183	Falls.[100]	12. Catskill.
186	McKunes.[101]	"
194	Tunkhannock.	"
199	Vosburg.	"
206	Mehoopany.	"
209	Meshoppen.	"
217	Laceyville.	"
227	Wyalusing.	11 b. Chemung.
233	Frenchtown.	"
237	Rummerfield.	"

89. River breaks out of coal field under cliffs of Pottsville conglomerate and runs in Mauch Chunk red shale.

90. River cuts across the coal field, leaving a small mound of coal measures isolated on the west bank.

91. Square across to the north, 6 miles, is seen the high end of the Schickshinny (Pocono) Mountain, reached by a good road from Bloomsburg, 7 miles, and affording one of the finest panoramic views in Pennsylvania.

92. Famous and extensive fossil ore (Clinton) iron mines, sunk deep. Iron works here and at Bloomsburg. Ore crops along both sides of mountain ridge for 15 miles. May be studied on the anticlinal arch in the gaps at both places. See also Note 134.

93. Famous collecting ground for rare minerals. Azoic ridge to the north. Remarkable outcrops, natural and artificial, of the calciferous limestones along the river north bank to Bethlehem. Many iron works. Laurentian rocks south of the river all the way up.

94. Zinc works. Saucon zinc mine in the mountains to the south, easily reached by N. P. Railroad.

95. Perhaps the best limonite open mine in America for study, lies 4 miles west, (Ironton). Best reached on wheels; also by rail, over a long, high iron bridge. Manganese, kaolin, lignite, with the ore. Mine very large and old.

96. Extensive roofing slate quarries here. Two miles further enter the Lehigh Water Gap between sloping walls of Oneida and Medina. Issue upon Clinton red shale. Notice a fine Eddy Hill opposite. Behind it is a terminal moraine, which a glacier, formerly descending the Lehigh, left across the mouth of the Aquashicola Creek, forcing that stream to excavate a new channel in the solid Medina rocks of the mountain. Two miles farther, at the bend of the river, north bank, the ice has crushed over the slates, polished the surface, and loaded it with till. From the Gap Hotel ride to the top of Stone Hill (Oriskany outcrop) for the view through the gap. Hydraulic lime quarries on the way up.

97. On the crest of one of the grandest anticlinals in the state. The gently south dipping Chemung and Hamilton here turn over and descend vertically. From here to Mauch Chunk the Devonian and Bernician systems are complete, vertical, and crossed at right angles, so as to give an easy section of 10,000 feet, up to the coal measures.

98. Fine geological headquarters. The gap in the second mountain gives the whole Pocono and Catskill. The river above gives the Mauch Chunk red shale. Mt. Pisgah the Pottsville conglomerate. Nine miles up the "passenger tourist's gravity road" lies the famous Summit Mine, mammoth coal bed, 60 feet thick, open quarry. In the gap notice the islet on which the first anthracite iron furnace once stood. Good specimens of dendrites to be got from the plates in the mountain opposite the hotel. From here to Penn Haven, the fine gorge of the Lehigh with its ox bow bend and walls of Catskill rocks.

99. Ascend 400 feet higher to the summit of Penobscot Knob, affording the finest view in the state. Notice the glacial scratches on the rock on the highest summit of the knob. From here all the collieries are visible below, and the whole structure of the third anthracite coal basin can be made out. Down Solomon's gap by three old incline planes, notice the erosion of the red shale.

100. Buttermilk Falls, not the falls of that name near Stroudsburg, but in nearly the same rocks, with the hollows filled with gravel.

101. Enter the long gorge of the north branch of the Susquehanna through the Allegheny mountain plateau, capped (further west) by the Mehoopany coal basin.

Lehigh Valley Railroad.

Ms.	(Pa. & N. Y. R. R.)—*Continued.*	
244	Wysauking.[102]	11 b. Chemung.
248	Towanda.[103]	"
255	Ulster.	"
259	Milan.	"
263	Athens.	"
265	Sayre.	"
268	Waverly, N. Y.	"

Mahanoy, Beaver Meadow & Hazleton Branch.

54	Penn Haven Ju.	13 b. Mauch Chk. r. s.
60	Weatherby.	14 b. Anth. Coal Mres.
70	Eckley.	"
70	Hazleton.[104]	"
66	Beaver Meadow.	"
70	Audenried.	"
59	Black Creek Ju.	"
66	Hartz's.	"
71	Switch Back.	"
73	Quakake Junct.	13 b. Mauch Chunk.
81	Mahanoy.	14 b. & c. Coal Mea'res.
84	Shenandoah.	"
89	Raven Run.	"
93	Centralia.	"
100	Mt. Carmel.[105]	"

Barclay Railroad.

0	Towanda.[103]	11 b. Chemung.
7	Greenwood.	12. Catskill.
16	Barclay.[106]	14 b. Coal Measures.

State Line and Sullivan Railroad.

0	Towanda.[103]	11 b. Chemung.
4	Monroeton.	"
24	Dushore.	12. Catskill.
29	Bernice.	14 b. Loyalsock Coal Measures, semi-Anthracite.

Muncy Creek Railway.

0	Hughesville.	5 b. Clinton.
6	Catawissa Junc.	

Danville, Hazleton & Wilkesbarre Railroad.

0	Sunbury.[26]	12. Catskill.
11	Danville.[134]	5 b. Clinton.
20	Catawissa.	11 b. Chemung.
54	Conyngham.	"
	Cranberry.	14 b. Anth. Coal Mres.
	Hazleton.[104]	"

Montrose Railroad.

0	Montrose.	11 b. Chemung.
8	Hunter's.	12. Catskill.
14	Springville.	"
22	Lobeck.	"
28	Tunkhannock.	"

Central Railroad of New Jersey.

75	Easton.[93]	3 a. Calciferous.
86	Bethlehem.[94]	"
95	Catasauqua.[95]	4 a. Trenton.
109	Lehigh Gap.[96]	11 b. Chemung.
120	Mauch Chnk.[98]	13 b. Mauch Chunk r. s.
127	Penn Haven Ju.	"
145	White Haven.	12. Catskill.
158	Penobscot.[99]	"
171	Ashley.	14 b. Anth'e Coal Mres.
174	Wilkesbarre.	" (Wyoming & Lackawan'a Valleys and coal field.)
183	Pittston.	"
187	Spring Brook.	"
193	Scranton.	"
195	Green Ridge.	"

Philadelphia and Reading Railroad.

0	Philadelphia.	1. Azoic.
4	Belmont.	"
8	W. Manay'k[107]	"
14	W.Consho'n[108]	"
17	Bridgeport.[109]	3 a. Calciferous.?
22	Port Kennedy.	2 b. Potsdam.
24	ValleyForge[110]	"
28	Phœnixville.[111]	16. Triassic.
32	Royer's Ford.	"
40	Pottstown.[112]	"

102. A remarkable fault in the 11 b. Chemung rocks in the Wysox Narrows. It slants up the hill-side and may be studied on the R. R. and on the common road 200 feet above. The centre line of the Towanda anticlinal crosses the river at the northern end of this cliff, 1,050 feet above the fault.

103. Fine cliffs, "The Red Rocks," just north of the fault and east from Wysauking station. Chemung fossils. Also another cliff directly opposite Towanda on east side of the river. Going north no such precipices are seen, the Chemung shales forming hills with rounded summits. Good view of Towanda village from the railroad. Boulders of white limestone from Central New York found in the river were formerly burnt for lime. Picturesque view at Ulster Narrows.

104. Mammoth and other anthracite beds mined extensively along this road.

105. In the centre of the Shamokin group of 3 anthracite sub-basins.

106. Barclay or Towanda C. Co.'s and Schroeder Mines on the top of the Towanda Mountain, 1,300 feet above the river at Towanda. Incline plane. High falls. Profound gorges splitting the mountain. Laurel swamps. Semi-bituminous coal.

107. Beautiful ravine of the Wissahiccon to the east, deeply trenching the Azoic belt. Serpentine and soapstone quarries 2 miles above Manyunk.

108. Trap, marble, near.

109. On south edge of the Trias country. Bone cavern in limestone quarry near Port Kennedy studied by Dr. Leidy and Prof. Cope.

110. Ditto. The hill back of it is the east end of the ridge of Potsdam sandstone forming the north wall of the Chester Valley far to the southwest. Under its north flank come up the Azoic.

111. In the tunnel here Mr. Wheatly found his coal plants (Trias) and reptile bones. Two miles southwest runs the edge of the Trias, with breccias, copper veins, on Azoic. Trias continues hence to near Reading. Mr. Wheatley has his collection here.

112. Trap hills to the north.

Ms.	**Philadelphia and Reading R.R.**—*Con.*	
45	Douglasville.	16. Triassic.
47	Monocacy.	"
52	Exeter.[113]	"
58	Reading.[114]	3 a. Calciferous.
66	Leesport.	4 b. Utica.?
70	Shoemakersville	4 c. Hudson River s. l.
75	Hamburg.	"
78	Pt. Clinton.[115]	5 b. Clinton.
83	Auburn.[116]	7. Lower Helderberg.
86	Landingville.	11 b. Chemung.
93	Pottsville.[117]	14 b. & c. An. Cl. Mres.

	Lebanon Valley Branch.	
0	Allentown.[118]	3 a. Calciferous.
6	Emaus.	"
10	Millerstown.	"
15	Shamrock.	"
18	Topton.	"
25	Fleetwood.	"
31	Temple.	"
36	Reading.[114]	"
45	Wernersville.	"
51	Womelsdorf.	"
58	Myerstown.	"
64	Lebanon.[119]	"
69	Annville.	"
74	Palmyra.	"
81	Hummelston[120]	"
90	Harrisburg.	4 b. Utica Slate.

	Little Schuylkill, East Mahanoy, Mine Hill and Mahanoy & Shamokin Branches.	
0	Herndon.	12. Catskill.
14	Trevorton.	14 b. & c. An. Cl. Mres.
21	Shamokin.[121]	"
25	Excelsior.	"
30	Mount Carmel.	"
43	Ashland.[122]	"
45	Girardville.	"
47	Mahanoy.[123]	"
98	Tamaqua.[124]	"
102	Ringgold.[125]	5 b. Clinton.

Ms.	**Philadelphia and Reading R. R.**—*Con.*	
	Chester Valley Branch.	
0	Bridgeport.	3 a. Calciferous.
6	Centreville.	"
10	Cedar Hollow.	"
16	Exton.	"
22	Downington.	"

	Schuylkill and Susquehanna Branch.	
0	Auburn.[116]	9. Upper Helderberg.
5	Hannon.	10. Hamilton.
12	Rock.	"
18	Pine Grove.	11 b. Chemung.
24	Ellwood.	13 b. Mauch Chu'k r.s.
30	Rausch Gap.	"
35	Yellow Spring.	"
38	Rattling Run.	"
46	Forge.	"
51	Dauphin.	"
54	Rockville.[8]	4 c. Hudson River Slate.
59	Harrisburg.	4 b. Utica Slate.

	Schuylkill Valley Branch.	
0	Pottsville.[117]	14 b. & c. An. Cl. Mres.
4	Port Carbon.	"
7	New Philadel'a.	"
13	Tuscarora.	"
18	Tamaqua.[124]	"

	Pickering Valley Branch.	
0	Phœnixville.[111]	16. Triassic.
11	Byers.	1. Azoic.

	Reading and Columbia Branch.	
0	Reading.[114]	3 a. Calciferous.
6	Sinking Springs	"
13	Reinholds.	16. Triassic.
16	Union.[126]	"
20	Ephrata.	3 a. Calciferous.
27	Litiz.	"
32	Manheim.	"
37	Landisville.[5]	"
41	Ironville.[127]	2 b. Potsdam.
46	Columbia.[46]	3 a. Calciferous.

113. Trap dikes to the south and west, across the river.

114. The "White Spot" high on the mountain to the east is supposed to be a remnant of Potsdam sandstone left lying unconformably on Laurentian.

115. A noble fault crosses the river three times in the gap; once at the canal locks, again at the rock at the west mouth of the old tunnel and then runs vertically up the steep. Hudson River slates dipping 10° south abut against the bottom plate of Oneida standing vertically. Between this and Auburn very fine exposures of Clinton red shales. No fossil ore.

116. Back of this on the south side of Summer Hill, multitudes of Hamilton and Portage fossils.

117. Centre of the soft anthracite collieries. Fine geological headquarters. For four miles before reaching this place the whole Devonian and Bernician systems stand vertical, affording a section of 20,000 feet of rock, up to the top of the lower productive coal series in the fold of the great synclinal in the lower part of the town. View from the top of Sharp Mountain, 800 feet high, instructive. Hotel at Mount Carbon close to where Lea's footprint was found.

118. Road runs along the base of the Laurentian Mountains, over calciferous, holding limonite beds.

119. Cornwall Magnetic Iron Mines 6 miles to the south; holds copper, trap and marble.

120. Iron mines, limonite, south of the town.

121. In the gap opposite the town five ribs of Pottsville conglomerate enclose the four lowest anthracite coal beds. A cross section of the coal measures up to the 12th bed can be made here.

122. Remarkable large fossil tree stems visible in the coal measures here. Glacial striæ cross white pebbles in the conglomerate crest of mountain west of the Ashland Gap, opposite Mt. Carmel.

123. Large collieries. Shaft sunk by diamond drill.

124. Little Schuylkill here makes a cross section of the Pottsville coal basin.

125. From here down to Port Clinton the Little Schuylkill cuts through ten anticlinals.

126. All along here the thinness of the Trias upon the Cambro-Silurian is revealed by erosion.

127. Famous old limonite mine.

Philadelphia and Reading R. R.—*Con.*

Lancaster and Quarryville Branch.

Ms.		
0	Lancaster Jun.	3 a. Calciferous.
8	Lancaster.	"
14	West Willow.	"
20	New Providence	1. Azoic.
23	Quarryville.	"

Lebanon and Tremont Branch.

0	Brookside.	14 b. Anth. Coal Mres.
13	Tremont.[128]	14 b. Coal Measures.
20	Pine Grove.	11 b. Chemung.
24	Irving.	10. Hamilton.
29	Murray.[129]	"
37	Jonestown.	4 c. Hudson River.
44	Lebanon.[119]	3 a. Calciferous.

Mine Hill and Schuylkill Haven Branch.

0	Schuylkill Hav.	11 b. Chemung.
9	Minersville.[130]	14 b. and c. Coal Mres.
14	Glen Dower.	"

Catawissa and Williamsport Branch.

0	Philadelphia.	(See main line.)
78	Port Clinton[115]	5 b. Clinton.
98	Tamaqua.[124]	14 b. and c. Coal Mres.
107	Tamanend.	13 b. Mk. Ck. r.s. & s.s.
114	Girard.	"
118	Brand'nville[131]	13 b. Mauch Chunk red [shale.
124	Ringtown.	"
132	Beaver Valley.	"
136	McAuley.[132]	"
139	Mainville.[133]	"
146	Catawissa.	11 b. Chemung.
154	Danville.[134]	5 b. Clinton.
162	Mooresburg.	10. Hamilton.
167	Pottsgrove.	"
170	Milton.[27]	5 b. Clinton.
175	White Deer.	"
182	Montgomery.	11 a. Portage.
187	Muney.[28]	5 b. Clinton.
190	Hall's.	7. Lower Helderberg.
195	Montoursville.	10. Hamilton.
199	Williamsport.[29]	11 a. Portage.

Philadelphia and Reading Railroad—*Con.*

Mill Creek and Mount Carbon Branch.

Ms.		
0	Pottsville.[117]	14 b. Anth. Coal Mres.
4	Dormer's.	"
7	New Castle.	"
12	Frackville.	"

Colebrookdale Branch.

0	Pottstown.[112]	16. Triassic.
6	Colebrookdale.	1. Azoic.
13	Mt. Pleasant.	"

Philadelphia and Chester Branch.

0	Eddystone.	1. Azoic.
4	Thurlow.	"

Germantown and Norristown Branch.

7	Germantown.	1. Azoic.
16	Norristown.	16. Triassic.

Chestnut Hill Branch.

0	Philadelphia.	1. Azoic.
11	Chestnut Hill.	"

South Mountain Branch.

0	Carlisle Junct'n.	4 a. Trenton.
8	Upper Mill.[135]	1. Azoic.
15	Laurel.	3 a. Calciferous.
18	Pine Grove.[136]	"

Berks and Lehigh Branch.

0	Reading.[114]	3 a. Calciferous.
43	Slatington.[137]	4 c. Hudson River s. l.

Perkiomen Branch.

0	Perkiomen.	16. Triassic.
6	Collegeville.	"
11	Schwenksville.	"
14	Salford.	"
18	Green Lane.	"
22	Hanover.	"
43	Allentown.[118]	3 a. Calciferous.

128. View from the mountain to the southwest of it down the fish tail double red shale valley, split by the great mass of the Pocono rocks, is fine and instructive.

129. Passing out of the gap Hole Mountain stands on the left (east) a curious synclinal outlier of Oneida capping a ridge of Hudson River, proving that no nonconformobility exists.

130. A line of great collieries on the mammoth vein extend westward. The gap of the west branch Schuylkill above Minersville, shows a superb arch of the conglomerate.

131. Making down grade from the conglomerate along the southern and western sides of the red shale valley of the Catawissa Creek crossed by numerous anticlinals from between the Beaver Meadow, Hazleton and Black Creek basins, to the east, and crenulating the (Pocono) Catawissa Mountain to the west.

132. A curious little oval mountain basin of anthracite lower coal beds (McCauley) stands out on the red shale plain to the right. Notice the rift in its southern side and its fortress like outline.

133. Fine gap through the Nescopic Mountain and section of white Pocono rocks with terraces of Red Catskill on its northern flank.

134. Fossil ore mines and Medina arch in the gap through Montour's Ridge. Fine cliffs of Portage and Chemung along the river. Also see Note 92.

135. Passes into the Papertown gap of the South Mountains and turns to the right (S. W.), up the Mountain Creek Valley, with its range of old and extensive limonite mines, open quarries; ore heavily charged with manganese. Ride to the left (E.) over the divide, on which is Strickler's mine, and down to the big bank. Very instructive. Over Strickler's, the mountain top is saddled with a 30 foot plate of Potsdam (?)

136. Extensive, well arranged limonite mine, planned by J. W. Harden.

137. Principal roofing slate quarries of the State. (See Note 96.)

Ms.	North Pennsylvania Railroad.	
0	Philadelphia.	1. Azoic.
10	Abington.	"
14	Ft. Washington.	16. Triassic.
18	Gwynedd.[138]	"
22	Lansdale.	"
25	Hatfield.	"
31	Sellersville.	"
38	Quakertown.	"
44	Coopersburg[139]	"
51	Hellertown.	3 a. Calciferous.
54	Bethlehem.[94]	"

New York & Philadelphia R.R. (New Line.)
Delaware and Boundbrook.

0	Philadelphia.	1. Azoic.
8	Jenkintown.	"
15	Somerton.	"
21	Langhorne.	16. Triassic.
29	Yardley.	"
88	Jersey City.	(See New Jersey.)

Wilmington and Northern Railroad.

0	Reading.[114]	3 a. Calciferous.
9	Birdsboro.	16. Triassic.
21	Springfield.[140]	1. Azoic.
27	Waynesburg Ju	"
36	Brandywine.	"
39	Coatesville.	4 a. Trenton.
45	Laurel Iron Wks	1. Azoic.
57	Chadd's Ford.	"
72	Wilmington, Del	(See Del. and Md.)

West Chester and Philadelphia Railroad.

0	West Philadel'a	1. Azoic.
7	Clifton.	"
14	Media.	"
18	Lenni.	"
27	West Chester.	"

Philadelphia and Baltimore Central R.R.

0	Philadelphia.	1. Azoic.
14	Lamokin Junc.	"
20	Rockdale.	"
25	Concord.	"
33	Fairville.	"
40	Avondale.	"
46	Penn.[141]	"
52	Oxford.	"
112	Baltimore.	(See Maryland.)

Ms.	Peachbottom Railroad.	
0	Oxford.	1. Azoic.
20	Dorsey[142]	"

Corning, Cowanesque and Antrim Railroad.

0	Corning.	11 b. Chemung.
15	Lawrenceville.	"
23	Tioga.	"
39	Wellsboro.	"
51	Antrim.	14 b. Semi-Bitumin's Coal Measures.
15	Lawrenceville.	11 b. Chemung.
27	Elkland.	"

Tioga Railroad.

0	Corning.	(See C. C. & A. R. R.)
15	Lawrenceville.	"
23	Tioga.	11 b. Chemung.
31	Mansfield.	" Iron ore.
36	Covington.	"
41	Blossburg.	14 b. Semi-Bitumin's Coal Measures.

F. B. C. Co. R. R.

48	Fall Brook.	"
41	Blossburg.	"
45	Morris Run.	"
41	Blossburg.	"
45	Arnot.	"

Buffalo, New York & Philadelphia Railroad.

0	Buffalo.	(See New York.)
78	State Line.	11 b. Chemung.
88	Larrabees.	"
96	Port Allegany.	"
107	Keating.	"
114	Shippen.	"
121	Emporium.[36]	"

Buffalo and McKean Railroad.

0	Larrabees.	11 b. Chemung.
9	Smethport.	"
15	Colegrove.	12. Catskill.
22	Clermont.[143]	14 b. Coal Measures.

Buffalo, Bradford & Pittsburg Railroad.

0	Carrolton, N.Y.	(See Erie Railway.)
11	Bradford.[144]	11 b. Chemung.
19	Big Shanty.	"
26	Gilesville.	14 b. Coal Measures.

138. Plants in the Trias as at Phœnixville. Trap.
139. Saucon zinc mines.
140. Warwick iron mine 3 miles to the east, on the edge of Trias; with trap; copper, &c. Jones' mine 1½ miles to the north at the east extremity of the Canestoga belt of the Lancaster Co. limestone. French Creek copper mines further east than Warwick.
141. Line of serpentine to the left. Road runs along the belt from Kennet Square for several miles.
142. Roofing slate quarries at Peach Bottom on the Susquehanna River.
143. Coal mines on the highest land at the only practicable north and south pass over the great water shed between the Pennsylvania and New York waters.
144. Latest discoveries and geologically the lowest of the Pennsylvania oil horizons; hundreds of new oil wells, all productive. Oil 1775 feet below the Oil-City-Olean conglomerate.

Dunkirk, Allegheny Valley & Pittsburg R.R.

Ms.		
0	Dunkirk.	(See New York.)
47	Russellsburg.	11 b. Chemung.
55	Warren.[142]	"
61	Irvineton.	"
67	Pittsfield.	"
71	Garland.[143]	"
79	Newton.	"
90	Titusville.[145]	"

Pittsburg, Titusville and Buffalo Railroad.

0	Irvineton.	11 b. Chemung.
9	Thompson.	"
15	Tidioute.[146]	"
23	Hickory.	"
30	Tionesta.	"
41	Oleopolis.	"
50	Oil City.	"
54	Rouseville.	"
57	Petroleum Cen.	"
68	Titusville.[145]	"
79	Centreville.	"
86	Spartansburg.	"
95	Corry.[144]	"

Oil City and Ridgeway Railroad.

	Oil City.	11 b. Chemung.
	Sidney's.	14 b. Coal Measures.

Atlantic and Great Western Railroad.

0	Salamanca.	(See New York.)
61	Corry.[144]	11 b. Chemung.
72	Union City.	"
79	Mill Village.	"
88	Cambridge.	"
92	Venango.	"
96	Seagertown.	"
102	Meadville.	"
110	Geneva.	"
116	Evansburg.	"
121	Atlantic.	"
129	Greenville.	"
131	Shenango.	"
135	Transfer.	"
	(Continued	in Ohio.)

Franklin Branch.

0	Meadville.	11 b. Chemung.
6	Shaw's.	"
11	Cochranton.	"
19	Utica.	"
28	Franklin.[147]	"
36	Oil City.	"

Erie and Pittsburg Railroad.

Ms.		
0	Erie.[148]	11 a. Portage.
11	Fairview.	"
15	Girard.	"
20	Crosses.	11 b. Chemung.
26	Albion.	"
35	Conneautville.	"
39	Summit.	"
43	Linesville.	"
47	Espyville.	"
56	Jamestown.	"
63	Greenville.	"
71	Clarksville.	"
77	Sharon.[149]	14 b. Coal Measures.
83	Middlesex.	"
87	Pulaski.	"
94	Harbor Bridge.	"
98	New Castle.[150]	"

Lake Shore and Michigan Southern R.R.

436	Girard.	11 a. Portage.
441	Fairview.	"
451	Erie.	"
459	Harbor Creek.	"
466	North East.	"
	(Continued	in Ohio.)

Franklin Division.

36	Jamestown.	11 b. Chemung.
45	Salem.	14 b. Coal Measures.
52	Clark.	"
57	Stoneboro.	"
65	Raymilton.	"
71	Summit.	"
78	Franklin.[147]	11 b. Chemung.
86	Oil City.	"

Shenango and Allegheny Railroad.

0	Greenville.	11 b. Chemung.
6	North Hamburg	14 b. Coal Measures.
12	Cool Spring.	"
17	Mercer.	"
33	Harrisville.	"
35	Centreville.	"
43	Armandale.	"
47	Hilliard.	"

Allegheny Valley Railroad.

0	Pittsburg.[25]	14 b. & c. Bar. Cl. Mres.
4	Sharpsburg.	"
10	Verona.	"
17	Parnassus.	"
21	Tarentum.	14 b. Lower Coal Mres.
29	West Pa. Junct.	"
35	Kelly's.	"

145. Here is the deepest of all oil wells, but unproductive.
146. The valley of the Alleghany River is full of derricks from here to Oil City; and the valley of Oil Creek up to Titusville.
147. Lubricating oil from the first oil sand.
148. Numerous gas wells used for lighting the city, heating, rolling iron, &c.
149. Commencement of the importance of the Sharon bed as a "block coal" raw fuel for iron furnaces. It becomes the great bed of Ohio.
150. Old iron making centre. Banks of the river faced with terraces of ferriferous limestone supporting large deposits of limonite ("buhr stone") iron ore, of the lower productive coal series.

Ms.	Allegheny Valley Railroad—*Continued.*	
44	Kittanning.[151]	14 b. Lower Coal Mres.
48	Cowanesha'ock.	"
55	Mahoning.	14 a. Pottsville Conglo.
64	Red Bank.[152]	"
68	Brady'sB'nd[153]	"
71	Catfish.	14 b. Lower Coal Mres.
82	Parker's.[154]	14 a. Pottsville Conglo.
89	Emlenton.	"
106	Scrubgrass.	"
115	Foster.	11 b. Chemung.
123	Franklin.[147]	"
132	Oil City.	"
149	Titusville.[145]	"
188	Corry.[44]	"

Low Grade Division.

0	Red Bank.[152]	14 b. Coal Measures.
15	Leathwood.	"
20	NewBethlehem.	"
40	Brookville.	"
55	Reynoldsville.	"
70	West Summit.	"
77	Pennfield.	"
87	Tyler's.	"
98	Grant.	12. Catskill.
110	Driftwood.	"

Union and Titusville Branch.

0	Titusville.[145]	11 b. Chemung.
8	Tryonville.	"
16	Lincolnville.	"
25	Union City.	"

Plum Creek Branch.

0	Pittsburg.[25]	14 b. & c. Bar. Cl. Mres.
12	Ink Works.	14 b. Lower Coal Mres.
17	Coal Works.	"

Sligo Branch.

0	Sligo Junction.	14 b. Lower Coal Mres.
10	Sligo.[155]	"

New Castle and Franklin Railroad.

0	New Castle.[150]	14 b. Lower Coal Mres.
9	Wilmington.	"
16	Leesburg.	"
22	Mercer.	"
30	Garvin's.	"
36	Stoneboro.	"
57	Franklin.[147]	"

Pittsburg, Fort Wayne and Chicago Railway.

Ms.		
0	Pittsburg.[25]	14 b. & c. Bar. Cl. Mres.
13	Sewickly.	"
21	Baden.	"
26	Rochester.	14 b. Lower Coal Mres.
29	New Brighton.	"
35	Homewood.[156]	"
46	Enon.	"
	(Continued	in Ohio.)

Pittsburg, Youngstown & Ashtabula R. R.

0	Pittsburg.[25]	14 b. & c. Bar. Cl. Mres.
47	Lawrence Junc.	14 b. Lower Coal Mres.
57	Lowell.	"
	(Continued	in Ohio.)

Cleveland and Pittsburg Railroad.

0	Pittsburg.[25]	14 b. & c. Bar. Cl. Mres.
26	Rochester.	14 b. Lower Coal Mres.
34	Industry.	"
40	Smith's F'ry[157]	"
	(Continued	in Ohio.)

Pittsburg, Cincinnati & St. Louis Railroad.

0	Pittsburg.[25]	14 b. & c. Bar. Cl. Mres.
8	Mansfield.	14 c. Upper Coal Mres.
15	Noblestown.	"
23	Bulger.[158]	"
32	Hanlin's.	"
	(Continued	in Ohio.)

Chartiers Railroad.

0	Pittsburg.[25]	14 c. Upper Coal Mres.
8	Mansfield.	"
22	Canonsburg.	14 c. Up. Barren Mres.
31	Washington.	"

Pittsburg, Virginia & Charleston Railroad.

0	Pittsburg.[25]	14 b. & c. Bar. Cl. Mres.
15	McKeysport[159]	14 c. Upper Coal Mres.
32	Mo'gahela City.	"
55	Brownsville.	"

151. The two Kittanning coal beds in the river hills low down; the two Freeport coal beds high up. These constitute the chief beds of the Lower Coal Measures.

152. Between the mouth of the Mahoning and the mouth of the Redbank, crosses the last of the great anticlinals, bringing up the conglomerate 100 feet above water level. It sinks 500 feet in 40 miles before reaching and crossing the Ohio River 4 miles below Pittsburgh.

153. Great iron works and iron and coal mines. Wells strike oil here 1,100 feet beneath the river bed in the third oil sand of the Venango-Butler oil group.

154. High cliffs of conglomerate back of the town. A forest of oil well derricks on both river banks and on top of the cliffs. Here the Butler Co. oil belt crosses the river into Clarion County. Oil wells numerous at intervals all the way up to Franklin and Oil City.

155. Deep old oil wells. Very old iron furnace, centre of a former group of 50 charcoal blast furnaces.

156. Immense sand stone cliffs (at the base of the coal measnres) wall in the valley of the Beaver. Homewood Furnace. Ferriferous limestone and ore all around.

157. Numerous old oil wells producing a little from the conglomerate and sandrocks below.

158. Prof. Stevenson's "Bulger anticlinal" crosses here. The Pittsburg coal bed is dwindling through this high upcountry to a small bed in Ohio.

Baltimore and Ohio Railroad.

Ms.	Pittsburg Division.	
0	Pittsburg.[25]	14 b. & c. Bar. Cl. Mres.
11	Port Perry.[159]	"
15	McKeysport.	"
22	Coultersville.	14 c. Upper Coal Mres.
33	West Newton.	"
40	Jacob's Creek.	14 b. & c. Bar. Cl. Mres.
49	Oakdale.	"
57	Connellsville[160]	"
65	Indian Creek[161]	12. Catskill.
74	Ohio Pyle.[162]	14 b. Coal Measures.
84	Confluence.[163]	"
92	Pinkerton.[164]	"
101	Mineral Pt.[165]	"
109	Yoder's.	"
116	Sand Patch.[166]	14 a. Pottsville Conglo.
126	Glencoe.	12. Catskill.
135	Bridgeport.[54]	10. Hamilton.
141	Cook's Mills.	"
146	Mt. Savage Jun.	"
150	Cumberland, Md	7. Lower Helderberg.

Huntingdon and Broad Top Railroad.

0	Huntingdon.[15]	10. Hamilton.
7	Grafton.	"
15	Coffee Run.	11 b. Chemung.
24	Saxton.[167]	12. Catskill.
31	Hopewell.[168]	13 b. Mch. Chunk r. s.
43	Bloody Run.[169]	5 b. Clinton.
53	Bedford.[53]	7. Lower Helderberg.

Wheeling, Pittsburg and Baltimore R. R.

0	Wheeling, W. Va	14 c. Coal Measures.
16	W. Alexander.	"
25	Taylorstown.	"
32	Washington.	14 c. Up. Barren Mres.

Cumberland Valley Railroad.

0	Harrisburg.	14 b. Utica Slate.
8	Mechanicsburg.	9. Corniferous.
19	Carlisle.[170]	4 a. Trenton.
30	Newville.	"
41	Shippensb'g[171]	"
52	Chambers'g.[172]	"
63	Greencastle.	"
74	Hagerstown, Md	"
94	Martinsburg.	(See Maryland.)

Hanover Junction, Hanover and Gettysburg Railroad.

0	Gettysburg.[173]	16. Triassic.
4	Granite.	" Trap dike.
5	Gulden's.	"
10	Oxford.	"
13	Valley.[49]	9. Corniferous.
17	Hanover.	" Trap dike.
20	Smith's.	1. Azoic.
22	Porter's.	"
26	Jefferson.	"
27	Cold Spring.	2–4 Siluro-Cambrian.
28	Strickhauser's.	"
30	Hanover Jun.[73]	"

159. Mines in the Pittsburg coal bed line the river on both sides in a continuous series; the bed descending slowly from 360 feet above water level at Pittsburg to within 30 or 40 feet in the neighborhood of Monongahela City. The bed rises again and goes into the air ascending the Youghiogheny River; the banks becoming hillslopes of the barren measures.

160. Pittsburg bed 12 feet thick in this narrow basin.

161. Fine gorge of the Youghiogheny through Chestnut Ridge, walls 1,300 feet high. Pulpit rocks of Piedmont sandstone (top member of Pottsville conglomerate) left standing like stranded ships on the broad summit of the mountain. Dry oil wells and old salt wells in the floor of the gorge on the river bank. Cow rock on the southern brow of the gorge covered with the sculptures of the aborigines.

162. Fine Cascade. The whole river falls over a horizontal plate of coal measure sandstone. Wild scenery all around. Coal bed 4 feet thick under the falls.

163. The Turkey Foot. Junction of the three great branches of the Youghiogheny. Very remarkable oval hill of coal measures terraced by coal bed outcrops all around, as if artificially, several hundred feet high. Flat top, a field from which Indian skeletons have been ploughed up ever since the first settlement of the the country, called Fort Hill.

164. Fine mountain nose full of coal beds and terraced by sandstone of the barren measures.

165. The fine isolated Pittsburg coal bed basin of the Salisbury Ridge, to the south, capped with fossiliferous limestones of the upper coal measures. Romantic falls on Elk Lick Creek not far up from its mouth.

166. Summit of the Alleghany Mountain.

167. Turn in here to the Broad Top Coal Mines up Shoup's Run. Hotel at Broad Top City, as high as the top of the Alleghany Mountain. Fine scenery. Curious geology.

168. Juniata flows in the red shale under cliffs of conglomerate on one side and a Pocono sandstone (terrace) mountain on the other. Iron works. Fine section up Yellow Creek into Morrison's Cove. Great crop of Hamilton limonite.

169. Long outcrop of Clinton fossil ore. Beautiful turnpike carriage drive, south, along the river, and over Wray's Hill, with wonderful sections of contorted Catskill all the way.

170. Trap dyke, 3 miles before reaching Carlisle; visible a long way off as a low mound across the great valley covered with trees, while all around is cultivation. West of Carlisle notice "Wagner's Gap" and "Doubling Gap" in the North or Blue Mountain. They are really not gaps but folds, caused by anticlinals passing through the mountain and elevating the vertical 5 a. Medina strata. The mode in which this was done may be understood by holding up the edge of a sheet of paper in a perpendicular manner and then elevating it in one spot from beneath, which will cause the upper edge to fold in an S shape, similar to these so-called gaps.

171. Five miles due east is a great spring rising at the south end of the limestone, and foot of the mountain; the head of Yellow Breeches Creek.

172. Back set of the mountains to the east and cross fault along the turnpike to Gettysburg. A mile or so south of the turnpike immense old limonite ore banks (Pond Bank, &c.) in which kaolin and lignite deposits occur like those of Brandon in Vermont. Five miles further south in the foot of the mountain are the Mont Alto ore banks. Back of Mont Alto in the mountains are magnetic ore beds, porphry rocks, copper ores.

Ms.	East Broad Top Railroad.[174]	
0	Mt. Union.[175]	5 a. Medina. 8. Oriskany. 10 a. Marcellus. 10 b. Hamilton.
4	Aughwich.	" Oriskany Ridge on east. Hamilton on w.
7	Shirley.	10 a. Marcellus.
11	Rockhill.[176]	"
14	Beersville.	11 a. Portage. 11 b. Chemung. 10 a. Marcellus.
18	Three Springs.	8. Oriskany, cut. 7 L. Helderberg l. s. 5 b. Clinton anticlin.
20	Saltillo.	6. Salina & waterlime. 7. L. Helderberg l. s. 8. Oriskany. 10 a. Marcellus. 11 b. Chemung, gap. 12. Catskill. 13 a. Pocono tunnel. 13 b. Mauch Ck. r. s. 14 a. Pott. con. on top.

Ms.	East Broad Top Railroad—*Continued.*	
25	Coles.	13 b. Mh. Ck. r. s. E. " tunnel. 14 a. & 14 b. on west.
28	Cook's.	13 b. Mauch Ck. r. s. 14 a. Conglomerate.
31	Robertsdale[177]	14 b. Lower Coal Series.

Philadelphia, Wilmington and Baltimore Railroad.

0	Philadelphia.	1. Azoic.
2	Gray's Ferry[178]	"
13	Chester.[179]	"
14	Lamokin.	"
16	Thurlow.	"
18	Linwood.	"
20	Claymont.	"
22	Holly Oak.	"
23	Belleview.	"
26	Edge Moor.	"
28	Wilmington.	"

(Continued in Maryland.)

173. "Round Top," "Cemetery Hill," "Macfarlane's Hill" and "Culp's Hill," forming the ridge on which the Union Army fought the great battle of Gettysburg, July 2d and 3d, 1863, are all trap dikes. This is a good place to study these curious formations. The scenery is beautiful and full of historical interest. (See the description of the 16. Triassic formation.)

174. By Charles A. Ashburner, assistant on the second geological survey of Pennsylvania.

175. Jack's Mountain on the west, 5 a. Medina, with 5 b. Clinton fossil ore on its flanks. Blue Ridge, 5 a. Medina, in the distance on the east. End of Chestnut Ridge, southeast from station, composed of Lewistown on 9 Upper Helderberg limestone and 8 Oriskany sandstone.

176. On the east Blacklog Mountain, 5 a. Medina. Shade Mountain also Medina. Blacklog Valley. Between them is anticlinal 3 c. Chazy and 4 a. Trenton limestone.

177. Coal openings on both sides of the railroad. The two upper seams worked, the lower seam not worked.

178. The Huronian (?) is here decomposed into Kaolin.

179. The road runs on the edge of the Azoic, masked by drift all the way to Wilmington.

ELEVATIONS.—The elevation above tide water of every railway station in Pennsylvania can be found in Report N. of the Second Geological Survey of this State, by Charles Allen, Assistant Geologist, 1877.

Ohio.*

GEOLOGICAL FORMATIONS FOUND IN OHIO.

	Groups.	Ohio Sub-Divisions.	Equivalents in other States.
Quat'ry.	20. Quaternary.	20 d. Alluvium, Peat. 20 c. Lacustrine Deposits. 20 b. Forest Bed. 20 a. Erie Clay.	Alluvium, Peat, General Loess, Missouri, Illinois, etc. Erie Clay, Boulder Clay, Canada, etc.
Carboniferous.	14. Coal Measures.	14 c. Upper Barren Measures. 14 c. Upper Coal Group. 14 b. Lower Barren Measures. 14 b. Lower Coal Group.	Upper Barren Measures, Pa. Upper Coal Group, Pa. Lower Barren Measures, Pa. Lower Coal Group, Pa.
	Conglomerate.	14 a. Conglomerate.	Scral Conglomerate, Pa.
	Carboniferous Limestone.	14 a. Maxville Limestone.	Chester Limestone, Illinois.
	13. Waverly.	13 d. Cuyahoga Shale. 13 c. Berea Grit. 13 b. Bedford Shale. 13 a. Cleveland Shale.	Vespertine, Pennsylvania. Kinderhook Group, Ill. Marshall Group, Michigan. Knobstones, Kentucky.
Devonian.	11. Erie.	11. Erie Shale.	11 b. Chemung, NewYork. 11 a. Upper Portage, N. Y.
	10. Huron.	10 c. Huron Shale.	10 c. Gardeau and Genesee Shales, New York. 10 c. U. Cadent Blk. Shale VIII. of Pa. & Va. [etc. 10 c. Bk. Sh. Ky., Tenn., Ia.,
	10. Hamilton.	10. Hamilton Limestone.	10. Hamilton Group, N. Y.
	9. Corniferous.	9 b. Sandusky Limestone. 9 a. Columbus Limestone.	9. Corniferous and Onondaga Limestone, N.Y.
	8. Oriskany.	8. Oriskany Sandstone ?	8. Oriskany Sandstone, N.Y.
Upper Silurian.	7. Helderberg.	7. Waterlime.	7. Waterlime, New York.
	6. Salina.	6. Salina Shales and Gypsum.	6. Salina Group, New York.
	5. Niagara.	5 h. Hillsboro Sandstone. 5 g. Cedarville Limestone. 5 f. Springfield Limestone. 5 e. West Union Limestone. 5 d. Niagara Shale. 5 c. Dayton Stone. 5 b. Clinton Limestone. 5 a. Medina Shale.	5. Niagara Group, NewYork, etc. 5 b. Clinton Group, N. Y. 5 a. Medina Group, N. Y.
L. Silurian.	4. Cincinnati.	Lebanon Beds. Cincinnati Beds. Point Pleasant Beds.	4 a. Hudson and 4 c. Trenton Groups, New York.
	2 & 3. Primordial. [In borings.]	3 a. Yellow Magnesian l. s. 3 a. Yellow Massive s. s.	3 a. Calci's sandrock ? N. Y. 2 b. Pot'm sandstone? N. Y

*Prepared by Prof. J. S. Newberry, Chief Geologist of Ohio.

Ohio.*

Ashtabula, Youngstown and Pittsburg Railroad.

Ms.		
0	L.S.& M.S.R.R.	
1	Ashtabula.	11. Erie Shale.
8	Austinburg.	"
12	Eagleville.	"
16	Rock Creek.	"
24	Orwell.	"& 13. Waverly.
29	Bloomfield.	13. Waverly.
34	Bristolville.	"
40	Champion.	"
45	Warren.	"
50	Niles.	"
55	Girard.	13. Waverly, 14 a. Cong., 14 b. Cl. Mres.
60	Youngstown.	"
65	Struther's.	14 b. Coal Measures.
68	Lowell.	"

Atlantic and Great Western Railroad.

0	Cincinnati.	
59	Dayton.	4. Cincinnati Group.
70	Osborne.	"
76	Enon.	"
80	Springfield.	5. Niagara.
89	Bowlusville.	"
95	Urbana.	5. Niag. & 7. Helderbg.
105	Mingo.	7. Helderberg.
114	Pottersburg.	"
121	Broadway.	"
129	Richwood.	"
138	Green Camp.	"
144	Marion.	9. Corniferous.
153	Caledonia.	"
164	Galion.	13. Waverly.
172	Ontario.	"
179	Mansfield.	"
187	Windsor.	"
196	Ashland.	"
207	Polk.	"
213	West Salem.	"
216	Burbank.	"
221	Pike.	"
225	Russel.	"
232	Wadsworth.	14 b. Coal Measures.
240	New Portage.	14 a. Conglomerate.
246	Akron.	"
250	Tallmadge.	14 b. Coal Measures.
256	Kent.	14 a. Conglomerate.
263	Ravenna.	14 b. Coal Measures.
269	Freedom.	"
279	Braceville.	13. Waverly.
283	Leavittsburg.	"
286	Warren.	"
294	Cortland.	"
307	Orangeville.	14 b. Coal Measures.

Atlantic & Great Western R. R.—*Continued.*

Mahoning Division.

Ms.		
0	Sharon.	
7	Hubbard.	14 b. Coal Measures.
15	Youngstown.	13. Wav'y & 14 a. Cong.
23	Niles.	"
31	Leavittsburg.	"
40	Mahoning.	14 b. Cl. Mres. "
51	Mantua.	"
57	Aurora.	14 a. Conglomerate.
65	Solon.	"
75	Newburg.	13. Waverly.
80	Cleveland.	11. Erie Shale.

Niles and New Lisbon Branch.

0	Niles.	13. Wav'y & 14 a. Cong.
6	Austintown.	14 b. Coal Measures.
12	Canfield.	"
18	Green.	"
23	Leetonia.	"
25	Franklin.	"
33	New Lisbon.	"

Liberty and Vienna Branch.

0	Vienna.	14 b. Coal Measures.
8	Vienna Junction	"

Baltimore, Pittsb'g & Chicago, (B. & O. R.R.)

0	Chicago Junc'n.	
8	Attica.	9. Corni's & 10. Huron.
16	Republic.	9. Corniferous.
24	Tiffin.	5. Niag. & 7. Held'berg.
30	Bascom.	5. Niagara.
37	Fostoria.	"
44	Bloomdale.	5. Niag. & 7. Held'berg.
50	New Baltimore.	
62	Deshler.	7. Helderberg.
74	Holgate.	
88	Defiance.	10 c. Huron Shale.
94	Delaware.	"

Central Ohio Railroad.—(B. & O. R. R.)

0	Baltimore, Md.	
376	Bellaire.	14 b. Coal Measures.
385	Glencoe.	"
395	Belmont.	"
403	Barnesville.	"
413	Salesville.	"
428	Cambridge.	"
437	Concord.	"
447	Sonora.	"
454	Zanesville.	"
468	Pleasant Valley	"
470	Black Hand.	13. Waverly.
480	Newark.	"
486	Union.	"
495	Pataskala.	"
504	Taylor's.	10. Huron & 13. Wav'y.
513	Columbus.	9 Cor., 10 Ham. & 13 W.

*The railroads of this State are arranged in alphabetical order.

Cincinnati, Hamilton and Dayton R. R.

Ms.		
0	Cincinnati.	4. Cincinnati Group.
5	Cumminsville.	"
15	Glendale.	"
19	Jones.	"
25	Hamilton.	"
37	Middletown.	"
49	Miamisburg.	"
60	Dayton.	"

Cincinnati, Hamilton & Indianapolis R. R.

0	Cincinnati.	
25	Hamilton.	4. Cincinnati Group.
32	McGonigle.	"
39	Oxford.	"
44	College Corners.	"

Cincinnati & Muskingum Valley Railroad.

0	Cincinnati.	4. Cincinnati Group.
36	Morrow.	"
46	Clarksville.	"
56	Wilmington.	4 Cin., 5 a Clin. & 5 a Ni.
66	Sabina.	5. Niagara.
77	Washington.	7. Helderberg.
87	New Holland.	10 c. Huron Shale.
95	Williamsport.	"
104	Circleville.	"
116	Amanda.	13. Waverly.
125	Lancaster.	"
130	Bremen.	"
134	New Lexington.	14 b. Coal Measures.
152	Roseville.	"
157	Zanesville.	"
168	Ellis.	"
176	Dresden Junct.	"

Cincinnati, Richmond & Chicago Railroad.

0	Cincinnati.	4. Cincinnati Group.
25	Hamilton.	"
36	Collinsville.	"
44	Camden.	"
53	Eaton.	5 a. Clinton & 5 c. Niag.
60	Florence.	"
70	Richmond, Ind.	See Indiana.

Cleveland, Columbus, Cincinnati and Indianapolis Railroad.
Columbus Division.

0	Cleveland.	11. Erie Shale.
13	Berea.	13. Waverly.
25	Grafton.	"
36	Wellington.	"
47	New London.	"
55	Greenwich.	"
67	Shelby.	"
70	Vernon.	"
76	Crestline.	"
80	Galion.	"
93	Gilead.	10. Huron & 13. Wav.
97	Cardington.	10 c. Huron Shale.
104	Ashley.	"
114	Delaware.	9 Cor., 10 Ham. & 10 Hu
122	Lewis Center.	10. Huron.
129	Worthington.	"
138	Columbus.	9 Cor., 10 Ham & 10 Hu

Cleveland, Columbus, Cincinnati and Indianapolis Railroad—*Continued.*

Indianapolis Division.

Ms.		
80	Galion.	13. Waverly.
92	Caledonia.	9. Corniferous.
101	Marion.	"
111	N. Bloomington.	7. Helderberg.
122	Mt. Victory.	"
132	Rushsylvania.	"
141	Bellefontaine.	7 Hel., 9 Cor. & 10 c Hu.
150	De Graff.	5. Niagara.
157	Pemberton.	"
164	Sidney.	"
182	Versailles.	"
190	Ansonia.	"
197	Union.	"

Cincinnati Division.

0	Delaware.	9 Cor., 10 Ham. & 10 c Hu
9	Ostrander.	9. Corniferous.
17	Marysville.	7. Helderberg.
22	Milford.	"
32	Mechanicsburg.	5. Niag. & 7. Heldberg.
43	Moorfield.	5. Niagara.
50	Springfield.	"
63	Osborn.	4. Cincinnati Group.
74	Dayton.	"
81	Carrollton.	"
90	Franklin.	"
99	Henderson.	"
108	Maud's.	"
120	Carthage.	"
130	Cincinnati.	"

Cleveland, Mt. Vernon & Columbus R.R.

0	Hudson.	13 a. Conglomerate.
7	Cuyahoga Falls.	"
14	Akron.	"
27	Clinton.	14 b. Coal Measures.
38	Orrville.	13. Waverly.
52	Fredericksburg.	13 Wa., 14 a Con. Cl. M.
61	Millersburg.	"
81	Gann.	"
90	Howard.	13. Waverly.
100	Mt. Vernon.	"
109	Mt. Liberty.	"
124	Sunbury.	13. Wav. & 10. Huron.
133	Westerville.	10. Huron.
145	Columbus.	9 Cor., 10 Ham. & 10 Hu

Cleveland and Pittsburg Railroad.

0	Cleveland.	11. Erie Shale.
8	Newburg.	13. Waverly.
14	Bedford.	"
26	Hudson.	14 a. Conglomerate.
38	Ravenna.	14 b. Coal Measures.
52	Limaville.	"
57	Alliance.	"
63	Homeworth.	"
69	Bayard.	"
81	Millport.	"
87	Salineville.	"
94	Irondale.	"
102	Wellsville.	"

[illegible] Pittsburg Railroad—*Continued.*
River Division.

	[illegible] Ferry.	14 b. Coal Measures.
13	Portland.	"
20	La Grange.	"
26	Steubenville.	"
35	Sloan's.	"
46	Wellsville.	"

Tuscarawas Branch.

0	Bayard.	14 b. Coal Measures.
8	Malvern.	"
12	Waynesburg.	"
23	Zoar.	"
32	New Philadel'a.	"

Cleveland, Tuscarawas Valley & Wheeling Railroad.

0	Uhrichsville.	14 b. Coal Measures.
12	Dover.	"
23	Barr's Mills.	"
35	Massillon.	"
48	Warwick.	"
59	Russel.	13. Waverly.
72	Medina.	"
85	Grafton.	"
16	Black River.	10. Huron.

Columbus, Chicago & Indiana Central R. R.

0	Columbus.	9 Cor., 10 Ham. & 10 Hu
18	Pleasant Valley.	7. Helderberg.
28	Milford Center.	"
38	Cable.	"
47	Urbana.	7. Helderb. & 5. Niaga.
58	St. Paris.	5. Niagara.
73	Piqua.	4 Cin., 5 a Clin. & 5 c Nia
83	Bradford Junct.	5. Niagara.
95	Greenville.	"
108	New Madison.	"
114	New Paris.	"
0	Bradford Junct.	"
10	Pikeville.	"
21	Union.	"

Continued in Indiana.

Columbus and Hocking Valley Railroad.

0	Columbus.	9 Cor., 10 Ham. & 10 Hu
12	Groveport.	10. Huron.
23	Carroll.	13. Waverly.
32	Lancaster.	"
42	Millville.	"
50	Logan.	"
60	Lick Run.	13. Wav. & 14 b. Cl. Ms.
62	Nelsonville.	"
70	Salina.	14 b. Coal Measures.
76	Athens.	"

Columbus, Springfield & Cincinnati R. R.

0	Springfield.	5. Niagara.
11	Plattsburg.	" & 7. Helderberg.
20	London.	7. Helderberg.
32	Georgesville.	9. Corniferous.
45	Columbus.	9 Cor., 10 Ham. & 10 Hu

Ms.	**Columbus and Xenia Railroad.**	
0	Columbus.	9 Cor., 10 Ham. & 10 Hu
9	Alton.	9. Corniferous.
25	London.	"
41	Selma.	5. Niagara.
55	Xenia.	4 Cin., 5 a Clin. & 5 Nia.

Dayton and Michigan Railroad.

0	Cincinnati.	
60	Dayton.	4. Cincinnati Group.
74	Tippecanoe.	"
87	Troy.	"
88	Piqua.	4 Cin., 5 a Clin. & 5 Niag
100	Sidney.	5. Niagara.
119	Wapakoneta.	7. Helderberg.
131	Lima.	"
144	ColumbusGrove	"
151	Ottawa.	"
165	Deshler.	"
176	Weston.	8. Oriskany & 9. Corn.
182	Tontogany.	7. Helderberg.
193	Perrysburg.	"
202	Toledo.	"

Dayton and Union Railroad.

0	Dayton.	4. Cincinnati Group.
12	Brookville.	4 Cin., 5 a Clin. & 5 Niag
21	Baltimore.	5. Niagara.
28	Arcanum.	"
35	Greenville.	"
47	Union.	"

Lake Erie and Louisville Railroad.

0	Fremont.	7. Helderberg.
10	Burgoon.	5. Niagara.
21	Fostoria.	"
27	Arcadia.	"
37	Findlay.	" & 7. Helderberg.
45	Rawson.	7. Helderberg.
52	Bluffton.	"
58	Beaver Dam.	"
68	Lima.	"

Lake Shore & Michigan Southern Railroad.
Main Line.

0	Buffalo, N. Y.	See N. Y.
116	Conneaut.	11. Erie Shale.
129	Ashtabula.	"
138	Geneva.	"
144	Madison.	"
155	Painesville.	"
174	Nottingham.	"
183	Cleveland.	"
196	Berea.	13. Waverly.
209	Elyria.	"
217	Oberlin.	"
227	Wakeman.	"
239	Norwalk.	"
243	Monroeville.	10. Huron.
251	Bellevue.	" & 9. Corniferous.
258	Clyde.	7. Helderberg.
267	Fremont.	"
279	Elmore.	5. Niagara.
296	Toledo.	7. Helderberg.

Lake Shore & Michigan Southern Railroad.

Ms.	Main Line—*Continued.*	
338	Wauseon.	10. Huron.
353	Stryker.	"
360	Bryan.	"
370	Edgerton.	"
0	Elyria.	13. Waverly.
10	Brownhelm.	"
14	Vermillion.	10 c. Huron.
21	Ceylon.	"
34	Sandusky.	9. Corniferous.
46	Port Clinton.	7. Helderberg.
58	Oak Harbor.	5. Niagara.
65	Graytown.	7. Helderberg.

Franklin Division.

0	Ashtabula.	11. Erie Shale.
11	Jefferson.	"
24	Andover.	13. Waverly.
30	Simon.	"
36	Jamestown.	See Pa.

Little Miami Railroad.

0	Cincinnati.	4. Cincinnati Group.
9	Plainville.	"
17	Miamiville.	"
23	Loveland.	"
36	Morrow.	"
45	Freeport.	"
56	Claysville.	"
65	Xenia.	4 Cinn., 5 Clin. & 5 Niag.

Mansfield, Coldwater & Lake Michigan R.R.

0	Toledo.	7. Helderberg.
6	Walbridge.	"
18	Woodville.	5. Niagara.
26	Helena.	"
31	Burgoon.	"
42	Tiffin.	" & 7. Helderberg.
52	Bloomville.	9. Corniferous.
62	New Washing'n	10 c. Huron & 10. Haml.
75	Vernon.	13. Waverly.
86	Mansfield.	"

Marietta and Cincinnati Railroad.

0	Cincinnati.	4. Cincinnati Group.
5	Cumminsville.	"
20	Remington.	"
31	Cozaddale.	"
41	Blanchester.	"
50	Martinsville.	5. Niagara.
62	Lexington.	"
74	Greenfield.	7. Helderberg.
85	Frankfort.	10. Huron.
98	Chillicothe.	" and 13. Waverly.
105	Schooley's.	13. Waverly.
117	Raysville.	14 a Cong. & 14 b Cl. Ms.
127	Hamden.	14 b. Coal Measures.
139	Zaleski.	"
152	Marshfield.	"
159	Athens.	"

Ms.	Marietta & Cincinnati R. R.—*Cont.*	
169	New England.	14 b. Coal Measures.
178	Cutler.	"
195	Moore's Junct.	"
199	Marietta.	"
41	Blanchester.	4. Cincinnati Group.
52	Lynchburg.	"
62	Hillsboro.	5. Niagara.
127	Hamden.	14 b. Coal Measures.
139	Jackson.	14 a Con. & 14 b Cl. Ms.
146	Vaughn's.	14 b. Coal Measures.
155	Washington.	"
165	Webster.	"
177	Sciotoville.	13. Waverly.
183	Portsmouth.	" and 10. Huron.
159	Athens.	14 b. Coal Measures.
170	Guysville.	"
182	Coolville.	"
187	Little Hocking.	"

Marietta, Pittsburg & Cleveland Railroad.

0	Marietta.	14 b. Coal Measures.
7	Caywood.	"
18	Warner.	"
27	Dexter.	"
36	Caldwell.	"
45	Glenwood.	"
59	Cambridge.	"
70	Kimbolton.	"
80	New Comerst'n.	"
90	Phillipsburg.	"
100	Dover.	"

Ohio and Mississippi Railroad.

0	Cincinnati.	1. Cincinnati Group.
9	Delhi.	"
13	North Bend.	"

Painesville and Youngstown Railroad.

0	Youngstown.	13. Wav. & 14 b. Cl. Ms.
9	Niles.	13. Wav. & 14 a. Congl.
15	Warren.	13. Waverly.
25	Southington.	"
31	Bundysburg.	14 a. Conglomerate.
38	Burton.	"
48	Chardon.	"
59	Painesville.	11. Erie Shale.

Pittsburg, Cincinnati & St. Louis Railroad.

0	Columbus.	9 Cor., 10 Ham. & 10 c Hu
10	Black Lick.	13. Waverly.
17	Pataskala.	"
33	Newark.	"
41	Hanover.	14 b. Coal Measures.
49	Frazeyburg.	"
55	Dresden Junct.	"
62	Conesville.	"
69	Coshocton.	"
75	West Lafayette.	"
83	N. Comerstown.	"
89	Port Washing'n	"

Pittsburg, Cincinnati and St. Louis Railroad—*Continued.*

Ms.		
0	Pittsburg.	See Pa.
97	Trenton.	14 b. Coal Measures.
100	Uhrichsville.	"
110	Bowerstown.	"
121	Fairview.	"
130	Unionport.	"
138	Smithfield.	"
150	Steubenville.	"

Pittsburg, Fort Wayne & Chicago Railroad.

0	Chicago.	See Indiana.
168	Dixon.	7. Helderberg.
173	Convoy.	"
181	Van Wert.	"
193	Delphos.	"
201	Elida.	"
208	Lima.	"
216	Lafayette.	"
222	Ada.	"
232	Dunkirk.	"
239	Forest.	5. Niagara.
251	UpperSandusky	7. Helderberg.
259	Nevada.	9. Corniferous.
267	Bucyrus.	9 Cor., 10 Ha. & 10 c Hu
280	Crestline.	13. Waverly.
293	Mansfield.	"
307	Perrysville.	" [Cl. Ms.
318	Lakeville.	13 Wa., 14 c Con. & 14 b
333	Wooster.	13. Waverly. [Cl. Ms.
344	Orrville.	13 Wa., 14 c Con. & 14 b
359	Massillon.	14 b. Coal Measures.
367	Canton.	"
379	Strasburg.	"
385	Alliance.	"
392	Damascus.	"
405	Leetonia.	"
414	Nor. Waterford.	Cont'd in Pa.

Sandusky, Mansfield and Newark Railroad—(B. & O. R. R.)

Ms.		
0	Sandusky.	9. Corniferous.
8	Prout's.	10. Hamilton.
15	Monroeville.	10 c. Huron.
23	Havana.	13. Waverly.
28	Chicago Junct.	"
35	Plymouth.	"
42	Shelby Junct'n.	"
49	Spring Mill.	"
54	Mansfield.	"
63	Lexington.	"
74	Independence.	"
84	Frederick.	"
91	Mt. Vernon.	"
103	Utica.	13. Wav. & 14 b. Cl. Ms.
116	Newark.	13. Waverly.

Straitsville, Somerset and Newark Railroad

0	Newark.	13. Waverly.
9	Avondale.	14 b. Coal Measures.
17	Glenford.	"
27	Wellans.	"
38	Bristol.	"
43	Shawnee.	"

Wabash, (Late Toledo, Wabash & Western.)

0	Toledo.	7. Helderberg.
9	South Toledo.	"
17	White House.	9. Corniferous.
29	Liberty.	10 c. Huron.
35	Napoleon.	10. Hamil. & 10 c. Hu.
52	Defiance.	"
61	Emerald.	10. Hamilton.
71	Antwerp.	9. Corniferous.
94	Ft. Wayne.	See Indiana.

Michigan.[1]

LIST OF THE GEOLOGICAL FORMATIONS OF MICHIGAN.

PROBABLE EQUIVALENTS OF DANA.	LOCAL DESIGNATIONS.
20. Quaternary.[2]	20. Quaternary, Lacustrine Drift.[2]
14 c. Upper Coal Measures.	14 c. Coal Measures.
14 a. Millstone Grit.	14 a. Parma Sandstone.
13 b. Upper Sub-Carboniferous.	13 b. Carboniferous Limestone.
"	13 b. Michigan Salt Group.
13 a. Lower Sub-Carboniferous.	13 a. Marshall Group.
11 b. Chemung.	11. Huron Group, Chemung Shale.
11 a. Portage.	11. Huron Group, Portage Shale.
10 c. Genesee.	11. Huron Group, Black Shale.
10 b. Hamilton.	10 b. Little Traverse Group.
9 c. Corniferous and 9 b. Schoharie.	9. Corniferous Group.
7. Lower Helderberg.	7. Lower Helderberg.
6. Salina.	6. Salina Group.
5 c. Niagara.	5. Niagara Group,
5 b. Clinton.	"
4 c. Cincinnati.	4 c. Cincinnati.
4 a. Trenton.	4 a. Trenton Group.
3. Canadian.	3 c. and 3 a. Chazy and Calciferous.
2 b. Potsdam.	2 b. Lake Superior Sandstone.
(Products of Eruption.)	2-4. Lower Siluro-Conglomerate.
1 b. Huronian.	1 b. Huronian.
1 a. Laurentian.	1 a. Laurentian.

Michigan Central Railroad.

Ms.		
0	Detroit.	10 b. Little Traverse, beneath Lacustrine.
3	Gd. Trunk Jun.	11. Huron, ben. Lacust.
10	Dearborn.	"
17	Wayne.	"
30	Ypsilanti.	13 a. Marshall ? L. Ridge
38	Ann Arbor.	" Deep Drift.
43	Delhi.	13 b. Mich. Salt, "
47	Dexter.	" "
55	Chelsea.	13 b. Carb. Limestone ?
62	Francisco.	"
66	Grass Lake.	"
69	Leoni.	"
76	Jackson.	14 c. Coal Meas. Mines.

Air Line Division.

76	Jackson.	14 c. Coal Meas. Mines.
83	Snyder's.	13 b. Carb. Limestone.
90	Concord.	"
99	Homer.	13 a. Marshall.
103	Clarendon.	"
109	Tekonsha.	"
117	Union City.	11. Hur. Kid'y Iron Ore.

Michigan Central Railroad.

Air Line Division—*Continued.*

Ms.			
124	Sherwood.	11. Hur. Kid'y Iron Ore.	
129	Colon.	"	
136	Wasepi.	"	
140	Centreville.	"	
145	Three Rivers.	"	
152	Corey's.	"	
160	Vandalia.	10 b. L. Traverse ?	Deep Drift.
165	Cassopolis.	"	
170	Dailey.	9. Corniferous.	
174	Barron Lake.	"	
179	Niles.	"	

Kalamazoo Division.

76	Jackson.	
81	Trumbull's.	14 c. Coal Measures.
87	Parma.	14 a. Parma s.s. outcrop
92	Bath's Mills.	13 b. Carb. Limestone.
96	Albion.	"
101	Marengo.	13 a. Marshall.
108	Marshall.	" Outcrops.
113	Ceresco.	"
115	White's.	"

1. This chapter was prepared for this work by Prof. Alexander Winchell, L L. D., of the Syracuse University, former Director of the Geological Survey of Michigan.

2. The rocky formations of the Lower Peninsula are deeply and generally covered by drift. In all the western half of the State, south of Little Traverse Bay, no good characteristic exposures exist, save in Kent county and near Holland in Ottawa county. Hence in most cases our knowledge of the underlying rocks is only a matter of inference. A. W.

Michigan Central Railroad.

Kalamazoo Division—*Continued.*

Ms.			
121	Battle Creek.	13 a. Marshall, outcrops.	Deep Drift.
126	Bedford.	"	
130	Augusta.	"	
135	Galesburg.	" ?	
140	Comstock.	11. Huron.	
144	Kalamazoo.	"	
149	Ostemo.	"	
156	Mattawan.	"	
160	Lawton.	"	
162	White Oaks.	"	
168	Decatur.	"	
172	Glenwood.	10 b. L. Traverse ?	
179	Dowagiac.	9. Corniferous ?	
185	Pokagon.	"	
191	Niles.	"	
197	Buchanan.	"	
202	Dayton.	"	
205	Galien.	"	
209	Avery's.	"	
211	Three Oaks.	"	
218	New Buffalo.	" Sand Dunes.	

(Continued in Indiana.)

Grand Rapids Division.

0	Jackson.	14 c. Coal Measures.
10	Rives Junction.	"
17	Onondaga.	"
24	Eaton Rapids.	"
35	Charlotte.	"
40	Chester.	"
46	Vermontville.	"
50	Nashville.	14 a. Parma Sandstone ?
55	Sheridan.	13 b. Carb. Limestone.
62	Hastings.	"
73	Middleville.	"
79	Caledonia.	"
85	Hammond.	"
94	Grand Rapids.	" Extensive exposures.

South Haven Division.

0	Kalamazoo.	11. Huron.	Concealed by Drift.
8	Alamo.	"	
14	Kendell's.	"	
17	Pine Grove.	"	
18	Gables.	"	
22	Bloomingdale.	"	
24	Bear Lake.	"	
27	Columbia.	"	
29	Grand Junction	"	
31	Geneva.	"	
39	South Haven.	"	

South Bend Division.

0	Niles.	9. Corniferous.
5	Bertrand.	"
9	Notre Dame.	"
11	South Bend.	"

Michigan Central Railroad—*Continued.*

Saginaw Division.

Ms.			
0	Jackson.	14 c. Coal Mres. Mines.	
11	Rives Junction.	"	
15	Leslie.	"	
25	Mason.	"	
37	Lansing.	"	
53	Laingsburg.	"	
65	Owosso.	"	
87	St. Charles.	" Lacustrine.	
101	Saginaw City.	" "	
103	East Saginaw.	" "	
105	Carrollton.	" "	
116	Wenona.	" "	
121	Bay City.[3]	" "	

Mackinaw Division.

0	Bay City.[4]	14 c. Coal Mres., Lacus.
6	Kawkawlin.	"
29	Standish.	"
41	Wells.	"
54	West Branch.	13 b. Michigan Salt.
67	St. Helenas.	" ?
78	Roscommon.	" ?
93	Grayling.	13 b. Carb. Limestone.
102	Forrest.	13 a. Marshall.
113	Otsego Lake.	"
121	Gaylord.	" ?

Bay City Division.

0	Detroit.	10 b. L. Traverse.	Qua'ry Deposits overlying.
10	Norris.	11. Huron, Lacust.	
14	Warren.	"	
17	Oakwood.	"	
24	Utica.	"	
29	Yates.	"	
31	Rochester.	13 a. Marshall.	
35	Goodison's.	"	
41	Orion.	"	
44	Oxford.	13 b. Mich. Salt.	
52	Metamora.	"	
60	Lapeer.	"	
61	Junction.	"	
64	Millville.	13 b. Carb. Limestone.	
65	Carpenter's.	"	
70	Columbiaville.	"	
74	Otter Lake.	13 b. Michigan Salt.	
80	Millington.	14 a. Parma Sandstone.	
87	Vassar.	14 c. Coal Measures.	
95	Reese.	"	
110	Bay City.[4]	"	

Lake Shore & Michigan Southern R. R.

Michigan Division.

0	Cleveland.	
113	Toledo.	9. Corniferous.
123	Sylvania.	"
130	Ottawa Lake.	"
133	Riga.	"
135	Blissfield.	10 b. Little Traverse.

3. Lacustrine deposits of Saginaw Valley 100 feet deep.
4. The shallow salt wells here are supplied from the base of the Coal Measures.

Lake Shore & Michigan Southern R. R.

Ms. | Michigan Division—*Continued.*

139	Palmyra.	11. Huron.
141	Lenawee Junct.	"
145	Adrian.	"
155	Clayton.	"
162	Hudson.	13 a. Marshall.
168	Pittsford.	"
172	Osseo.	"
178	Hillsdale.	" Ext. Quarries.
182	Jonesville.	" "
187	Allen's.	" "
194	Quincy.	11. Huron.
200	Coldwater.	"worked for Brick.
215	Bronson.	"
218	Burr Oak.	"
224	Sturgis.	"
229	Douglas.	"
236	White Pigeon.	"

Detroit Division.

0	Toledo.	9. Corniferous.
7	West Toledo.	"
10	Alexis.	"
15	Vienna.	"
20	La Salle.	"
25	Monroe Junct'n	" & L. Helder'g.

25	Monroe Junct. [5]	9. Corniferous.	Generally beneath Lacustrine deposits.
32	Newport.	"	
38	Rockwood.	"	
44	Trenton.	" exposu.	
48	Wyandotte.	10 b. L. Traver.	
51	Ecorces.	"	
57	Gd. Trunk Jun.	11. Huron.	
62	Det. & Mil. Jun	"	
65	Detroit.	10 b. L. Traver.	

0	Monroe Junct'n	9. Corniferous.
10	Ida.	6. Salina, exposures.
17	Petersburg.	9. Corniferous.
20	Deerfield.	"
26	Wellsville.	10 b. Little Traverse.
29	Lenawee Junct.	11. Huron.
33	Adrian.	"

Jackson Division.

0	Adrian.	11. Huron.
4	Lenawee Junct.	"
8	Chase's.	"
13	Tecumseh.	"
18	Clinton.	13 a. Marshall.
25	Manchester.	"
32	Norvell.	"
36	Napoleon.	" Exposures extensively quarried.
40	Eldred.	13 b. Carb. Limestone?
46	Jackson.	14 c. Coal Measures.

Lake Shore & Mich. Southern R. R.—*Con.*

Ms. | Kalamazoo Division.

0	White Pigeon.	11. Huron.	Generally concealed by drift.
4	Constantine.	"	
12	Three Rivers.	"	
17	Moore Park.	"	
20	Flowerfield.	"	
24	Schoolcraft.	"	
30	Portage.	"	
37	Kalamazoo.	"	
43	Cooper.	13 a. Marshall.	
46	Argenta.	"	
49	Plainwell.	"	
52	Otsego.	"	
62	Allegan.	"	
70	Hopkins.	"	
73	Hilliards.	"	
77	Dorr.	13 b. Michigan Salt?	
83	Byron Center.	"	
89	Grandville.	"	
93	Eagle Mills.	13 b. Carb. Limestone.	
95	Grand Rapids.	" Exposures.	

Lansing Division.

0	Jonesville.	13 a. Marshall, exposu.
7	Litchfield.	"
14	Homer.	"
22	Albion.	13 b. Carb. Limestone.
29	Devereux.	14 a. Parma Sandstone.
33	Springport.	"
38	Charlesworth.	14 c. Coal Measures.
42	Eaton Rapids.	"
52	Diamondale.	"
59	South Lansing.	"
60	Lansing.	"

Grand Rapids and Indiana Railroad.

0	Cincinnati, O.	(See Indiana.)
143	Lima.	11. Huron.
147	Sturgis.	"
157	Nottawa.	"
159	Wasepi.	"
163	Mendon.	"
168	Portage Lake.	"
173	Vicksburg.	"
178	Austin.	"
185	Kalamazoo.	"
194	Travis.	13 a. Marshall.
197	Plainwell.	"
202	Monteith.	"
203	Martin.	"
207	Shelby.	"
210	Bradley.	" ?
213	Wayland.	13 b. Michigan Salt.
221	Ross.	"
227	Fisher.	13 b. Carb. Limestone.
234	Grand Rapids.	"
237	D. & M. Cross'g	"
244	Belmont.	"

5. Extensive quarries, exposing in places the waterlime of Lower Helderberg.

Ms.	Grand Rapids & Indiana R. R.—*Con.*	
248	Rockford.	13 b. Carb. Limestone.
251	Edgerton.	14 c. Parma Sandstone.
255	Cedar Springs.	14 c. Coal Measures.
257	Lockwood.	"
260	Sand Lake.	"
262	Pierson.	"
266	Maple Hill.	"
268	Howard City.	"
274	Morley.	"
281	Stanwood.	"
290	Low. Big Rapids	"
291	Up. Big Rapids	"
295	Paris.	" ?
302	Reed City.	?
309	Ashton.	?
314	Le Roy.	?
319	Tustin.	13 b. Michigan Salt?
331	Clam Lake.	"
334	Linden.	13 b. Carb. Limestone.
343	Manton.	"
352	Walton.	13 a. Marshall.
352	Walton.	13 a. Marshall.
356	Fife Lake.	"
362	Sou. Boardman.	"
371	Kalkaska.	"
375	Leetsville.	"
380	Havana.	"
384	Mancelona.	"
390	Cascade.	11. Huron.
394	Simons.	"
399	Elmira.	"
408	Boyne Falls.	10 b. Little Traverse?
415	Melrose.	"
424	Petoskey.	" ext. cliffs.
	Traverse City Railroad.	
352	Walton.	13 a. Marshall.
361	Kingsley.	"
364	Mayfield.	11. Huron.
378	Traverse City.	" Lacustrine.

Detroit and Milwaukee Railroad.

0	Detroit.	10 b. Little Traverse.
3	L. S. & M. S. Jun	11. Huron.
4	Gd. Trunk Jun.	"
13	Royal Oak.	"
18	Birmingham.	13 a. Marshall.
26	Pontiac.	"
31	Drayton Plains.	13 b. Michigan Salt.
33	Waterford.	13 b. Carb. Limestone.
35	Clarkston.	"
41	Davisburg.	"
47	Holly.	14 a. Parma Sandstone.
50	Fenton.	14 c. Coal Measures.
55	Linden.	"
63	Gaines.	"
70	Vernon.	"
75	Corunna.	" Mines.
78	Owosso.	"
88	Ovid.	"
92	Shepardsville.	"

Ms.	Detroit & Milwaukee R. R.—*Continued.*	
98	St. Johns.	14 c. Coal Measures.
107	Fowler.	"
112	Pewamo.	"
117	Muir.	"
124	Ionia.	" Quarries in upper sandstone.
132	Saranac.	14 c. Coal Measures.
139	Lowell.	14 a. Parma Sandstone.
148	Ada.	13 b. Carb. Limestone.
158	Grand Rapids.	"ext. quarries.
167	Berlin.	13 b. Michigan Salt.
173	Coopersville.	13 a. Marshall.
180	Nunica.	"
186	Spring Lake.	"
187	Ferrysburg.	11. Huron.
189	Grand Haven.	" Remarkable Sand Dunes.

Flint and Pere Marquette Railroad.

0	Toledo.	9. Corniferous.
25	Monroe.	" & 7. Low. Heldb.
34	Grafton.	9. Corniferous.
36	Carlton.	"
39	Waltz.	10 b. Little Traverse.
40	Belden.	11. Huron.
43	New Boston.	"
51	Wayne.	"
58	Plymouth.	"
	D., L. and L. M. Crossing.	
62	Northville.	13 a. Marshall.
66	Novi.	"
70	Wixom.	13 b. Michigan Salt.
76	Milford.	"
80	Highland.	13 b. Carb. Limestone.
83	Clyde.	"
91	Holly.	14 a. Parma Sandstone.
100	Grand Blanc.	14 c. Coal Measures.
108	Flint.	"
115	Mount Morris.	"
119	Pine Run.	"
123	County Line.	"
125	Birch Run.	"
134	Bridgeport.	"
138	S. & M. C. Jun.	"
142	E. Saginaw.[6]	"
142	E. Saginaw.	14 c. Coal Mres., buried 100 ft. ben. Lacus. dep.
	J., L. and S. Crossing.	
152	Freeland.	14 c. Cl. Mres.
162	Midland.	"
167	Averill.	"
169	Sanford.	"
175	North Bradley.	"
181	Coleman.	"
186	Loomis.	"
191	Clare.	"
196	Farwell.	"
200	Remick.	"
203	Lake.	"

Rocks totally concealed beneath heavy beds of Quaternary deposits.

6. Salt wells 850 feet deep to Marshall sandstone; supplied from overlying Michigan salt group.

Flint & Marquette R. R.—*Continued.*

Ms.			
209	Chippewa.	14 c. Coal Mres.	No rock exposures. Drift 200 to 300 feet.
213	Sears.	"	
217	Evart.	"	
226	Hersey.	"	
230	Reed City.	?	
237	Chase.	?	
239	Summitville.	?	
241	Nirvana.	?	
248	Baldwin.	13 b. Carb. l. s.	
264	Weldon Creek.	"	
272	Amber.	"	
278	Ludington.	"	

Flint River Division.

0	Flint.	14 c. Coal Measures.
4	Junction.	"
8	Genesee.	"
14	Otisville.	14 a. Parma Sandstone.
19	Otter Lake.	13 b. Michigan Salt.
142	East Saginaw.[6]	14 c. Coal Measures.
153	Portsmouth.	"
155	Bay City.	"

Detroit, Lansing & Lake Michigan R. R.

0	Detroit.	10 b. Little Traverse.
3	Gd. Trunk Jun.	11. Huron.
13	Redford.	"
15	Fisher's.	"
16	Elmwood.	"
19	Livonia.	13 a. Marshall.
23	Plymouth.	"
29	Salem.	"
34	South Lyon.	13 b. Carb. Limestone.
43	Brighton.	14 a. Parma Sandstone.
46	Genoa.	14 c. Coal Measures.
52	Howell.	"
57	Fleming.	"
60	Fowlerville.	"
65	Le Roy.	"
71	Williamston.	" Outcrops.
76	Meridan.	"
79	Okemos.	"
85	Lansing.	"
86	North Lansing.	"
92	Delta.	"
94	Ingersoll's.	"
97	Grand Ledge.	" Outcrops.
102	Eagle.	"
106	Danby.	"
109	Portland.	"
114	Collins.	"
118	Lyons.	"
122	Ionia.	" Quarries in upper sandstone.
0	Ionia.	14 c. Coal Measures.
5	Stanton Junc'n.	" Cond
9	Wood's Corners	"
14	Fenwick.	"
19	Sheridan.	"
24	Stanton.	"

Detroit, Lansing and Lake Michigan Railroad—*Continued.*

Ms.			
122	Ionia.	14 c. Coal Mres.	Beneath drift, from 100 to 200 feet deep.
130	Palmer's.	"	
133	Chadwick.	"	
135	Kiddville.	"	
141	Greenville.	"	
146	Gowen.	"	
151	Trufant's.	"	
153	Maple Valley.	"	
156	Coral.	"	
160	Howard.	"	

Chicago and Michigan Lake Shore R. R.

	Chicago.	
0	New Buffalo.	9. Cornif., Sand Dunes.
7	Chickaming.	"
10	Troy.	"
15	Bridgeman.	"
16	Morris.	"
20	Stevensville.	"
28	St. Joseph.	"
30	Benton Harbor.	"
39	Coloma.	" ?
42	Watervliet.	10 b. Little Traverse?
47	Hartford.	11. Huron.
54	Bangor.	"
58	Breedsville.	"
62	Grand Junction.	"
75	Rennsville.	"
79	Richmond.	" [fossils.
90	Holland.	13 a. Marshall, outcrops
90	Holland.	13 a. Marshall.
95	Zeeland.	"
104	Hudsonville.	"
110	Grandville.	13 a. Michigan Salt.
115	Grand Rapids.	13 b. Carb. Limestone.
90	Holland.	13 a. Marshall.
99	Olive.	"
109	Robinson.	"
110	Nunica.	"
116	Fruitport.	"
126	Muskegon.	"
126	Muskegon.	13 a. Marshall.
130	B. R. Junction.	"
136	Twin Lake.	"
142	Holton.	"
150	Fremont Centre	"
160	Allyton.	13 b. Carb. Limestone.
161	Morgan.	"
170	Traverse Road.	"
181	Big Rapids.	14 c. Coal Measures.
126	Muskegon.	13 a. Marshall.
142	Whitehall.	"
143	Montague.	13 b. Michigan Salt.
157	Shelby.	13 b. Carbon. l. s., extensive detached tables.
163	Mears.	13 b. Carb. Limestone.
170	Pentwater.	"

Grand Rapids, Newaygo and Lake Shore Railroad.

Ms.		
0	Grand Rapids.	13 b. Carb. Limestone.
7	Alpine.	"
14	Sparta.	"
19	Tyrone.	"
21	Casinovia.	"
25	County Line.	"
27	Ashland.	"
30	Grant.	"
36	Newaygo.	"
39	Croton.	"
46	Morgan.	"
67	Big Rapids.	14 c. Coal Measures.

Detroit, Hillsdale and S. W. Railroad.

0	Ypsilanti.	13 a. Marshall.
11	Saline.	"
17	Bridgewater.	"
28	Manchester.	"
36	Brooklyn.	"
41	Woodstock.	"
44	Somerset.	"
49	Jerome.	"
53	North Adams.	"
61	Hillsdale.	" Outcrops foss.
65	Banker's.	"
	Reading.	11. Huron.
	Camden.	"

Chicago and Canada Southern Railroad.

0	Fayette.	11. Huron.
7	Morenci.	"
13	Weston.	"
17	Fairfield.	10 b. Little Traverse.
20	Ogden.	"
25	Blissfield.	"
32	Deerfield.	"
36	Petersburg.	"
40	Dundee.	9. Corniferous.
42	Nor. Rainsville.	" ext. quarries.
47	Maybee.	"
50	Exeter.	"
55	Carlton.	"
57	Bryar Hill.	"
61	Flat Rock.	"
67	Slocum Junct'n.	"

Toledo, Canada Southern and Detroit R. R.

0	Detroit.	10 b. Little Traverse.
2	M. C. Junction.	11. Huron.
9	Ecorces.	10 b. Little Traverse.
12	Wyandotte.	"
16	Trenton.	9. Corniferous.
17	Slocum Junct'n.	"
15	Stony Creek.	" & 7. L. Heldb. ext. expos. & quarries.
20	Monroe.	9. Corn. & 7 L. Heldb.
25	La Salle.	9. Corniferous. } Deep La. deposits.
30	Vienna.	"
34	Alexis.	"
40	Toledo.	"

Grand Trunk Railroad.

Ms.			
196	Port Huron.	11. Huron.	Deep Quaternary deposits. Many surface signs of Petroleum.
207	Smith's Creek.	"	
217	Ridgeway.	"	
223	New Haven.	"	
237	Mount Clemens.	"	
250	Milwaukee Jun.	"	
255	Detroit Junct'n.	"	
		10 b. L. Trav.	
258	Detroit.	Drift over 100 feet deep.	

Chicago and Lake Huron Railroad.
Eastern Division.

0	Port Huron.	11. Huron.
4	Gd. Trunk Jun.	"
10	Thornton.	"
19	Emmet.	"
27	Capac.	13 a. Marshall.
34	Imlay City.	"
39	Attica.	"
46	Lapeer.	13 b. Michigan Salt.
53	Elba.	13 b. Carb. Limestone.
57	Davison.	14 a. Parma Sandstone.
66	Flint.	14 c. Coal Measures.

Peninsular Division.

0	Lansing.	14 c. Coal Measures.
5	Millett's.	"
10	Sevastopol.	"
12	Potterville.	"
19	Charlotte.	"
27	Olivet.	14 a. Parma Sandstone.
32	Bellevue.	13 b. Car. l.s., quar. fos.
37	Madison.	13 b. Michigan Salt.
45	Battle Creek.	13 a. Mar., outcro. foss.
55	Climax.	13 a. Marshall.
60	Scott's.	11. Huron.
64	Indian Lake.	"
68	Vicksburg.	"
74	Schoolcraft.	"
85	Marcellus.	"
89	Volinia.	"
94	Jamestown.	10 b. Little Traverse.
98	Cassopolis.	9. Corniferous.
106	Edwardsburg.	"

(Continued in Indiana.)

Saginaw Valley and St. Louis Railroad.

0	East Saginaw.[6]	
2	Saginaw.	14 c. Coal Measures.
6	Tittabawassee J	"
9	Swan Creek.	"
11	Graham's.	"
12	Sand Ridge.	"
16	Hemlock.	"
16	Porter's.	"
22	West Mill.	"
26	Wheeler's.	"
28	Breckenridge.	"
35	St. Louis.	"
	Elm Hall.	"

Chicago & North-Western Railroad.

Ms.	Green Bay and Lake Superior Line.	
0	Chicago, Ill.	(See Wisconsin.)
264	Menomonee.	4 a. Trenton.
273	Little River.	"
279	Wallace.	"
285	Stephenson.	"
291	Gravel Pit.	"
295	Bagley.	"
302	Kloman.	"
305	Spaulding.	"
316	Bark River.	"
321	Ford River.	"
328	Escanaba.	"
331	Flat Rock.	"
333	Bay Siding.	"
337	Mason.	"
340	Day's River.	"
345	Beaver.	"
352	Maple Ridge.	"
357	Centreville.	"
362	Helena.	3 a. Calc. & 3 c. Chazy.
369	Little Lake.	2 b. Lake Superior s. s.
370	Smith Mine Jun	1 a. Laurentian.
382	Cascade Junc'n.	1 b. Huronian.
384	Goose Lake.	"

Chicago & North-Western Railroad.

Ms.	Green Bay and Lake Superior Line—*Con.*	
389	Negaunee.	1 b. Hur'n, Iron Mines.
393	Ishpeming.	" "
401	Marquette.	"
441	L'Anse.	2 b. Lake Superior s. s.

Marquette, Houghton & Ontonagon R.R.

0	Marquette.	1 b. Huronian.
3	Bancroft.	"
7	Morgan.	"
8	Eagle Mills.	"
12	Negaunee.	" Iron Mines.
15	Ishpeming.	" Exten. Mines.
21	Greenwood.	"
25	Clarksburg.	"
26	Humboldt.	"
35	Republic.	"
31	Champion.	" Iron Mines.
38	Michigamme.	" "
47	Sturgeon.	1 a. Laurentian.
56	Palmer.	1 b. Huronian.
63	L'Anse.	2 b. Lake Superior s. s.
93	Houghton.	2–4. Eruptive rocks, with Native Copper Mines.
93	Hancock.	

Indiana.

LIST OF THE GEOLOGICAL FORMATIONS FOUND IN INDIANA.

20. Quaternary.*	13 b. Upper Sub-Carbonifer's.	9 c. Corniferous.
15. Permian ?	13 a. Lower Sub-Carbonifer's.	8. Oriskany.
14 c. Upper Coal Measures.	10 c. Genesee.	5 c. Niagara.
14 b. Lower Coal Measures.	10 b. Hamilton.	5 b. Clinton.
14 a. Millstone Grit.		4 c. Cincinnati.

Michigan Central Railroad.

Ms.		
0	Chicago.	(See Illinois.)
23	Gibson's.	5 c. Niagara.
29	Tolleston.	"
35	Lake.	"
44	Porter.	"
50	Furnessville.	"
56	New Buffalo.	"
	(Continued	in Michigan.)

Joliet Division.

0	Lake.	5 c. Niagara.
7	Ross.	"
14	Dyer.	"
45	Joliet, Ill.	(See Illinois.)

Lake Shore and Michigan Southern R.R.

Western Division.

0	Chicago.	
14	Colehour.	5 c. Niagara.
30	Miller's.	"
41	Chesterton.	"
45	Burdick.	"
49	Otis.	"
51	Holmesville.	"
59	Laporte.	"
66	Rolling Prairie.	"
73	New Carlisle.	"
75	Terre Coupee.	"
80	Warren.	"
86	South Bend.	"
90	Mishawaka.	"
96	Osceola.	"
101	Elkhart.	"

Air Line Division.

0	Elkhart.	5 c. Niagara.
10	Goshen.	"
18	Millersburg.	"
25	Ligonier.	"
30	Wawaka.	"
34	Brimfield.	"
41	Kendallville.	"

Lake Shore and Michigan Southern R.R.

Ms. | Air Line Division— *Continued.*

47	Corunna.	5 c. Niagara.
50	Sedan.	"
54	Waterloo.	"
62	Butler.	"
69	Edgerton.	"
	(Continued	in Ohio.)

Baltimore and Ohio Railroad.

Chicago Division.

0	Chicago.	(See Illinois.)
34	Mich. Cen. Jun.	5 c. Niagara.
50	L. N. A. & C. Jun	"
58	Wellsboro.	"
72	Walkerton Jun.	"
89	Bremen.	"
106	Milford Junc'n.	"
110	Syracuse.	"
118	Cromwell.	"
128	Albion.	"
138	Avilla.	"
143	Garrett.	"
146	Auburn Junc'n.	"
147	Auburn.	"
163	Hicksville.	"

Pittsburg, Fort Wayne and Chicago R.R.

0	Chicago.	(See Illinois.)
16	Sheffield.	5 c. Niagara.
20	Cassello.	"
24	Clarke.	"
31	Liverpool.	"
37	Wheeler.	"
44	Valparaiso.	"
53	Wanatah.	"
59	Hanna.	"
78	Donelson.	"
84	Plymouth.	"
95	Bourbon.	"
99	Etna Green.	"
104	Selby.	"
109	Warsaw.	"

* Four-fifths of the State of Indiana is covered with drift. It is 90 feet to the rock in Indianapolis. At some points north of Wabash River the drift has been bored into 200 feet. It thins out as you go toward Ohio River, does not reach it at some points, and is sparingly found south of that stream.

Pittsburg, Fort Wayne and Chicago Railroad—*Continued.*

Ms.		
115	Kosciusko.	5 c. Niagara.
117	Pierceton.	"
122	Larwill.	"
129	Columbia.	"
140	Arcola.	"
148	Fort Wayne.	"
158	Maples.	"
	(Continued	in Ohio.)

Pittsburg, Cincinnati and St. Louis R. R, First Division.

0	Indianapolis.	10 c. Genesee.
11	Cumberland.	"
17	Philadelphia.	"
21	Greenfield.	10. Hamilton.
28	Cleveland.	"
30	Charlottsville.	"
34	Knightstown.	"
35	Raysville.	"
38	Ogden's.	5 c. Niagara.
39	Dunreith.	"
44	Lewisville.	"
51	Dublin.	"
53	Cambridge City.	"
58	Germantown.	"
63	Centerville.	4 c. Cincinnati.
68	Richmond.	"
74	New Paris.	"
79	Wiley's.	"
	(Continued	in Ohio.)

Second Division.

0	Chicago.	
20	Dalton.	5 c. Niagara.
27	Lansing.	"
34	Shererville.	"
41	Crown Point.	"
47	Cassville.	"
51	Hebron.	"
61	Koutt's.	"
67	La Crosse.	"
77	North Judson.	"
91	Winimac.	"
97	Star City.	"
101	Rosedale.	"
105	Royal Centre.	"
111	Gebhardt.	"
117	Logansport.	8. Oriskany & 10 b. Ham
121	Anoka.	10 b. Hamilton.
127	Onward.	"
132	Bunker Hill.	"
140	North Grove.	"
142	Amboy.	"
145	Converse.	"
148	Mier.	"
157	Marion.	5 c. Niagara.
162	Jonesboro.	"
169	Upland.	"
175	Hartford.	"
185	Dunkirk.	"
189	Red Key.	"

Pittsburg, Cincinnati and St. Louis R. R. Second Division—*Continued.*

Ms.		
193	Power's.	5 c. Niagara.
197	Ridgeville.	"
200	Deerfield.	"
203	Warren.	"
210	Union.	"
	(Continued	in Ohio.)

Columbus, Chicago & Indiana Central Division.

0	Chicago.	
117	Logansport.	8. Orisk. & 10 b. Ham
122	Anoka.	10 b. Hamilton.
127	Walton.	"
130	Lincoln.	"
133	Galveston.	"
139	Kokomo.	"
145	Tampico.	"
149	Nevada.	"
152	Windfall.	"
157	Curtisville.	"
161	Elwood.	"
166	Frankton.	"
171	Florida.	"
175	Anderson.	9 c. Cornif. & 8. Orisk.
	Bellefontaine Crossing.	
184	Middletown.	5 c. Niagara.
187	Honey Creek.	"
190	Sulphur Springs	"
195	Junction.	"
197	New Castle.	"
201	Ashland.	"
204	Millville.	"
208	Hagerstown.	"
215	Washington.	"
	Centreville Pike	
224	Richmond.	4 c. Cincinnati.

Indianapolis and Vincennes Division.

0	Indianapolis.	10 c. Genesee.
4	Maywood.	"
8	Valley Mill.	"
11	West Newton.	"
12	Friendswood.	"
16	Mooresville.	"
18	Mathews'.	"
20	Brooklyn.	"
23	Centerton.	"
26	Hastings.	"
30	Martinsville.	"
33	Hynds.	"
37	Paragon.	"
44	Gosport.	13 b. Upper Sub-Carb.
53	Spencer.	"
62	Freedom.	"
65	Farmer's.	14 a. Millstone Grit.
71	Worthington.	14 a. Mills. Gr. & 14 b. L.
78	Switz City.	" Cl. Mres.
82	Lyons.	"
87	Marco.	"
97	Edwardsport.	14 c. Upper Coal Mres.
108	Bruceville.	"
117	Vincennes.	"

Ms.	Detroit and Eel River Railroad.	
0	Logansport.	8. Orisk. & 10 b. Ham.
18	Denver.	5 c. Niagara.
21	Chili.	"
27	Roann.	"
33	Laketon.	"
37	N. Manchester.	"
45	Collamer.	"
47	South Whitley.	"
51	Taylor's.	"
56	Columbia City.	"
62	Collin's.	"
66	Cherubusco.	"
70	Potter's.	"
74	C. R. Crossing.	"
76	Cedar Creek.	"
81	Auburn Junc'n.	"
82	Auburn.	"
88	Mooresville.	"
93	Butler.	"

Wabash Railroad.
(Late Toledo, Wabash and Western Railroad.)

0	Toledo.	(See Ohio.)
88	New Haven.	5 c. Niagara
94	Fort Wayne.	"
109	Roanoke.	"
118	Huntington.	5 c. Niag. & 10 b. Ham.
131	Lagro.	"
136	Wabash.	"
150	Peru.	"
157	Waverly.	"
166	Logansport.	8. Orisk. & 10 b. Ham.
180	Rockfield.	10 b. Hamilton.
186	Delphi.	10 c. Genesee.
195	Buck Creek.	"
203	Lafayette.	13 a. Lower Sub-Carb.
213	West Point.	"
225	Attica.	14 a. Millstone Grit.
233	West Lebanon.	"
242	State Line.	14 c. Upper Coal Mres.
	(Continued	in Illinois.)

L. M. & B. Division.

0	Lafayette June.	13 a. Lower Sub-Carb.
8	Porter's.	"
10	Montmorency.	"
21	Templeton.	13 b. Upper Sub-Carb.
23	Oxford.	"
29	Boswell.	"
37	Ambia.	"

Cincinnati, Lafayette & Chicago Railroad.

	Cincinnati.	
	Indianapolis.	10 c. Genesee.
0	Lafayette.	13 a. Lower Sub-Carb.
7	Porter's.	"
9	Montmorency.	"
13	Otterbien.	"
18	Templeton.	13 b. Upper Sub-Carb.
23	Atkinson.	"
28	Fowler.	"

Cincinnati, Lafayette and Chicago Railroad—*Continued.*

Ms.		
35	Earl Park	13 b. Upper Sub-Carb.
41	Raub.	"
46	Sheldon.	"

Indianapolis, Bloomington & Western R. R.

0	Indianapolis.	10 c. Genesee.
14	Brownsburg.	"
18	Pittsboro.	13 a. Lower Sub-Carb.
22	Lizton.	"
27	Jamestown.	"
33	New Ross.	13 b. Upper Sub-Carb.
44	Crawfordsville.	"
54	Waynetown.	14 a. Millstone Grit.
65	Veedersburg.	14 a. Mill. Gt. & 14 b.L.
72	Covington.	14 c. " Coal Mres.
85	Danville, Ill.	14 c. "
	(Continued	in Illinois.)

Cleveland, Columbus, Cincinnati and Indianapolis Railroad.
Indianapolis Division.

0	Indianapolis.	10 c. Genesee.
9	Lawrence.	"
14	Oakland.	"
16	McCord's.	"
21	Fortville.	"
28	Pendleton.	8. Orisk. & 9 c. Cornif.
35	Anderson.	9 c. Cornif. & 8. Orisk.
41	Chesterfield.	"
43	Daleville.	5 c. Niagara.
48	Yorktown.	"
54	Muncie.	"
60	Selma.	"
67	Farmland.	"
75	Winchester.	"
84	Union.	"
	(Continued	in Ohio.)

Indianapolis and St. Louis Railroad.

0	Indianapolis.	10 c. Genesee.
2	Asylum.	"
6	Sunnysid	"
8	Spray.	"
12	Avon.	"
16	Easton.	"
19	Danville.	13 a. Lower Sub-Carb.
23	Hadley.	"
27	Reno.	"
31	Malta.	13 b. Upper Sub-Carb.
32	Darwin.	"
38	Greencastle.	13 b. U. Sub-Car. & 14 a
44	Fern.	" Mills. Grit.
48	Lena.	14 a. Millstone Grit.
53	Carbon.	14 b. Lower Coal Mres.
56	Perth.	"
61	Fountain.	"
64	Grant.	14 c. Upper Coal Mres.
67	Markle.	"
69	Gravel Pit.	"
72	Terre Haute.	"

St. Louis, Vandalia, Terre Haute and Indianapolis Railroad.

Ms.		
0	Indianapolis.	10 c. Genesee.
4	Fairview.	"
9	Bridgeport.	13 a. Lower Sub-Carb.
14	Plainfield.	"
17	Cartersburg.	"
19	Belleville.	"
20	Clayton.	"
25	Amo.	"
28	Coatsville.	"
33	Fillmore.	13 b. Upper Sub-Carb.
39	Greencastle.	13 b. & 14 a. Mills. Gt.
43	Hamrick's.	14 a. Millstone Grit.
47	Reelsville.	"
50	Eagle's.	"
53	Harmony.	14 b. Lower Coal Mres.
54	Knightsville.	"
57	Brazil.	"
60	Williams.	14 c. Upper Coal Mres.
62	Staunton.	"
65	Seeleyville.	"
73	Terre Haute.	"

Cincinnati, Hamilton and Indianapolis R. R.

0	Cincinnati.	(See Ohio.)
25	Hamilton.	4 c. Cincinnati.
32	McGonigle's.	"
39	Oxford.	"
44	College Corner.	4 c. Cincinnati.
52	Liberty.	"
58	Brownsville.	"
66	Connersville.	5 c. Niagara.
76	Glenwood.	"
84	Rushville.	"
91	Arlington.	"
98	Morristown.	5 c. Niag. & 9 c. Cornif.
103	Fountaintown.	"
123	Indianapolis.	10 c. Genesee.

Indianapolis, Cincinnati and Lafayette R.R.

0	Cincinnati.	(See Ohio.)
18	Valley Junction	"
20	Elizabethtown.	"
25	Lawrenceburg.	4 c. Cincinnati.
26	Newton.	"
33	Guilford.	"
34	Hansell's.	"
40	Harman's.	"
42	Weisburg.	"
46	Sunman's.	"
48	Spades.	"
51	Morris.	5 c. Niagara.
54	Batesville.	"
60	New Point.	"
62	Smith's Cross'g.	"
65	McCoy's.	"
68	Greensburg.	"
74	Adams.	"
78	St. Paul.	"
81	Waldron.	"
84	Prescott.	"

Indianapolis, Cincinnati and Lafayette Railroad—*Continued.*

Ms.		
88	Shelbyville.	10. Hamilton.
95	Fairland.	"
99	London.	"
100	Brookfield.	"
102	Acton.	"
106	Gallaudet.	10 c. Genesee.
115	Indianapolis.	"
125	Augusta.	"
130	Zionsville.	"
135	Whitestown.	"
138	Holmes.	"
143	Lebanon.	13 a. Upper Sub-Carb.
148	Hazelrigg.	"
152	Thorntown.	"
157	Colfax.	"
163	Clark's Hill.	"
166	Stockwell.	"
171	Culver's.	"
179	Lafayette.	"

Jefferson, Madison and Indianapolis R. R.

0	Indianapolis.	10 c. Genesee.
7	Southport.	"
11	Greenwood.	13 a. Lower Sub-Carb.
13	Worthsville.	"
15	Whiteland.	"
20	Franklin.	"
25	Amity.	13 a. & 10 c. Genesee.
31	Edinburg.	"
35	Taylorsville.	"
38	Lowell.	"
41	Columbus.	"
46	Walesboro.	"
48	Waynesville.	"
52	Jonesville.	"
57	Rockford.	"
59	Seymour.	"
64	Chestnut Ridge.	"
66	Langdon's.	13 a. Lower Sub-Carb.
69	Retreat.	"
71	Crothersville.	"
75	Austin.	10 b. Hamilton.
77	Marshfield.	"
82	Vienna.	"
89	Henryville.	"
93	Memphis.	"
100	Sellersburg.	"
108	Jeffersonville.	"

Ohio and Mississippi Railroad.

0	Cincinnati.	(See Ohio.)
26	Lawrenceburg.	4 c. Cincinnati.
24	Aurora.	"
26	Cochran.	"
33	Dillsboro.	"
37	Cold Springs.	"
40	Moore's Hill.	"
42	Milan.	"
45	Pierceville.	"
47	Delaware.	"

Ohio & Mississippi Railroad—*Continued.*

Ms.		
52	Osgood.	5 c. Niagara.
56	Poston.	"
58	Holton.	"
62	Nebraska.	"
66	Butlerville.	"
73	North Vernon.	5 c., 9, 10 c., 10 b.
79	Hardenburgh.	10. Hamilton.
83	Fleming's.	"
87	Seymour.	"
92	Shields' Mill.	13 a. Lower Sub-Carb.
98	Brownstown.	"
101	Velonia.	"
106	Medora.	"
111	Sparksville.	"
114	Fort Ritner.	"
117	Tunnelton.	13 a. and 13 b.
121	Scotville.	13 b. Upper Sub-Carb.
127	Mitchell.	"
133	Georgia.	"
139	Huron.	13 b. & 14 a. Mills. Gt.
150	Shoals.	14 a. & 14 b. L. Cl. Mrs.
158	Loogootee.	14 b. Lower Coal Mres.
162	Clark's.	"
165	Montgomery's.	"
173	Washington.	14 c. Upper Coal Mres.
180	Wheatland.	"
185	Richland.	"
191	Vincennes.	"
	(Continued	in Illinois.)

Fort Wayne and Jackson Railroad.

0	Fort Wayne.	5 c. Niagara.
16	New Era.	"
23	Auburn.	"
28	Waterloo.	"
33	Summit.	"
37	Pleasant Lake.	"
42	Angola.	"
50	Fremont.	"
54	State Line.	"
	(Continued	in Michigan.)

Grand Rapids and Indiana Railroad.

275	Sturgis.	(See Michigan.)
286	La Grange.	5 c. Niagara.
290	Valentine.	"
295	Wolcottville.	"
297	Rome City.	"
304	Kendallville.	"
310	Avilla.	"
314	La Otto.	"
320	Huntertown.	"
333	Fort Wayne.	"

Cincinnati, Richmond and Fort Wayne R.R.

333	Fort Wayne.	5 c. Niagara.
338	Adams.	"
354	Decatur.	"
360	Monroe.	"
366	Berne.	"
370	Geneva.	"

Cincinnati, Richmond and Fort Wayne Railroad—*Continued.*

Ms.		
374	Briant.	5 c. Niagara.
381	Portland.	"
392	Ridgeville.	"
400	Winchester.	"
406	Snow Hill.	"
409	Lynn.	"
416	Newport.	"
418	Haley.	"
422	Parry.	"
424	Richmond.	4 c. Cincinnati.
(Co	ntinued in Ohio,	Cinn. Rich. & Ch. R.R.)

Fort Wayne, Muncie and Cincinnati R. R.

0	Fort Wayne.	5 c. Niagara.
3	Wabash Junc'n.	"
7	Ferguson's.	"
11	Sheldon.	"
14	Ossian.	"
19	Eagleville.	"
24	Bluffton.	"
35	Keystone.	"
38	Montpelier.	"
47	Hartford.	"
54	Eaton.	"
65	Muncie.	"
71	McGowan's.	"
75	Springport.	"
78	Summit.	"
80	N. C. Junction.	"
83	New Castle.	"
90	New Lisbon.	"
96	Cambridge City.	"
98	Milton.	"
103	Beeson's.	"
108	Connersville.	"

Cincinnati, Wabash and Michigan Railroad.

0	Anderson Junc.	8. Orisk. & 9 c. Cornif.
13	Alexandria.	5 c. Niagara.
34	Marion.	"
54	Wabash.	"
69	N. Manchester.	"
90	Warren.	"
103	Milford.	"
115	Goshen.	"
125	Elkhart.	"

Indianapolis, Peru and Chicago Railroad.

0	Indianapolis.	10 c. Genesee.
6	Malott Park.	"
11	Castleton.	"
15	Fisher's.	"
17	Britton's.	"
22	Noblesville.	"
28	Cicero.	"
31	Arcadia.	"
34	Buena Vista.	"
40	Tipton.	10 b. Hamilton.
42	Jackson's.	"
46	Sharpsville.	"

Indianapolis, Peru and Chicago Railroad— *Continued.*

Ms.		
49	Fairfield.	10 b. Hamilton.
54	Kokomo.	"
59	Cassville.	"
61	Bennett's.	"
63	Miami.	"
67	Bunker Hill Crg	5 c. Niagara.
75	Peru.	"
81	Courter.	"
83	Denver.	"
85	Deed's.	"
88	Birmingham.	"
90	Lincoln.	"
93	Wagner's.	"
98	Rochester.	"
102	Sturgeon.	"
103	Tiosa.	"
105	Walnut.	"
108	Railsback's.	"
110	Argos.	"
118	Plymouth.	"
125	Tyner.	"
128	Knott's.	"
132	Walkerton.	"
136	Kankakee.	"
141	Stillwell.	"
148	La Porte.	"
155	Webbers.	"
161	Michigan City.	"

Louisville, New Albany and St. Louis R.R.

0	Princeton.	14 c. Upper Coal Mres.
5	Lyle's.	"
10	Mount Carmel.	(See Illinois.)
11	C. & V. Junc'n.	"
15	Brown's.	"
19	Bellmont.	"
27	Crackle's.	"
29	Albion, Ill.	"

Louisville, New Albany and Chicago R. R.

0	New Albany.	10 c. Gen. & 13 a. L. Sub-
6	Smith's Mills.	" Carb.
12	Wilson's.	"
18	Providence.	13 a. Lower Sub-Carb.
23	Pekin.	"
27	Farabee's.	"
30	Harristown.	13 b. Upper Sub-Carb.
35	Salem.	"
40	Hitchcock's.	"
45	Campbellsburg.	"
47	Saltillo.	"
52	Lancaster.	"
56	Orleans.	"
61	Mitchell.	"
65	Juliet.	"
71	Bedford.	"
78	Salt Creek.	"
82	Guthrie.	"
85	Harrodsburg.	"
89	Smithville.	"
92	Clear Creek.	"
97	Bloomington.	"

Louisville, New Albany and Chicago Railroad— *Continued.*

Ms.		
101	Wood Yard.	13 b. Upper Sub-Carb.
104	Ellettsville.	"
109	Stinesville.	"
113	Gosport.	"
117	Spring Cave.	"
122	Quincy.	"
125	Oakland.	"
128	Cloverdale.	"
134	Putnamville.	"
139	Greencastle.	13 b. & 14 a. U. Cl. Mrs.
143	Maple Grove.	13 b. Upper Sub-Carb.
148	Bainbridge.	"
152	Carpentersville.	"
156	Ashby's.	"
159	Ladoga.	"
163	Whitesville.	"
170	Crawfordsville.	"
175	Cherry Grove.	"
180	Linden.	"
184	Corwin.	"
187	Raub's.	"
190	Taylor's.	"
198	Lafayette.	13 a. Lower Sub-Carb.
204	Battle Ground.	"
211	Brookston.	"
215	Chalmers.	"
221	Reynolds.	13 a. U. Sub-C. & 10 c. G.
229	Bradford.	10 b. Genes. & 5 c. Niag.
237	Francesville.	5 c. Niagara.
244	Medarysville.	"
252	San Pierre.	"
260	La Crosse.	"
267	Wanatah.	"
271	Haskell's.	"
273	Lake Huron Cro	ssing. "
276	Westville.	"
279	Otis.	"
281	Beatty's.	"
288	Michigan City.	"

Indiana North and South Railroad.

0	Attica.	14 a. Millstone Grit.
4	Rob Roy.	"
7	Strader's.	"
10	Stone Bluff.	"
11	Kirkland's.	"
12	Ludlows.	"
15	Veedersburg.	14 a. & 14 b. L. Cl. Mrs.

Evansville, Terre Haute and Chicago R.R.

0	Terre Haute.	14 c. Upper Coal Mres.
5	Ellsworth.	"
11	Atherton.	"
15	Clinton.	"
20	Summit Grove.	"
23	Hillsdale.	"
25	Highland.	"
28	Opedee.	"
31	Newport.	"
37	Eugene.	"
55	Danville, Ill.	(See Illinois.)

Ms.	Evansville and Crawfordsville R. R.	
0	Evansville.	14 c. Upper Coal Mres.
3	Fair Ground.	"
5	Erskine.	"
10	Ingle's.	"
13	Stacer's.	"
15	St. James.	"
17	Haubstadt.	"
20	Fort Branch.	"
24	King's.	"
27	Princeton.	"
31	Patoka.	"
38	Hazelton.	"
40	Decker's.	"
45	Purcell's.	"
51	Vincennes.	"
57	John Smith's.	"
62	Emison's.	"
34	Busseron.	"
66	Oak Town.	"
68	Griswold.	"
70	Ehrman.	"
73	Carlisle.	"
77	Paxton's.	"
83	Sullivan.	"
88	Shelburn.	"
93	Farmersburg.	"
97	Hartford.	"
101	Young's.	"
109	Terre Haute.	"

Ms.	St. Louis and South-Eastern Railroad.	
	St. Louis.	(See Illinois.)
136	Upton.	14 c. Upper Coal Mres.
142	Mount Vernon.	"
154	Belknap.	"
161	Evansville.	"
	(Continued	in Kentucky.)

Cincinnati, Rockport and South-Western Railroad.

0	Rockport.	14 a. to 14 c. Upper & Lower Coal Mres.
11	Wright's.	"
17	Lincoln.	"
20	Dale.	"
24	Ferdinand.	14 a. Mills. Grit & 14 b. Lower Coal Mres.

Lake Erie, Evansville and South-Western Railroad.

0	Evansville.	14 c. Upper Coal Mres.
6	Garvin.	"
13	Chandlersville.	"
18	Booneville.	"

Illinois.[1]

List of the Geological Formations on the Illinois Railroads.

18 and 19. Cretaceous or Tertiary.
14 c. Upper Coal Measures.
14 b. } Lower Coal Measures and Con-
14 a. } glomerate.
13 a. Low. Carboniferous Limestone.*
9–12. Devonian.
5 c. Niagara Group.
4 c. Cincinnati Croup.
4 a. Trenton and Galena Limestone.
3 c. St. Peter's Sandstone.
3 a. Calciferous and Lower Magnesian Limestone.

Baltimore, Pittsburg and Chicago Railroad.

Ms.	(B. & O.)	
0	Chicago.	5 c. Niagara.
12	Kingston.	"
14	South Chicago.	"
21	Edgemoor.	"
30	Miller's.	"
34	Mich. Cent. Jun.	"

Illinois Central Railroad.

0	Chicago.	5 c. Niagara, 88 miles.
14	Kensington.	"
24	Homewood.	"
27	Matteson.	"
34	Monee.	"
40	Peotone.	"
47	Manteno.	"
56	Kankakee.[2]	"
65	Chebanse.	"
69	Clifton.	"
81	Gilman.	"
85	Onarga.	"
93	Bulkley.	4 c. Cincinnati, 16 ms.
99	Loda.	"
103	Paxton.	"
105	Ludlow.	14 a. & b. L. Cl. Mrs. & Conglom., 21 ms.
114	Rantoul.	"
119	Thomasboro.	"
128	Champaign.	14 c. U. Cl. Mrs. 155 ms
137	Tolono.	"
143	Pesotum.	"
150	Tuscola.	"
158	Arcola.	"
173	Mattoon.	"
185	Neoga.	"
199	Effingham.	"

Ms.	**Illinois Central Railroad**—*Continued.*	
215	Edgewood.	14 c. Upper Coal Mres.
230	Kinmundy.	"
244	Odin.	"
252	Central City.[3]	"
253	Centralia.	"
263	Richview.	"
267	Ashley.	"
274	Dubois.	"
280	Tamaroa.	"
289	Du Quoin.[4]	14 a. & b. L. Cl. Mrs. & Conglom., 43 ms.
302	De Soto.	"
308	Carbondale.	"
316	Makanda.	"
323	Cobden.[5]	"
328	Anna.[6]	4 a. Trenton, 20 miles.
339	Dongola.	"
344	Ullin.	18. & 19. Cretaceous or Tertiary, 21 miles.
365	Cairo.	"

Dubuque to Cairo.

0	Dubuque.	4 a. Trenton, 71 miles.
2	Dunleith.[7]	"
19	Galena.[7]	"
26	Council Hill.[7]	"
31	Scales Mound.[8]	"
40	Apple River.	"
46	Warren.	"
49	Nora.	"
57	Lena.	"
70	Freeport.	"
74	Baileysville.	5 c. Niagara, 3 miles.
82	Forreston.	4 a. Trenton, 42 miles.
87	Haldane.	"
92	Polo.	"
105	Dixon.[9]	"

* Consisting of the 1. Kinderhook limestone and sandstone, 2. Burlington limestone, 3. Keokuk limestone, 4. St. Louis limestone and 5. Chester limestone and sandstone.

1. The notes are by Prof. A. H. Worthen, State Geologist of Illinois.
2. Rich in Niagara corals.
3. Shelly limestone of Upper Coal Measures filled with fossil shells, bryozoa, &c.
4. Roof shales of coal rich in fossil plants.
5. Upper Chester shales beneath conglomerate with a few fossil shells, corals, &c.
6. Quarries of St. Louis limestone with some small shells, corals, &c.
7. A few fossils characteristic of the Galena limestone.
8. Rich fossiliferous band near the base of the Cincinnati group, and crystals of barite, pyrite and dolomite in pockets of the Galena limestone.
9. Lower Trenton or Blue limestone two miles northeast of Dixon full of characteristic fossils.

Illinois Central Railroad.

Ms.	Dubuque to Cairo—*Continued.*	
117	Amboy.	4 c. Cincinnati, 3 miles.
125	Sublette.	4 a. Trenton, 20 miles.
133	Mendota.	"
141	Dimmick.	"
149	La Salle.[10]	14 a. Conglo. & 14 b. L. Coal Mres. 8 ms.
158	Tonica.	"
169	Wenona.	14 c. U. Cl. Mrs. 196 ms
180	Minonk.	"
188	Panola.	"
191	El Paso.	"
200	Hudson.	"
207	Normal.	"
209	Bloomington.[11]	"
227	Wapella.	"
231	Clinton.	"
240	Maroa.	"
253	Decatur.	"
258	Wheatland.	"
263	Macon.	"
269	Moawequa.	"
276	Assumption.	"
285	Pana.	"
303	Ramsey.[12]	"
315	Vandalia.	"
330	Patoka.	"
339	Sandoval.	"
344	Central City.	"
345	Centralia.	"
358	Cairo.	18. & 19. Creta. & Ter'y.

Chicago, Burlington and Quincy Railroad.

0	Chicago.	5 c. Niagara, 44 miles.
30	Naperville.	"
38	Aurora.	"
43	Oswego.[13]	"
47	Bristol.	4 c. Cincinnati, 11 ms.
53	Plano.	"
57	Sandwich.	4 a. Trenton, 45 miles.
61	Somonauk.	"
67	Leland.	"
74	Earl.	"
84	Mendota.	"
100	Malden.	"
105	Princeton.	14 a. Cong.l and 14 b. Low. Cl. Mrs. 92 ms.
112	Wyanet.	"
118	Buda.	"
124	Neponsett.	"
132	Kewanee.[14]	"

Chicago, Burlington and Quincy Railroad— *Continued.*

Ms.		
140	Galva.	14 a. Cong. and 14 b. Low. Coal Measures.
148	Altona.	"
152	Oneida.	"
156	Wataga.	"
164	Galesburg.	"
179	Monmouth.[15]	"
186	Kirkwood.	"
198	Sagetown.[16]	13 a. Lower Carbon's Limestone, 15 miles.
207	Burlington.	"

164	Galesburg.	14 a. Cong. and 14 b. L. Coal Mrs. 54 ms.
173	Abingdon.	"
183	Avon.	"
186	Prairie City.	"
192	Bushnell.	"
203	Macomb.	"
210	Colchester.[17]	"
212	Tennessee.	"
223	Plymouth.	13 a. L. Carb. l.s. 5 ms.
227	Augusta.	14 a. Cong. and 14 b. L. Coal Mrs. 27 ms.
242	Camp Point.	"
252	Fowler.	13 a. L. Carb. l.s. 13 ms
263	Quincy.[18]	"

Galesburg and Peoria Division.

164	Galesburg.	13 a. L. Carb. Limest.
169	Knoxville.	"
180	Maquon.	"
188	Yates City.	"
190	Elmwood.	"
209	Kickapoo.	"
217	Peoria.	"

Galena Junction.

0	Galena Junction	5. Niagara.
6	East Batavia.	"
13	Aurora.	"

Fox River Line.

0	Aurora.	5. Niagara, 6 miles.
6	Oswego.	"
13	Yorkville.	4 c. Cincinnati, 11 ms.
23	Millington.	4 a. Trenton, 21 miles.
28	Sheridan.	"
32	Serena.	13 a, Lower Coal Mres.
36	Wedron.	" [3 a. Calcif. in
40	Dayton.	" bed of river.]
44	Ottawa.	3 a. Calciferous, 2 ms.
60	Streator.	13 a. Lower Coal Mres.

10. Limestone of the Upper Coal Measures full of fossils.
11. Minute shells in roof of coal seam, probably No 3.
12. Upper Coal Measure limestone with fossil shells near Ramsey.
13. Cincinnati group rich in fossils.
14. Fossils in roof shales of coal seam, probably coal No. 5 or 6.
15. Outcrop of Burlington limestone 2 miles north of Monmouth.
16. Burlington limestone rich in fossils.
17. Roof shales of coal rich in fossil plants, coal No. 2.
18. Burlington limestone rich in fossils.
19. Fossils abundant in roof shales of coal No. 5.
20. Fossils in roof shales of coals No. 2 and 3.
21. Fossils in roof shales of coal No. 5.

Chicago, Burlington & Quincy R. R.—*Cont.*

Buda and Rushville Branch.

Ms.		
0	Buda.	14 b. Lower Coal Mres.
20	Wyoming.	"
38	Brimfield.	"
45	Elmwood.	"
47	Yates City.	"
53	Farmington.	"
64	Canton.[19]	"
78	Lewiston.[20]	"
95	Vermont.	"
110	Rushville.[21]	"

Geneva Branch.

0	Aurora.	5. Niagara.
9	Batavia.	"
13	Geneva.	"

Mendota and Clinton Branch.

0	Mendota.	4 a. Trenton.
9	La Moille.	"
19	Ohio.	"
26	Walnut.	"
32	Deer Grove.	4 c. Cincinnati.
45	Prophetstown.	5. Niagara.
62	Fulton.	4 c. Cincinnati.
66	Clinton.	"

Galva, New Boston and Keithsburg.

0	Galva.	13 a. Lower Coal Mres.
14	Woodhull.	"
37	Aledo.	"
51	New Boston.	"
54	Keithsburg.	"

Burlington, Carthage and Quincy.

0	Burlington.	13 a. L. Carb. Limest.
10	Lomax.	"
24	Adrian.	"
32	Carthage.	"
44	West Point.	"
58	Mendon.	"
62	Ursa.	"
72	Quincy.	"

Rock River Division.

0	Shabbona.	4 c. Cincinnati, 3 miles.
8	Paw Paw.	4 a. Trenton.
16	Brooklyn.	4 c. Cincinnati, 5 miles.
26	Amboy.	4 a. Trenton.
37	Harmon.	4 c. Cincinnati.
47	Rock Falls.	"

Chicago, Rock Island and Pacific Railroad.

Ms.		
0	Chicago.	5. Niagara, 48 miles.
16	Blue Island.	"
30	Mokena.	"
40	Joliet.	"
51	Minooka.	14 a. Cong. and 14 b. L. Coal Mrs. 41 ms.
61	Morris.[22]	"
71	Seneca.	"
76	Marseilles.	"
84	Ottawa.	3 a. Calciferous, 9 ms.
94	Utica.	"
99	La Salle.	14 b. Low. Coal Mrs. and Conglomerate.
100	Peru.[23]	"
114	Bureau.	"

0	Bureau.	"
13	Henry.	"
20	Sparland.	"
28	Chillicothe.	"
46	Peoria.[24]	"
	Pekin.	"
	Jacksonville.	"

114	Bureau.	14 L. Coal Mrs. & Congl.
122	Tiskilwa.	"
136	Sheffield.	"
146	Annawan.	"
152	Atkinson.	"
159	Geneseo.	"
170	Colona.	"
179	Moline.[25]	"
182	Rock Island.[25]	"

Chicago and Alton Railroad.

0	Chicago.	5. Niagara.
26	Lemont.[26]	"
33	Lockport.[26]	"
38	Joliet.[26]	"
53	Wilmington.[27]	4 c. Cincinnati.
58	Braidwood.[28]	14 a. & 14 b. Conglo. and Lower Coal Mrs.
61	Braceville.[28]	"
65	Gardner.	"
74	Dwight.	"
82	Odell.	"
92	Pontiac.	"
103	Chenoa.	"
111	Lexington.	14 c. U. Cl. Mrs. 120 ms
119	Towanda.	"
124	Normal.	"
126	Bloomington.	"
146	Atlanta.	"
157	Lincoln.	"

22. Fossil plants abundant in roof shales of coal No. 2.
23. Limestone of Upper Coal Measures full of fossils.
24. Fossils in roof shales and limestone over coal No 5.
25. Fine outcrops of Devonian shale and limestone between these points full of fossils.
26. Niagara fossils occur sparingly at each of these points.
27. Fossils abundant in Cincinnati group.
28. Fossil plants in roof shales of coal No. 2.

Ms.	Chicago & Alton Railroad—*Continued.*	
164	Broadwell.	14 c. Upper Coal Mres.
185	Springfield.[29]	"
194	Chatham.	"
206	Virden.	"
210	Girard.	"
214	Nilwood.	"
223	Carlinville.[30]	14 a. & b. Low. Coal Mrs. & Congl. 22 ms.
238	Shipman.	"
245	Brighton.[31]	"
257	Alton.[32]	13 a. L. Carb. l. s. 2 ms
258	Upper Alton.	14 a. & b. Low. Coal Mres. and Conglom.
261	Milton.	"
269	Mitchell.	13 a. Lower Carb. l. s.
276	Venice.	"
280	East St. Louis.	"
126	Bloomington.	14 c. Upper Coal Mres.
149	Hopedale.	"
157	Delavan.	14 a. & b. Lower Coal Measures and Congl.
171	Mason City.	"
187	Petersburg.[33]	"
215	Jacksonville.	
242	Drake.	13 a. Lower Carb. l. s.
265	Pleasant Hill.	"
274	Quincy Junction	5. Niagara.

St. Louis, Louisiana, Quincy, Keokuk, Burlington and St. Paul Line.

0	East St. Louis.	13 a. Lower Carb. l. s.
3	Venice.	"
16	Edwardsville Jn	14 a. and b.
23	Alton.	13 a. Lower Carb. l. s.
28	Godfrey.	14 a. and b.
36	Delhi.	"
43	Jerseyville.	"
48	Kane.	13 a. Lower Carb. l. s.
56	Carrollton.[34]	"
65	Whitehall.[35]	"
69	Roodhouse.	14 a. and b.

Chicago, Pekin and South-Western R.R.

0	Chicago.	5. Niagara.
37	Joliet.	"
89	Streator.	14 a. & b. L. Cl. Mres.
93	Reading.	"
98	Long Point.	"

Ms.	Chicago, Pekin and South-Western Railroad—*Continued.*	
108	Minonk.	14 c. Upper Coal Mres.
124	Roanoke.	"
126	Eureka.	"
133	Washington.	"
141	Morton.	"
145	Groveland.	14 a. & b. L. Cl. Mres.
153	Pekin.	"
161	Peoria.	"

Jacksonville Division.

126	Bloomington.	14 c. Upper Coal Mres.
149	Hopedale.	"
157	Delavan.	14 a & 16 b. L. Cl. Mres.
171	Mason City.	"
187	Petersburg.	"
200	Ashland.	"
215	Jacksonville.	"
	Roodhouse.	"

Western Division.

0	Chicago.	14 a. & b. L. Cl. Mres.
74	Dwight.	"
96	Streator.	"
109	Wenona.	14 c. Upper Coal Mres.
118	Varna.	"
128	Lacon.	14 a. & b. L. Cl. Mres.
118	Varna.	14 c. Upper Coal Mres.
122	La Rose.	"
128	Washburn.	"
133	Cazenovia.	"
137	Metamora.	"
144	Washington.	"

Cairo and St. Louis Railroad.

0	East St. Louis.	13 a. Low. Carbon. l. s.
13	East Carondelet	"
14	Columbia.[36]	"
19	Attica.	"
28	Waterloo.[37]	"
32	Cambria.	"
37	Red Bud.[38]	"
45	Baldwin.	"
54	Sparta.[39]	14 a. & b. L. Cl. Mres.
75	Ava.	
90	Murphysboro[40]	14 a. Low. Carbon. l. s.
116	Jonesboro.[41]	9–12. Devonian.
135	Hodge's Park.	19. Tertiary.
147	Cairo.	"

29. Fossils abundant in roof shales of coal No. 8, and also in that of No. 5, in the shafts opened in this vicinity.
30. Upper Coal Measure limestone with a few fossils.
31. Outcrop of coal No. 5, 1½ m. west of the station with numerous fossils in the roof shales.
32. St. Louis limestone with numerous fossils.
33. Coal Measure fossils abundant in this vicinity.
34. Outcrop of Keokuk limestone with characteristic fossils 3 miles northeast of the town.
35. Keokuk limestone 1½ miles south of town with a few characteristic fossils.
36. Outcrop of St, Louis limestone 1½ miles east of the station wiih numerous fossils.
37. St. Louis limestone in heavy outcrops on Fountain creek 2 miles west of the station, and of Chester limestone 2½ miles southwest, both formations abounding in characteristic fossils.
38. Outcrops of Chester limestone on Prairie du Long creek 2½ miles north of the station with numerous fossils.
39. Fossils abundant in the limestone over the coal No. 6?
40. Fossil plants in roof shales and iron concretions of coal No. 2.

Cairo and Vincennes Railroad.

Ms.		
0	Vincennes.	
10	St. Francisville.	14 c. Upper Coal Mres.
25	Mount Carmel.	"
41	Grayville.[42]	"
56	Carmi.	"
81	Eldorado.	"
89	Harrisburg.	14 a. & b. L. Coal Mrs.
102	Stonefort.	"
126	Vienna.	13 a. Low. Carbon. l. s.
151	Mound City.	18 & 19. Creta. & Ter'y.
157	Cairo.	"

Chicago Danville and Vincennes Railroad.

0	Chicago.	5. Niagara, 86 miles.
20	Blue Island.	"
34	Bloom.	"
38	Crete.	"
52	Grant.	"
58	Momence.	"
69	St. Anne.	"
86	Watseka.	14 a. & b. L. Coal Mres.
108	Hoopston.	" 46 miles.
132	Danville.[43]	"

Chicago and North-Western Railroad.

0	Chicago.	5. Niagara.
6	Austin.	"
9	Oak Park.	"
25	Wheaton.	"
36	Geneva.	"
38	St. Charles.	"
44	Blackberry.	"
55	Cortland.	"
58	De Kalb.	"
64	Malta.	"
75	Rochelle.	4 c. Cincinnati.
84	Ashton.	"
88	Franklin.	4 a. Trenton.
98	Dixon.	"
110	Sterling.	" & 5. Niagara.
124	Morrison.	5. Niagara.
136	Fulton.	
138	Clinton.	4 c. Cincinnati.

(Continued in Iowa.)

Green Bay and Lake Superior Line.

0	Chicago.	5. Niagara.
22	Arlington Heights.	"
26	Palatine.	"
38	Cary.	"
43	Crystal Lake.	"
51	Woodstock.	"
63	Harvard Junc'n	"
71	Sharon.	4 c. Cincinnati.
78	Clinton Junct'n.	"
91	Janesville.	"

Evansville, Terre Haute & Chicago R.R.

0	Danville.	14 c. Upper Coal Mres.
8	Gessie.	"

Chicago and North-Western Railroad.

Milwaukee Division.

Ms.		
0	Chicago.	5. Niagara.
12	Evanston.	"
21	Highland Park.	"
35	Waukegan.	"
45	State Line.	"

Freeport and Dubuque Line.

0	Chicago.	5. Niagara, 66 miles.
6	Austin.	"
9	Oak Park.	"
25	Wheaton.	"
30	Junction.	"
39	Clintonville.	"
42	Elgin.	"
66	Marengo.	"
78	Belvidere.	4 c. Cincinnati.
93	Rockford.	4 a. Trenton.
100	Winnebago.	"
107	Pecatonica.	"
121	Freeport.	"

Kenosha Division.

0	Rockford.	4 a. Trenton, 18 miles.
16	Poplar Grove.	"
21	Capron.	4 c. Cincinnati.
28	Harvard Junc'n	5. Niagara.
34	Alden.	"
45	Genoa.	"
51	Bassett's Mills.	"

Madison and St. Paul Line.

77	Caledonia Junc.	4 a. Trenton.
78	Caledonia.	"
85	Roscoe.	"
90	Beloit.	"

Chicago and Paducah Railroad.

93	Pontiac.	14 a. & b. L. Coal Mrs.
104	Fairbury.	"
126	Gibson.	"
134	Foosland.	14 c. Upper Coal Mres.
145	Mansfield.	"
158	Monticello.	"
180	Lovington.	"
188	Sullivan.	"
200	Windsor.	"
229	Altamont.	"
99	Streator.	14 a. & b. L. Coal Mrs.
105	Newtown.	"
110	Cornell.	"
115	Rowe.	"
118	Chicago Junc'n.	"

Carbondale and Shawneetown Railroad.

0	Marion.	14 a. & b. L. Coal Mrs.
3	Bainbridge.	"
11	Fredonia.	"
18	Carbondale.	"

41. St. Louis limestone fossils scarce, 3 miles west of the town outcrops of Hamilton and Corniferous limestone with fossils.

42. Band of ferruginous shale abounding in Upper Coal Measure fossils.

43. Numerous fossil shells replaced with yellow pyrite occur in the roof shales of coal No. 7.

Chicago and Illinois Southern R. R.

Ms.		
0	Mattoon.	14 c. Upper Coal Mres.
10	Nelson.	"
19	Hampton.	"
23	Bethany.	"
29	Dalton.	"
33	Hervey City.	"

Chicago and Iowa Railroad.

0	Chicago.	5 c. Niagara.
39	Aurora.	"
57	Hinckley.	"
64	Waterman.	"
69	Shabbona.	4 c. Cincinnati.
79	Steward.	"
86	Rochelle.	"
89	Flag Centre.	4 a. Trenton.
94	King's.	"
98	Holcomb.	"
100	Davis Junction.	"
113	Rockford.	"

Chicago, Milwaukee and St. Paul R. R.

0	Chicago.	5 c. Niagara.
6	Pacific Junction	"
14	Montrose.	"
24	Deerfield.	"
32	Libertyville.	"
39	Gurnee.	"
47	Russell.	"

Chicago and Pacific Railroad.

0	Chicago.	5. Niagara.
8	Galewood.	"
19	Salt Creek.	"
24	Roselle.	"
35	Elgin.	"
50	Hampshire.	"
59	Genoa.	"
62	Kingston.	4 c. Cincinnati.
74	Monroe.	4 a. Trenton.
88	Byron.	"

Cincinnati, Lafayette and Chicago R. R.

0	Lafayette, Ind.	
46	Sheldon, Ill.	5 c. Niagara.
49	Iroquois.	"
59	St. Mary.	"
65	St. Anne.	"
75	Kankakee.	"
131	Chicago.	"

Grand Tower and Carbondale Railroad.

0	Grand Tower.[44]	9–11. Devonian. 13 a. L. Carbon. l. s.
10	Sand Ridge.	14 a. & b. L. Coal Mrs.
15	Mount Pleasant.	"
19	Mount Carbon.	"
24	Carbondale.	"

Gilman, Clinton and Springfield Railroad.

Ms.		
0	Springfield.	14 c. Upper Coal Mres.
24	Mount Pulaski.	"
44	Clinton.	"
62	Farmer City.	
82	Gibson.	14 a. L. Cl. Mrs. 15 ms
97	Roberts.	4 b. Cincinnati, 14 ms.
111	Gilman.	5. Niagara, 5 miles.

Wabash Railroad.

Hannibal Division.

0	Bluffs.	13 a. L. Sub-Carb. l. s.
4	Naples.	"
13	Griggsville.	14 a. Lower Coal Mres.
17	Maysville.	"
6	Pittsfield.	"
20	New Salem.	"
27	Hadley.	13 a. Low. Carbon. l. s.
37	Kinderhook.[45]	"
40	Hulls.	"
50	Hannibal, Mo.	"

Illinois Midland Railroad.

0	Terre Haute.	14 a. & b. L. Cl. Mrs. 27
22	Paris.	" miles.
27	May's.	"
31	Redmon.	14 c. Upper Coal Mres.
57	Arcola.	"
71	Williamsburg.	"
87	Hervey City.	"
96	Decatur.	"
128	Waynesville.	"
142	Armington.	"
166	Morton.	"
166	Morton.	"
170	Groveland.	14 a. & b. L. Coal Mrs.
178	Pekin.	"
170	Farmdale.	"
176	Peoria.	"

Indianapolis, Bloomington & Western R. R.

74	Mound City.	
85	Danville.	14 a. & b. L. Coal Mrs.
107	St. Joseph.	"
116	Urbana.	14 c. Upper Coal Mres.
118	Champaign.	"
128	Mahomet.	"
141	Farmer City.	"
151	Le Roy.	"
166	Bloomington.	"
177	Danver's.	"
186	Mackinaw.	"
193	Tremont.	
202	Pekin.	14 a. & b. L. Coal Mrs.
211	Peoria.	

44. Fine outcrops of Upper Silurian and Devonian strata with characteristic fossils.
45. Fine outcrop of the Kinderhook division of the Lower Carboniferous, with characteristic fossils, and Burlington limestone capping the bluffs.

Indianapolis, Bloomington and Western Railroad—*Continued.*

Ms.		
116	Urbana.	14 c. Upper Coal Mres.
118	Champaign.	"
128	Mahomet.	"
139	Monticello.	"
164	Decatur.	"
141	Deland.	"
158	Clinton.	"
180	Lincoln.	"
187	Burtonview.	14 a. & b. L. Coal Mrs.
198	Mason City.	"
219	Havana.	"

Illinois and St. Louis Railroad.

1	East St. Louis.	13 a. Low. Carbon. l. s.
5	Centreville.	"
7	Pittsburg.[46]	14 a. & b. L. Coal Mrs.
11	Lenz.	"
15	Bellville.[47]	"

Indianapolis, Decatur and Springfield R.R.

0	Decatur.	14 c. Upper Coal Mres.
20	Hammond.	"
36	Tuscola.	"
42	Camargo.	"
52	Newman.	"
68	Chrisman.	14 a. & b. L. Coal Mrs.
76	Illiana.	"

Iron Mountain, Chester and Eastern R.R.

0	Tamaroa.	14 a. & c. L. Coal Mrs.
10	Pinckneyville[48]	"
20	Cutler.	"
26	Steel's Mills.	"
31	Bremen.	13 a. Low. Carbon. l. s.
41	Chester.[49]	"

Jacksonville, North-Western and South-Eastern Railroad.

0	Jacksonville.	14 a. & b. L. Coal Mrs.
12	Franklin.	"
18	Waverly.	"
25	Lowder.	"
31	Virden.	14 c. Upper Coal Mres.

Lake Shore and Michigan Southern R.R.

0	Chicago.	5 c. Niagara.
7	Englewood.	"
12	South Chicago.	"

Michigan Central Railroad.

0	Chicago.	5. Cincinnati.
14	Kensington.	"
35	Lake.	"

Michigan Central Railroad—*Continued.*

Ms.	Joliet Division.	
0	Lake.	5. Cincinnati.
15	Dyer.	"
24	Matteson.	"
32	Frankfort.	"
37	Spencer.	"
45	Joliet.	"

Ohio and Mississippi Railroad.

0	St. Louis.	(See Missouri.)
2	East St. Louis.	13 a. L. Car. l. s. 5 ms.
10	Caseyville.[50]	14 a. & b. L. Coal Mrs.
18	O'Fallon.	"
24	Lebanon.	"
27	Summerfield.	"
31	Trenton.	"
39	Breese.	14 c. Upper Coal Mres.
48	Carlyle.	"
61	Sandoval.	"
65	Odin.	"
70	Salem.	"
87	Xenia.	"
96	Flora.	"
103	Clay City.	"
118	Olney.	"
130	Sumner.	"
139	Lawrenc'ville[51]	"
149	Vincennes.	"

Springfield Division.

0	Beardstown.	14 a. & b. L. Coal Mrs.
13	Virginia.	"
29	Pleasant Plns[52]	"
40	Bradford.	"
44	Coal Shaft.	14 c. Upper Coal Mres.
45	Springfield.	"
53	Rochester.	"
63	Edinburg.	"
72	Taylorsville.	"
88	Pana.	"
121	Altamont.	"
132	Edgewood.	"
146	Louis.	"
153	Flora.	"
174	Fairfield.	"
181	Barnhill.	"
194	Enfield.	"
199	Sacramento.	"
209	Omaha.	14 a. Lower Coal Mres.
216	Ridgeway.	"
225	St. L. & S.E. Jn	"
228	Shawneetown.	"

46. Roof shale and limestone of No. 6 coal full of fossils.
47. Another outcrop of the same.
48. Fossils in the limestone over the coal.
49. Outcrop of nearly 250 feet of Chester limestone and shale abounding in the characteristic fossils of this group.
50. Fossils in limestone and shale over coal No. 6.
51. Fossils of Upper Coal Measures abundant in shale below the mill dam and 2 miles east of town at the bridge on the wagon road.
52. Fossils in shale and limestone over coal No. 5.

Ms.	Paris and Danville Railroad.	
0	Danville.	14 a. Lower Coal Mres.
10	Georgetown.	"
16	Ridge Farm.	"
23	Chrisman.	"
30	Paris.	"
52	Marshall.	14 c. Upper Coal Mres.
81	Robinson.	"
90	Flat Rock.	"
97	Pinkstaff.	"
102	Lawrenceville.	"
103	O. & M. Junc'n	"
108	Beman.	"
112	Vincennes.	"

	Pekin, Lincoln and Decatur Railroad.	
0	Decatur.	14 c. Upper Coal Mres.
9	Warrensburg.	"
22	Mount Pulaski.	"
33	Lincoln.	"
41	Hartsburg.	"
51	Delavan.	14 a. & b. L. Coal Mrs.
68	Pekin.	"
77	Peoria.	"

	Peoria, Pekin and Jacksonville Railroad.	
0	Peoria.	14 a. & b. L. Coal Mrs.
10	Pekin.	"
22	Manito.	"
27	Forest City.	"
41	Havana.	"
49	Bath.	"
59	Chandlerville.	"
68	Virginia.	"
83	Jacksonville.	"

	Peoria and Rock Island Railway.	
0	Peoria.	14 a. & b. L. Coal Mrs.
15	Dunlap.	"
22	Princeville.	"
31	Wyoming.	"
36	Toulon.	"
42	Lafayette.	"
48	Galva.	"
53	Bishop Hill.	"
62	Cambridge.	"
68	Osco.	"
80	Coal Valley.	"
86	Milan.	"
91	Rock Island.	"9-11. Dev.

	Pittsburg, Fort Wayne and Chicago R.R.	
0	Chicago.	5 c. Niagara.
13	Hobart.	"

Ms.	Quincy, Alton and St. Louis Railroad.	
0	Quincy.	13 a. Low. Carbon. l. s.
10	Fall Creek.	"
17	Hannibal.[53]	"
19	Hull's.	"
36	Rockport.[54]	"
41	Pike.	5. U. Silur. Niag. group.
43	Louisiana.[55]	"

	Springfield and North-Western Railroad.	
0	Springfield.	14 c. Upper Coal Mres.
13	Athens.	14 b. Lower Coal Mres.
22	Petersburg.	"
31	Oakford.	"
47	Havana.	"

	Sycamore and Cortland Railroad.	
0	Cortland.	
5	Sycamore.	

	St. Louis, Rock Island and Chicago Railroad.	
	St. Louis.	13 a. Low. Carbon. l.s.
	East St. Louis.	"
0	Alton.	"
20	Upper Alton.	14 a. & b. L. Coal Mrs.
25	Brighton.	"
38	Medora.	"
42	Kemper.	"
55	Greenfield.	"
67	Whitehall.	13 a. Low. Carbon. l. s.
82	Winchester.[56]	"
87	Riggston.	14 a. & b. L. Coal Mres.
92	Chapin.	"
101	Arenzville.	"
111	Beardstown.	"
115	Frederick.	"
120	Browning.	"
135	Vermont.	"
154	Bushnell.	"
170	Roseville.	"
182	Monmouth.	"
203	Rio.	"
220	Orion.	"
227	Port Byron.[57]	"
239	Rock Island.	9–11. Devonian.
242	Moline.	"
246	Port Byron Jun.	"
255	Rock River Jun	5. Niagara.
268	Erie.	"
278	Lyndon.	"
280	R. I. Junction.	"
291	Sterling.	4 a. Trenton.

53. Burlington limestone and Kinderhook group.
54. Kinderhook group with a few feet of Devonian and Upper Silurian at the base of the bluff.
55. Kinderhook, Devonian and Upper Silurian, the highest bluffs capped with Burlington limestone.
56. St. Louis limestone and Lower Coal Measures with characteristic fossils.
57. Niagara limestone with numerous fossils.

Ms.	St. Louis, Alton and Terre Haute R.R.	
0	East St. Louis.	13 a. Low. Carbon. l. s.
6	Centreville.	"
10	Ogles.	14 a. & b. L. Coal Mrs.
13	West Bellville.	"
14	Bellville.	"
22	Freeburg.[58]	"
29	New Athens.	"
47	Coulterville.	"
61	Pinckneyville.	"
71	Du Quoin.	"

	St. Louis and South-Eastern Railroad.	
0	East St. Louis.	13 a. Low. Carbon. l. s.
14	Bellville.	14 a. & b. L. Coal Mres.
0	Bellville.	"
6	O'Fallon.	"
20	Reutchler's.	"
25	Mascoutah.	"
32	New Memphis.	"
35	Venedy.	"
49	Nashville.	14 c. Upper Coal Mres.
60	Ashley.	"
69	Woodlawn.	"
87	Belle River.	"
100	Shawnee Junc'n	"
0	Shawnee Junc'n	"
1	McLeansboro.	"
13	Broughton.	"
22	Eldorado.	"
30	Equality.	14 b. Lower Coal Mres.
36	Cyprese Junc'n.	
42	Shawneetown.	
101	McLeansboro.	14 c. Upper Coal Mres.
113	Enfield.	"
123	Carmi.	"
131	Wabash.	"

	St. Louis, Vandalia and Terre Haute R. R.	
0	East St. Louis.	13 a. Low. Carbon. l. s.
11	Collinsville.	14 a. Lower Coal Mres.
19	Troy.	"
30	Highland.[59]	14 b. Upper Coal Mres.
40	Pocahontas.	"
49	Greenville.	"
67	Vandalia.	"
81	St. Elmo.	"
86	Altamont.	"
98	Effingham.	"
102	Teutopolis.	"
122	Greenup.	"
130	Casey.[60]	"
137	Martinsville.	"
148	Marshall.[61]	"
151	Griffiths.	"

Ms.	St. Louis, Vandalia and Terre Haute Railroad—*Continued.*	
155	Dennison.	13 a. Low. Carbon. l. s.
158	Farrington.	"
166	Terre Haute.	"

	Toledo, Peoria and Warsaw Railroad.	
0	State Line.	5. Niagara.
2	Sheldon.	"
11	Watseka.[62]	"
25	Gilman.	"
29	La Hogue.	4 c. Cincinnati.
40	Chatsworth.	"
47	Forrest.	"
52	Fairbury.	
63	Chenoa.	14 a. & b. L. Coal Mrs.
67	Meadows.	14 c. Upper Coal Mres.
78	El Paso.	"
92	Eureka.	"
99	Washington.	"
109	Hilton.	14 a. Lower Coal Mres.
111	Peoria.	"
139	Canton.	"
149	Cuba.	"
171	Bushnell.	"
189	Blandinsville.	"
195	La Harpe.	13 a. Low. Carbon. l. s.
215	Burlington.	"
195	La Harpe.	"
200	La Crosse.	"
210	Ferris.	"
216	Elvaston.	"
222	Hamilton.[63]	"
227	Warsaw.[63]	"

	Wabash Railroad.	
0	Toledo,(see Indiana.)	14 b. U. Cl. Mrs.
242	State Line.	"
250	Danville.	"
262	Fairmount.	"
269	Homer.	"
275	Sidney.	"
280	Philo.	14 c. Upper Coal Mres.
286	Tolono.	"
303	Bement.	"
311	Cerro Gordo.	"
323	Decatur.	"
339	Illiopolis.	"
348	Buffalo.	"
362	Springfield.	"
378	Berlin.	"
385	Alexander.	"
395	Jacksonville.	"
413	Bluffs.	"
426	Versailles.	13 c. Low. Carbon. l. s.
436	Mount Sterling.	"
446	Clayton.	"

58. Coal shale 1½ miles northeast of station full of fossil shells.
59. Limestone over No. 9 coal with fossils.
60. Upper Coal Measure limestone full of fossils.
61. Fossils in roof shales and limestone of coals No 5 and 6.
62. Coal Measure limestone with fossil corals and shells.

Ms.	Wabash Railroad—*Continued.*	
446	Clayton.	13 c. Low. Carbon. l. s.
453	Labuda.	"
462	Bowen.	"
467	Denver.	"
476	Carthage.	13 a. Low. Carbon. l. s.
481	Elvaston.	"
488	Hamilton.	"
452	Camp Point.	14 b. Lower Coal Mres.
457	Coatsburg.	"
463	Fowler.	13 a. Low. Carbon. l. s.
474	Quincy.	"

St. Louis Division.

324	Decatur.	14 c. Upper Coal Mres.
331	Boody.	"
351	Taylorville.	"
383	Litchfield.	"
397	Staunton.	"
413	Edwardsville.	14 b. Lower Coal Mres.
429	Venice.	13 a. L. Sub-Carb. l. s.
432	East St. Louis.	"

Ms.	Western Union Railroad.	
0	Racine.	(See Wisconsin.)
69	Beloit.	4 a. Trenton.
90	Davis'.	"
103	Freeport.	"
111	Florence.	5. Niagara.
117	Shannon.	"
124	Lanark.	"
131	Mt. Carroll.[64]	4 a. Trenton.
142	Savanna.[64]	4 c. Cincinnati.
159	Fulton.	"
166	Albany.	14 b. Niagara.
181	Port Byron.	"
187	Hampton.	14 b. Lower Coal Mres.
194	Moline.	"
197	Rock Island.	Devonian.

63. Fine outcrops of Keoknk limestone with numerous fossils, and geodes containing crystalized quartz, chalcedony, calcite, dolomite, arragonite, blende and pyrite.

64. Cincinnati group with characteristic fossils, and near Savanna the Niagara limestone caps the hills and affords silicified corals in abundance.

Wisconsin.[1]

LIST OF THE GEOLOGICAL FORMATIONS IN WISCONSIN:

20. Quaternary, { Post Glacial.[2] / Glacial.
10. Hamilton, (Milwaukee Cement Rock.)
7. Lower Helderberg.
5 c. Niagara Limestone.[3]
5 b. Clinton.[4]
4 c. Cincinnati Shale.
4 b. Galena Limestone.
4 a. Trenton Limestone.[5]
3 c. St. Peter's Sandstone, (Chazy of New York ?)
3 a. Lower Magnesian, (Calciferous.)[6]
2 b. Potsdam Sandstone.[7]
Copper bearing series.
1 b. Huronian.
1 a. Laurentian.

Chicago and North-Western Railroad.

Ms.	Chicago, St. Paul and Minneapolis Line.	
0	Chicago.	(As before.)
90	Beloit.	4 b. Galena l. s. 4 a. Trenton l. s. 3 c. St. Peter's s. s.
98	Afton.	4 a. Trenton l. s. 3 c. St. Peter's s. s.
104	Hanover.	4 a. Trenton limestone.
107	Footville.	4 a. Trenton l. s. 3 c. St. Peter's s. s.
111	Magnolia.	"
116	Evansville.	4 a. Trenton limestone.
122	Brooklyn.	20. Moraine Drift.
128	Oregon.	4 a. Trenton l. s. 3 c. St. Peter's s. s.
133	Syene.	3 c. St. Peter's s. s. 3 a. Lower Magn. l.s.
138	Madison.	20. Quat. Mor. Drift. 3 a. Lower Magn. l.s. 2 b. Madison s. s. Mendota limestone. Potsdam sandstone.
143	Mendota.	In cut, 3 a. L. Magn. 2 b. Mad. s. s.
148	Waunakee.	3 a. Lower Magn. l. s. on bluffs. 2 b. Potsdam s. s.

Chicago and North-Western Railroad.

Ms.	Chicago, St. Paul and Minneapolis Line—*Continued.*	
153	Dane.	3 a. Lower Magn. l.s. (on top of high dividing ridge.)
158	Lodi.	3 a. Lower Magn. l.s. capped bluffs. 2 b. Mad. s.s. } bluff 2 b. Mend.l.s. } sides. 2 b. Potsdam s. s. valley bottom.
164	Merrimac.	2 b. Potsdam sandstone.
172	Devil's Lake.	1. Archæan Quartzite. 2 b. Potsdam sandstone and Conglom.
175	Baraboo.	1. Archæan Quartzite. 2 b. Potsdam s. s.
181	North Freedom.	2 b. Potsdam sandstone.
184	Ableman's.	1. Archæan Quartzite. 2 b. Potsdam s. s. (in gorge 200 ft. deep, uncomformability & exact junction.)
191	Reedsburg.	2 b. Potsdam sandstone.
198	Lavelle.	"
205	Wonowoc.	"
208	Union Centre.	"
212	Elroy.	"

1. Prepared by Professor T. C. Chamberlin, of Beloit, the State Geologist, and Professors R. D. Irving and M. Strong, Assistant Geologists.
2. Including the Champlain and Terrace.
3. Including four sub-divisions in the southern part of the State and six in the northern, among which are the Racine and Guelph limestones.
4. The Clinton produces the Iron Ridge iron ore, the fossil ore of other States.
5. Including two sub-divisions in the lead region and four in southeastern Wisconsin.
6. The Calciferous may include more than the Lower Magnesian.
7. Including several sub-divisions, among them the Madison sandstone and the Mendota limestone.

Chicago & North-Western Railroad—*Cont.*

via West Wisconsin Railroad.

Ms.		
212	Elroy.	2 b. Potsdam sandstone.
226	Camp Douglas.	"
227	Wis. Vall. Jun.	"
242	Lowery's.	"
244	Warren's.	"
249	Rudd's.	"
265	Blk River Falls.	2 b. Potsdam sandstone, resting on 1 Archæan Gneiss.
277	Merrillan.	2 b. Potsdam sandstone.
282	Humbird.	"
289	Fairchild.	"
299	Augusta.	"
309	Fall Creek.	"
321	Eau Claire.	"
323	West Eau Claire	"
332	Elk Mound.	"
339	Rusk.	"
344	Menomonee.	"
353	Knapp.	3 a. Lower Magnesian.
358	Wilson.	20. Quaternary.
361	Hersey.	"
369	Baldwin.	"
372	Hammond.	"
378	Roberts.	"
390	Hudson.	2 b. Potsdam.
394	Stillwater Junc.	
410	St. Paul.	(See Minnesota.)

Kenosha and Rockford Division.

0	Kenosha.	20. Quaternary.
6	Pleasant Prairie	"
10	Woodworth.	"
12	Bristol.	"
15	Salem.	"
19	Fox River.	"
22	Bassett.	"
27	Genoa Junction.	"
44	Harvard Junctn	(See Illinois.)
72	Rockford.	"

Minnesota Division.

0	Chicago.	(As before.)
212	Elroy.	2 b. Potsdam sandstone.
217	Glendale.	"
227	Wilton.	"
233	Norwalk.	"
246	Sparta.	"
255	Bangor.	"
260	Salem.	"
267	Winona Junc'n.	"
276	La Crosse.	"
267	Winona Junc'n.	"
269	Onalaska.	"
273	Midway.	"
278	Lytles.	"
284	Trempeleau.	"
292	Marshland.	"
297	Winona.	(See Minnesota.)

Chicago & North Western Railroad—*Cont.*

Milwaukee, Green Bay and Lake Superior Division.

Ms.		
0	Chicago.	(As before.)
45	State Line.	20. Quaternary.
51	Kenosha.	"
60	Racine Junct'n.	5 c. Niag. (Racine) l. s.
62	Racine.	"
70	County Line.	20. Quaternary.
75	Oak Creek.	"
81	St. Francis.	"
83	Elizabeth St.	"
85	Milwaukee.	10. Hamilton, Milwaukee Cement Rock. 5 c. Niagara.
90	Lake Shore Jun	20. Quaternary
91	Lindwerm.	"
100	Granville.	5 c. Niagara.
107	Germantown.	"
112	Jackson.	"
119	West Bend.	20. Moraine Drift.
120	Barton.	"
126	Kewaskum.	" 5 c. Niaga.
133	New Cassel.	" "
140	Eden.	" "
148	Fond du Lac.	4 b. Galena limestone.
165	Oskosh.	4 b. Galena l. s. 4 a. Trenton l. s.
178	Menasha and Neenah.	"
180	West Menasha.	"
185	Appleton.	4 b. Galena l. s. 4 a. Trenton l. s.
190	Little Chute.	4 b. Galena limestone.
192	Kaukauna.	"
198	Wrightstown.	"
208	De Pere.	"
214	Ft. Howard and Green Bay.	4 c. Cincinnati shale. 4 b. Galena l. s.
218	Duck Creek.	4 b. Galena limestone.
222	Big Suamico.	"
228	Little Suamico.	"
233	Brookside.	20. Quaternary.
237	Pensaukee.	4 b. Galena l. s. 4 a. Trenton l. s.
242	Oconto.	20. Quaternary.
252	Cavoits.	"
256	Peshtigo.	4 b. Galena l. s. 4 a. Trenton l. s.
263	Marinette.	4 b. Galena limestone.
264	Menomonee.	"
382	Escanaba, Mich. (Continued	(See Michigan.) in Michigan.)

Chicago, Milwaukee and St. Paul Railroad.

Chicago, Milwaukee, La Crosse, St. Paul and Minneapolis Division.

0	Chicago.	(As before.)
43	Wadsworth.	20. Quaternary.
52	Kenosha Junc'n	"
53	Truesdell.	"
62	W. U. Junction	"

Chicago, Milwaukee and St. Paul Railroad.

Chicago, Milwaukee, La Crosse, St. Paul and Minneapolis Division—*Continued.*

Ms.		
85	Milwaukee.	10. Hamilton, Milwaukee Cement Rock. 5 c. Niagara l. s.
98	Brookfield.	20. Quaternary.
109	Pewaukee.	5 c. Niagara limestone.
109	Hartland.	20. Quaternary.
111	Nashotah.	"
116	Oconomowoc.	"
129	Watertown.	4 b. Galena limestone.
130	Watertown Jun	"
139	Reeseville.	20. Quaternary.
144	Elba.	"
148	Columbus.	3 a. Lower Magn. l. s.
152	Fall River.	"
158	Doylestown.	"
163	Rio.	"
168	Wyocena.	2 b. Mad. s.s. in R. 2 b. Men. s. s. R. cut 2 b. Potsdam s. s.
176	Portage City.	2 b. Potsdam sandstone.
193	Kilbourn.	2 b. Potsdam s. s., finely exposed in dalles of Wisc'n.
202	Lyndon.	2 b. Potsdam sandstone.
209	Lemonweir.	"
212	Mauston.	" large out-
220	Lisbon.	" liers.
225	Camp Douglas.	" "
238	Tomah.	"
242	Greenfield.	"
249	Lafayette.	"
255	Sparta.	"
265	Bangor.	"
270	West Salem.	"
277	Winona Junc'n.	"
280	La Crosse.	"
410	St. Paul.	(See Minnesota.)
420	Minneapolis.	"

Prairie du Chien, and Iowa and Minnesota Division.

Ms.		
0	Milwaukee.	10. Hamilton, Milwaukee Cement Rock. 5 c. Niagara l. s.
6	Wauwatosa.	5 c. Niagara limestone.
10	Elm Grove.	20. Quaternary.
14	Brookfield Jun.	"
17	Forest House.	"
21	Waukesha.	5 c. Niagara limestone.
28	Genesee.	"
31	North Prairie.	20. Quaternary.
37	Eagle.	Kettle Range. 20. Moraine Drift.
42	Palmyra.	"
51	Whitewater.	4 b. Galena limestone.
56	Lima.	20. Quaternary.
62	Milton.	"
64	Milton Junction	"
71	Edgerton.	4 a. Trenton. 3 c. St. Peter's s. s.

Chicago, Milwaukee and St. Paul Railroad.

Prairie du Chien, and Iowa and Minnesota Division—*Continued.*

Ms.		
81	Stoughton.	20. Quaternary.
89	McFarland.	20. Heavy Drift. 3 a. Lower Magn. l.s.
96	Madison.	20. Moraine Drift. 3 a. Lower Magn. l.s.
102	Middleton.	2 b. Madison s. s. 2 b. Mendota l. s. 2 b. Potsdam s. s. 3 a. Lower Magn. l.s. (capping bluffs.)
110	Cross Plains.	2 b. Mad. s.s. bluff 2 b. Men. l.s. sides. 2 b. Potsdam s.s. valley bottom.
115	Black Earth.	"
119	Mazomanie.	"
125	Arena.	2 b. Potsdam sandstone.
132	Spring Green.	3 a. Low. Magn., &c., on bluffs. 2 b. Potsdam s. s. on low ground.
139	Lone Rock.	2 b. Potsdam in the valley. Adjacent bluffs capped with 3 a. Lower Magnesian limestone.
145	Avoca.	
151	Muscoda.	
166	Boscobel.	
176	Wauzeka.	
183	Wright's Ferry.	
186	Bridgeport.	3 a. Lower Magnesian.
194	Prairie du Chien	"

Ms.		
64	Milton Junction	20. Quaternary.
71	Janesville.	4 a. Trenton l. s. 3 c. St. Peter's s. s.
78	Hanover.	4 a. Trenton limestone.
83	Orford.	4 a. Trenton l. s. 3 c. St. Peter's s. s.
90	Brodhead.	"
105	Monroe.	4 b. Galena limestone.

Madison Division.

0	Madison.	3 a. Lower Magnesian.
12	Sun Prairie.	4 a. Trenton.
18	Deanville.	20. Quaternary.
20	Marshall.	"
23	Waterloo.	4 a. Trenton l. s. 3 a. Lower Magn. l.s. 1 a. Arch. Quartzite.
27	Hubbleton.	20. Quaternary.
37	Watertown Jun	4 b. Galena limestone.

Northern Division.

0	Milwaukee.	10. Hamilton, Milwaukee Cement Rock. 5 c. Niagara l. s.
9	Schwartzburg.	"
15	Granville.	"
20	Germantown.	"
25	Richfield.	20. Quaternary.
33	Schleising'ville.	" Moraine.

Chicago, Milwaukee and St. Paul Railroad.

Northern Division—*Continued.*

Ms.		
37	Hartford.	5 c. Niagara l. s. 5 b. Clinton iron ore. 4 c. Cincinnati shale.
41	Rubicon.	20. Quaternary.
46	Woodland.	"
47	Iron Ridge.	5 c. Niagara l. s. 5 b. Clinton iron ore. 4 c. Cincinnati shale.
54	Horicon Junc'n.	20. Quaternary.
59	Burnett Junc'n.	"
68	Waupun.	4 b. Galena limestone.
76	Brandon.	20. Quaternary.
83	Ripon.	4 b. Galena l. s. 4 a. Trenton l. s. 3 c. St. Peter's s. s. 3 a. Lower Magn. l.s.
96	Berlin.	3 a. Lower Magn. l.s. 2 b. Potsdam s. s. 1. Arch. Porphyry.
90	Picket's.	4 a. Trenton limestone.
102	Oshkosh.	4 b. Galena l. s. 4 a. Trenton l. s.
90	Rush Lake.	3 a. Lower Magn. l. s.
95	Waukau.	"
99	Omro.	20. Quaternary.
104	Winneconne.	"
54	Horicon Junc'n.	20. Quaternary.
57	Minnesota Jun.	"
59	Rolling Prairie.	"
63	Beaver Dam.	4 b. Galena l. s. 4 a Trenton l. s.
69	Fox Lake Jun.	4 a. Trenton limestone.
74	Randolph.	4 a. Trenton l. s. 3 c. St. Peter's s. s. 3 a. Lower Magn. l.s.
80	Cambria.	3 a. Lower Magn. l.s. 2 b. Madison s. s. 2 b. Mendota l. s. 2 b. Potsdam s. s.
90	Pardeeville.	2 b. Potsdam sandstone,
98	Portage City.	"

Madison and Portage Division.

0	Madison.	(As before.)
1	East Madison.	"
12	Windsor.	3 a. Lower Magn. l.s. 2 b. Potsdam s. s.
16	Morrison.	3 a. Lower Magn. l. s.
21	Arlington.	3 c. St. Peter's s. s. 3 a. Lower Magn. l.s.
25	Poynette.	2 b. Potsdam sandstone.
39	Portage.	"

Western Union Railroad.

0	Racine.	5 c. Niag. (Racine) l. s.
2	Junction.	"
8	W. U. Junction.	20. Quaternary.
10	Windsor.	"
15	Union Grove.	"

Western Union Railroad—*Continued.*

18	Kansasville.	20. Quaternary.
27	Burlington.	5 c. Niagara limestone.
31	Lyons.	"
34	Springfield.	20. Quaternary.
41	Elkhorn.	"
46	Delavan.	"
50	Darien.	"
54	Allen's Grove.	"
59	Clinton	"
69	Beloit.	4 b. Galena l. s. 4 a. Trenton l. s. 3 c. St. Peter's s. s.
	(Continued	in Illinois.)
0	Eagle.	20. Moraine Drift.
6	Troy Center.	"
9	Mayhew's.	20. Quaternary.
11	Fayette.	"
17	Elkhorn.	"

Sheboygan and Fond du Lac Railroad.

0	Sheboygan.	5 c. Niagara limestone.
5	Sheboygan Falls	"
10	Town Line.	20. Quaternary.
14	Plymouth.	"
20	Glenbeulah.	Kettle Range. Moraine Drift.
26	St. Cloud.	5 c. Niagara l. s. 20. Quaternary.
30	Calvary.	5 c. Niagara limestone.
43	Fond du Lac.	4 b. Galena limestone.
44	Fond du Lac Ju.	"
47	Woodhull.	20. Quaternary.
52	Eldorado.	"
55	Rosendale.	"
57	West Rosendale	"
63	Ripon.	4 b. Galena l. s. 4 a. Trenton l. s. 3 c. St. Peter's s. s. 3 a. Lower Magn. l.s.
69	Green Lake.	4 a. Trenton l. s. 3 c. St. Peter's s. s. 3 a. Lower Magn. l.s.
72	St. Marie.	3 a. Lower Magn. l. s.
78	Princeton.	"

Green Bay and Minnesota Railroad.

0	Green Bay.	5 c. Niagara l. s. 4 c. Cincinnati shale. 4 b. Galena l. s.
10	Oneida.	"
17	Seymour.	4 a. Trenton l. s. 3 c. St. Peter's s. s.
23	Black Creek.	3 a. Lower Magn. l. s.
31	Shiocton.	20. Quaternary.
39	New London.	3 a. Lower Magn. l.s. 2 b. Potsdam s. s.
46	Royalton.	20. Quaternary.
50	Manawa.	"
55	Ogdensburg.	"
61	Scandinavia.	"

Ms.	Green Bay & Minnesota R. R.—*Cont.*	
78	Amherst.	20. Heavy Drift.
82	Plover.	2 b. Potsdam s. s.
96	Grand Rapids.	1. Archæan Gneiss, overlaid by 2 b. Potsdam s.s. and altering into Kaolin.
111	Dexterville.	2 b. Potsdam sandstone.
119	Scranton.	"
142	Hatfield.	"
149	Merrillan.	"
153	Alma Center.	"
159	Hixton.	"
166	Taylor.	"
172	Blair.	"
179	Whitehall.	"
193	Arcadia.	"
210	Marshland.	2 b. Potsdam s. s. 3 a. Lower Magn. l.s.
214	Winona.	(See Minnesota.)

Milwaukee, Lake Shore and Western Railroad.

0	Milwaukee.	10. Hamilton, Cement Rock. 5 c. Niagara l. s.
4	Lake Shore Jun	20. Quaternary.
6	White Fish Bay.	10. Hamilton.
10	Dillman's.	20. Quaternary.
13	Mequon.	"
20	Ulao.	"
25	Port Washing'n	5 c. Niagara.
31	Decker's.	"
33	Belgium.	20. Quaternary.
38	Cedar Grove.	"
42	Oostburg.	"
46	Wilson.	"
48	Weeden's.	"
52	Sheboygan.	5 c. Niagara l. s.
58	Mosel.	20. Quaternary.
64	Centreville.	"
69	Newton.	"
77	Manitowoc.	5 c. Niagara l. s.
84	Branch.	20. Quaternary.
89	Cato.	5 c. Niagara.
91	Grimms.	"
94	Reedville.	"
100	Brillion.	"
104	Forest Junction	20. Quaternary.
108	Dundas.	"
113	Kaukauna.	4 b. Galena.
115	Little Chute.	"
120	Appleton.	4 b. Galena l. s. 4 a. Trenton l. s.
77	Manitowoc.	20. Quaternary.
84	Two Rivers.	"

Wisconsin Central Railroad.

0	Milwaukee.	10. Hamilton, Cement Rock. 5 c. Niagara l. s.
	Schwartzburg.	5 c. Niagara.
18	Thienville.	20. Quaternary.
23	Cedarburg.	5 c. Niagara l. s.
25	Grafton.	"
29	Saukville.	"
36	Fredonia.	"
41	Random.	20. Quaternary.
46	Sherman.	"
50	Waldo.	"
55	Plymouth.	"
62	Elkhart Lake.	20. Quaternary. 20. Moraine. Kettle Range.
68	Kiel.	5 c. Niagara.
72	Holstein.	20. Quaternary.
	Hayton.	"
79	Chilton.	"
86	Hilbert.	"
86	Hilbert.	20. Quaternary.
91	Forest Junction	"
	Holland.	"
99	Greenleaf.	"
	Ledgeville.	5 c. Niagara.
109	De Pere.	4 b. Galena.
113	Green Bay.	5 c. Niagara l. s. 4 c. Cincinnati shale. 4 b. Galena l. s.
86	Hilbert.	20. Quaternary.
92	Sherwood.	5 c. Niagara l. s.
102	Menasha.	4 b. Galena l. s. 4 a. Trenton l. s.
113	Medina.	3 a. Lower Magnesian.
115	Dale.	"
129	Weyauwega.	2 b. Potsdam.
136	Waupaca.	1. Archæan.
	Sheridan.	20. Quaternary.
150	Amherst.	"
165	Stevens' Point.	2 b. Potsdam s.s. and 1. Archæan Gneiss.
176	Junction City.	1. Archæan.
	Mill Creek.	"
	Auburndale.	1. Archæan, overlaid by heavy drift.
197	Marshfield.	"
	Mannville.	"
206	Spencer.	"
212	Unity.	"
216	Colby.	"
228	Dorchester.	"
232	Medford.	"
244	Chelsea.	"
248	Westboro.	"
266	Worcester.	"
273	Phillips.	"
281	Wauboo.	"
287	Fifield.	"
297	Butternut Creek	"
309	Chippewa.	"
324	Penokee.*	1. Hur'n, with iron ore.
	White River.	20. Quaternary.
351	Ashland.	" on Lake Superior.

Ms.	Wisconsin Central Railroad—*Cont.*	
165	Stevens' Point.	(As before.)
170	Plover.	2 b. Potsdam, overlaid by drift.
176	Buena Vista.	"
187	Plainfield.	"
193	Hancock.	"
211	Westfield.	"
220	Pachwaukee.	"
236	Portage.	"

North Wisconsin Railroad.

0	Clayton.	20. Drift.
24	New Richmond	"
39	North Wis. Jun	"
42½	Hudson.	2 b. Potsdam s. s.

Wisconsin Valley Railroad.

0	Tomah.	2 b. Potsdam sandstone.
7	Valley Junction	"
10	Norway.	"
18	Beaver.	"
29	Remington.	"
42	Port Edwards.	2 b. Potsdam s. s. on 1. Archæan Gneiss.
46½	Centralia.	"
54	Rudolph.	1. Archæan.
60	Junction City.	"
70	Knowlton.	"
76	Mosinee.	"
89	Wausau.	" (lumber region.)

Ms.	Mineral Point Railroad.	
0	Mineral Point.	4 b. Galena l. s. 4 a. Trenton l. s. 3 c. St. Peter's s.s.
10	Calamine.	4 b. Galena l. s. 4 a. Trenton l. s. 3 c. St. Peter's s. s.
20	Belmont.	4 b. Galena limestone.
28	Platteville.	4 b. Galena l. s. 4 a. Trenton l. s.
0	Mineral Point.	(As before.)
10	Calamine.	4 b. Galena limestone.
16	Darlington.	4 a. Trenton limestone.
26	Gratiot.	4 b. Galena l. s. 4 a. Trenton l. s.
33	Warren.	(See Illinois.)

Galena and South Wisconsin Railroad.

0	Galena, Ill.	4 b. Galena limestone.
7	Bell's.	"
11	Gillett's.	"
15	Benton.	"
20	St. Rose.	"
32	Platteville.	4 b. Galena l. s. 4 a. Trenton l. s.

* Unconformability between Huronian and Laurentian finely shown at Penokee.

NOTE.—Where several formations are given it is to be understood that they occur in the vicinity, not necessarily immediately at the station. Also, that where the drift effectually conceals the underlying formations, they are not usually given, though in almost all cases definitely known.

Minnesota. *

List of the Geological Formations found in Minnesota:

FORMATIONS PER GENERAL LIST.	MINNESOTA SUB-DIVISIONS.	FORMATIONS PER GENERAL LIST.	MINNESOTA SUB-DIVISIONS.
20. Quaternary.	20. Quater'y or drift.	4 a. Trenton.	4 b. Galena l. s.
18. Cretaceous.	18 b. Benton.	"	4 a. Trenton l. s.
"	18 a. Dakota.	3 a. Calciferous.	3 b. St. Peters s. s.
10. Hamilton.	10 a. Hamilton l. s.	"	3 a. Low Magnesian.*
9 c. Corniferous.	9 c. Corniferous.	2 b. Potsdam.	2 c. St. Croix s. s.
5 c. Niagara.	5 c. Niagara l. s.	"	2 b. Potsdam s. s.
4 c. Cincinnati.	4 c. Maquoketa sh.	1. Archæan.	1. Archæan.

*Sub-divided into 3 Shakopee l. s., 2 Jordan s. s., and 1 St. Lawrence l. s.

Ms.	1 Southern Minnesota R. R.	
0	Milwaukee.	
0	La Crescent.	2 b. Potsdam. Bluffs. / 3 a. Calciferous. "
1	Gr'nd Crossing	"
32	Rushford.	" "
37	Peterson.	"
46	Whalan.	"
51	Lanesboro.	3 a. Calciferous. [1]
57	Isinours.	" [2]
62	Fountain.	3 b. St. Peters. / 4 a. under village.
70	Wykoff.	4 a. Trenton. Freq'nt sink-holes.
77	Spring Valley.	4 b. Galena.
86	Grand Meadow	18 Cretac's (probably) heavy drift.
101	Brownsdale.	"
106	Ramsay.	18 Cretaceous.
113	Oakland.	" probably.
122	Hayward.	"
128	Albert Lea.	" over Devon'n.
138	Alden.	" "
147	Wells.	" heavy drift.
162	Delaware.	" "
171	Winnebago.	" "

Ms.	2 Winona & St. Peter's (C. & N. W.) R. R.	
297	Winona.	2 b. Potsdam, and 3 a. Calcifr's in bluffs.
303	Minnesota City	"

Ms.	Winona and St. Peter's—*Continued.*	
308	Stockton.	3 a. Calciferous.
316	Lewiston.	"
319	Utica.	"
325	St. Charles.	4 a. Trenton. / 3 b. St. Peters. / 3 a. Calciferous. } in bl'ffs.
329	Dover.	3 b. and 4 a.
334	Eyota.	4 a. Trenton.
347	Rochester.	(Same as St. Charles.)
356	Byron.	4 b. Galena l. s.
362	Kasson.	"
368	Dodge Centre.	18 Cretaceous.
375	Claremont.	"
382	Havana.	"
387	Owatonna.	4 a. Trenton. Heavy drift.
396	Meriden.	18 Cretaceous.
402	Waseca.	" "
413	Janesville.	" "
428	Mankato Junc.	" "
"	St. Paul and Sioux city Jn	3 a. Calciferous.
428	Mankato.	18 Cretaceous clays. [3]
437	St. Peters.	"
446	Oshawa.	"
467	New Ulm.	2 a. Acadian. Granite, Red Quatzite.
545	Marshall.	18 Cretaceous. Heavy drift.

*Prepared expressly for this work, by Prof. N. H. Winchell, of Minneapolis, the State Geologist of Minnesota.

1 The three sub-divisions of the Lower Magnesian: 1, St. Lawrence l.; 2, Jordan s. s.; and 3, Shakopee l. s. are here seen.

2 In the immediate river bluffs, are the Jordan and Shakopee. Further back are the St. Peter's and Trenton.

3 Overlying 3 a. Calciferous, i. e., its two upper members—the 2 Jordan sandstone and the 3 Shakopee limestone, seen in the bluffs.

Ms.	3 St. Paul and Sioux City R. R.	
0	St. Paul.	3 b. St. Peter's, and 4 a. Trenton.
6	Mendota Junc.	"
11	Nicols.	"
19	Hamilton.	21 Quatern. drift bluffs.
22	Bloomington.	" "
28	Shakopee.	3 a. Calcif's, Shakopee l.
34	Merriam.	" "
39	Jordan.	" and Jordan s. s.
43	St. Lawrence.	3 a. Calciferous. St. Lawrence.
47	Belle Plaine.	18 Cretaceous. Over 3 a. Calciferous.
51	Blakeley.	"
58	E. Henderson.	"
62	Le Sueur.	3 a. Calciferous, Shakopee l. s. Jordan s.s.
69	Ottawa.	"
75	St. Peter.	"
77	Kasota.	"
86	Mankato.	" 18 cret. over
89	South Bend.	"
91	Minneopa.[4]	"
99	Lake Crystal.	18 Cretac's. Heavy drift
109	Madelia.	"
116	Lincoln.	"
122	St. James.	"
137	Mountain Lake	"
148	Windom.	"
154	Wilder.	"
160	Heron Lake.	"
170	Hersey.	"
178	Worthington.	"

Ms.	4 Hastings and Dakota R. R.	
0	Hastings.	3 a. Calciferous bluffs.
8	Vermillion.	"
12	Auburn.	"
18	Farmington.	3 b. St. Peter's s. s.
22	Fairfield.	" or 4 a. Trenton
33	Prior Lake.	" "
41	Shakopee.	3 a. Shakopee l. s.
65	Chaska.	3 a. Calcif's. heavy drift
48	Carver.	" "
74	Glencoe.	18 Cretaceous. "

5 Chicago, Milwaukee and St. Paul R. R. (Iowa and Minnesota Division.)		
0	N. McGregor.	See Iowa.
85	Le Roy.	10 Hamilton.
96	Adams.	"
111	Austin.	18 Cretaceous.
114	Ramsey.	"
117	Lansing.	"
126	Blo'm'g Prairie	"
135	Aurora.	"

Chicago, Milwaukee and St. Paul—*Cont.*		
Ms.		
144	Owatonna.	4 a. Trenton, on river banks.
150	Medford.	3 a. Calcif. Shakopee l.s.
159	Faribault.	4 a. Trenton. 3 a. St. Peter's.
170	Dundas.	3 a. Calc. (Shakopee.)
173	Northfield.	3 a. Calcif's. and 4 a. Trenton on high blfs.
179	Castle Rock.	[5] 3 b. St. Peter's, s. s.
186	Farmington.	" and 4 a. Trn. near
193	Rosemount.	4 a. Tren. Heavy drift.
199	Westcott.	" "
206	St. Paul Junc.	"
212	St. Paul.	" and 3 b. St. Pet.
	(La Crosse and St. Paul Division.)	
306	Winona.	3 a. Calciferous. Bluffs 2 b. Potsdam.
313	Minnesota City	"
323	Minneiska.	"
326	Weaver.	"
333	Kellogg.	"
340	Wabasha.	"
342	Read's Land'g.	"
352	Lake City.	"
359	Frontenac.	"
369	Red Wing.	"
390	Hastings.	"
396	Langdon.	"
401	Newport.	"
409	St. Paul.	4 a. Trenton. 3 b. St. Peters.
	Ft. Snelling.	"
	Minnehaha.	"
424	Minneapolis.[6]	"

6 Minneapolis and St. Louis R. R.		
0	Minneapolis.[6]	4 a. Trenton. 3 c. St. Peter's s.s.
21	Chaska.	3 a. Calciferous.
23	Carver.	"
26	Sioux City Jun	"

7 St. Paul and Pacific R. R.		
0	St. Paul.	4 a. Trenton. 3 c. St. Peter's s. s.
10	St. Anthony.	"
11	Minneapolis.	"
25	Wayzata.	18 Cretaceous. ?
28	Long Lake.	"
33	Maple Plain.	"
35	Armstrong.	"
43	Delano.	2. Primordial. ?
49	Waverly.	"
54	Howard Lake.	"
57	Smith Lake.	"
61	Cokato.	1. Metamorph. probably

Heavy drift.

4 The cascade at Minneopa Falls, 30 feet high, is caused by the Jordan sandstone. This R. R. crosses the gorge ¼ mile below the fall.

5 The outlier of the St. Peter's s. s. 70 feet high, visible from the Station toward the east, gives the name to the place.

6 The Falls of St. Anthony, at Minneapolis, are caused by the rapid wearing out of the very friable St. Peter's sandstone under the Trenton limestone, leaving a projecting shelf of the latter.

Ms.	St. Paul and Pacific—*Continued.*		
67	Dassel.	1. Metamorph. probably	
72	Darwin.	"	"
78	Litchfield.	"	"
86	Swede Grove.	"	"
91	Atwater.	"	"
98	Kandiyohi.	"	"
104	Willmar.	"	"
111	St. John's.	"	"
118	Kerkhoven.	"	"
127	Degraff.	"	"
134	Benson.	"	"
141	Randall.	"	"
150	Hancock.	"	"
159	Morris.	"	"
168	Douglass.	"	"
178	Herman.	1. Archæan.	"
185	Gorton.	"	"
194	Tintah.	"	"
201	Campbell.	"	"
209	Doran.	"	"
217	Breckenridge.	"	"

Heavy drift.

Perhaps Cretac's

(Branch Line St. P. and P. R. R.)

0	St. Paul.	4 a. Trenton. 3 a. St. Peter's s. s.
10	St. Anthony J.	4 a. Trenton.
17	Manomin.	3 b. St. Peter's s. s.
27	Anoka.	3 a. Calciferous.
34	Itaska.	"
39	Elk River.	2. Primordial.
48	Big Lake.	"
56	Becker.	"
63	Clear Lake.	1. Archæan.
75	St. Cloud.	"
76	Sauk Rapids.	"
108	Melrose.	"

8 St. Paul, Stillwater & Taylor's Falls R.R.

0	St. Paul.	4 a. Trenton. 3 a. St. Peter's.
3	Post's.	4 a. Trenton.
13	Wier's.	"
16	Stillwater Jun.	3 a. Calciferous.
20	Stillwater.	"

9 Lake Superior and Mississippi R. R.

1	St. Paul.	4 a. Trenton. 3 b. St. Peter's s.
3	Post's.	4 a. Trenton.
	W. D. Junct'n.	"
12	W. Bear Lake.	3 b. St. Peter's s.
	Stillwater.	3 a. Calciferous.
17	Centreville.	"
25	Forest Lake.	"
30	Wyoming.	2. Primordial.
42	North Branch.	"

Ms.	Lake Superior and Mississippi—*Cont.*	
47	Harris.	2. Primordial.
54	Rush City.	"
64	Pine City.	"
77	Hinckley.	"
	Miller.	1. Archæan.
95	Kettle River.	"
110	Moose Lake.	"
	Barnum.	"
121	Black Hoof.	"
132	N. P. Junction	"
123	Thomson.	"
141	Fond du lac.	2. Primordial.
155	DULUTH.	1. Archæan.

10 Northern Pacific R. R.

0	Duluth.	1. Archæan.
4	Oneota.	2. Primordial.
9	Spirit Lake.	"
15	Fond du Lac.	"
23	Thompson.	1. Archæan.
24	N. P. Junction.	"
46	Island Lake.	1. Archæan. Heavy dft.
58	Sicotte's.	" "
76	Kimberly.	" "
88	Aiken.	" "
98	Withington.	" "
115	Brainerd.	" "
127	Pillager.	" "
137	Motley.	" "
	Hayden.	2. Primordial. "
153	Aldrich.	" "
162	Wadena.	" "
175	N. Y. Mills.	" "
185	Perham.	3 a. Calciferous.? "
197	Frazee City.	" "
207	Detroit.	3 b. St. Peter's.? "
211	Oak Lake.	4 a. Trenton.? "
213	Audubon.	" "
220	Lake Park.	4 b. Galena l. s.? "
231	Hawley.	" "
	Muskoda.	4 c. Cincinnati ? "
244	Glyndon.	5 c. Niagara l. s. ? "
253	Morehead.	9-12. Devonian ? "
254	Fargo.	" "

Dakota.

266	Maple River.	9-12 Up. Devonian ?
312	Wahpeton.	18. Cretaceous ?
327	Eckelson.	"
347	Jamestown.	"
384	Crystal Springs	"
450	Bismarck.	" with Lignite near Ft. A. Lincoln.

Heavily cov'd by drft.

Iowa.*

LIST OF THE GEOLOGICAL FORMATIONS FOUND IN IOWA:

20. Bluff Deposit, Post Tertiary.
20. Glacial Drift.
18 a. Lower Cretaceous.
14 c. Upper Coal Measures.
14 b. Low. Coal Mrs. (producing Coal.)
14 a. Millstone Grit.
13 b. Upper Sub-Carboniferous.
13 a. Lower Sub-Carboniferous.
10 b. Hamilton.
5 c. Niagara.
4 c. Cincinnati.
4 b. Galena Limestone.
4 a. Trenton.
3 b. St. Peter's Sandstone.
3 a. Lower Magnesian Limestone.
2 b. Potsdam.

Chicago, Milwaukee and St. Paul Railroad.

Prairie du Chien, and Iowa and Minnesota Division.

Ms.		
0	North McGregor	3 b. St. Peter's s.s. in hills; 2 b. Potsdam, 3 a. L. Magnesian.
6	Giard.	3 a. Lower Magnesian.
15	Monona.	4 a. Trenton.
19	Luana.	"
26	Postville.	"
32	Castalia.	"
37	Ossian.	"
43	Calmar.	"
46	Conover.	"
53	Ridgeway.	"
62	Cresco.	5 c. Niagara.
73	Lime Springs.	"
78	Chester.	"
85	Le Roy.	"
	(See Minnesota, 5.)	

Iowa and Dakota Division.

0	Calmar.	4 a. Trenton.
6	Fort Atkinson.	"
18	Lawler.	5 c. Niagara.
27	New Hampton.	10 b. Hamilton.
35	Chickasaw.	"
38	Bassett.	"
47	Charles City.	"
50	Floyd.	"
59	Rudd.	"
64	Nora Springs.	"
74	Mason City.	"
84	Clear Lake.	20. Glacial Drift.
95	Garner.	"
105	Britt.	"
115	Wesley.	"
126	Algona.	"

Chicago, Milwaukee & St. Paul R. R.—*Con.*

Mason City and Austin Division.

Ms.		
0	Mason City.	10 b. Hamilton.
8	Plymouth.	"
21	Carpenter.	"
28	Lyle.	"
40	Austin, Minn.	18. Cretaceous.

Illinois Central Railroad.

Iowa Division.

0	Dubuque.	4 b. Galena limestone.
10	Julien.	"
15	Peosta.	"
23	Farley.	5 c. Niagara.
29	Dyersville.	"
37	Earlville.	"
41	Delaware.	"
47	Manchester.	"
54	Masonville.	"
61	Winthrop.	10 b. Hamilton.
69	Independence.	"
78	Jesup.	"
86	Raymond.	"
93	Waterloo.	"
98	Jn. C.F. & M. RR	"
99	Cedar Falls.	"
109	New Hartford.	"
118	Parkersburg.	"
123	Aplington.	13 a. Low. Sub-Carbon.
132	Ackley.	"
143	Iowa Falls.	"
149	Alden.	"
158	Williams.	"
172	Webster City.	" & 14 b. L. Coal Mrs.
192	Fort Dodge.	"
210	Manson.	20. Glacial Drift.

* Prepared by Dr. C. A. White, late State Geologist of Iowa.

Illinois Central Railroad.

Ms.	Iowa Division—*Continued.*	
218	Pomeroy.	20. Glacial Drift.
226	Fonda.	"
235	Newell.	"
245	Storm Lake.	"
258	Aurelia.	"
268	Cherokee.	"
283	Marcus.	"
291	Remsen.	"
302	Le Mars.	"
319	James'.	20. Bluff Deposit.
327	Sioux City.	18 a. Lower Cretaceous.

Cedar Falls and Minnesota Branch.

0	Waterloo.	10 b. Hamilton.
12	Janesville.	"
18	Waverly.	"
27	Plainfield.	"
35	Nashua.	"
46	Charles City.	"
52	Floyd.	"
63	Osage.	"
67	West Mitchell.	"
72	St. Ansgar.	"
80	Mona.	"

Dubuque and South-Western Railroad.

0	Farley.	5 c. Niagara.
7	Worthington.	"
14	Sand Spring.	"
20	Monticello.	"
24	Langworthy.	"
31	Anamosa.	"
38	Viola.	"
42	Springville.	"
50	Marion.	10 b. Hamilton.
56	Cedar Rapids.	"

Western Union Railroad.
Sabula, Ackley and Dakota Division.

0	Sabula.	5 c. Niagara.
6	Elk River.	"
15	Miles.	"
20	Preston.	"
28	Riggs.	"
33	Delmar Junc'n.	"
40	Elwood.	"
52	Oxford Junct'n.	"
62	Olin.	"
74	Martelle.	"
79	Paralta.	10 b. Hamilton.
87	Marion.	"

Chicago and North-Western Railroad.
Iowa Midland Division.

0	Clinton.	5 c. Niagara.
3	Lyons.	"
10	Almont.	"
17	Bryant.	"
25	Charlotte.	"
33	Delmar Junct'n.	"
38	Maquoketa.	"
44	Nashville.	"
47	Baldwin.	"

Chicago and North-Western Railroad.

Ms.	Iowa Midland Division—*Continued.*	
50	Monmouth.	5 c. Niagara.
57	Onslow.	"
64	Amber.	"
71	Anamosa.	"

Omaha and California Division.

0	Chicago.	(As before.)
138	Clinton.	5 c. Niagara.
143	Camanche.	"
147	Low Moor.	"
152	Malone.	"
157	De Witt.	"
163	Grand Mound.	"
169	Calamus.	"
173	Wheatland.	"
178	Loudon.	"
185	Clarence.	"
190	Stanwood.	"
195	Mechanicsville.	"
202	Lisbon.	10 b. Hamilton.
203	Mount Vernon.	"
210	Bertram.	"
219	Cedar Rapids.	"
227	Fairfax.	"
234	Norway.	"
244	Blairstown.	"
249	Luzerne.	"
254	Belle Plaine.	"
260	Chelsea.	"
270	Tama.	13 a. Low. Sub-Carbon.
277	Montour.	"
280	Le Grand.	"
283	Quarry.	"
288	Marshall.	"
296	Lamoille.	"
303	State Centre.	14 b. Lower Coal Mres.
310	Colo.	"
317	Nevada.	"
326	Ames.	"
330	Ontario.	"
335	Midway.	"
340	Boone.	"
346	Moingona.	"
352	Ogden.	"
357	Beaver.	"
363	Grand Junction.	"
370	New Jefferson.	"
379	Scranton.	"
388	Glidden.	20. Glacial Drift.
396	Carroll.	"
406	Arcadia.	"
408	West Side.	"
415	Vail.	"
424	Denison.	"
433	Dowville.	"
441	Dunlap.	"
450	Woodbine.	"
458	Logan.	14 c. Upper Coal Mres.
467	Mo. Valley Jun.	"
482	Crescent.	" and 20. Bluff Deposit.
488	Council Bluffs.	"

Chicago, Rock Island and Pacific R. R.

Ms.		
0	Chicago.	(As before.)
183	Davenport.	14 c. Upp. Coal Mrs. and 20. Bluff Deposit.
195	Walcott.	"
199	Fulton.	"
208	Wilton.	"
211	Moscow.	"
216	Atalissa.	"
221	West Liberty.	"
227	Downey.	"
237	Iowa City.	"
252	Oxford.	"
257	Homestead.	"
267	Marengo.	"
277	Victor.	"
287	Brooklyn.	14 a., (equivalent to Millstone Grit).
293	Malcolm.	"
302	Grinnell.	"
313	Kellogg.	"
322	Newton.	14 b. Lower Coal Mres.
334	Colfax.	"
340	Mitchellsville.	"
357	Des Moines.	"
372	Booneville.	14 c. Upper Coal Mres.
379	De Soto.	"
392	Dexter.	"
397	Stuart.	"
403	Guthrie.	"
408	Casey.	"
415	Adair.	"
422	Anita.	"
436	Atlantic.	"
455	Avoca.	"
463	Shelby.	"
474	Neola.	"
490	Council Bluffs.	" and 20. Bluff Deposit.

South-Western Division.

208	Wilton.	10 b. Hamilton.
220	Muscatine.	"
233	Ononwa.	13 a. Lower Sub-Carb.
240	Fredonia.	"
242	Columbus Junc.	"
252	Ainsworth.	"
258	Washington.	"
271	Brighton.	13 b. Upper Sub-Carb.
286	Fairfield.	14 b. Lower Coal Mres.
292	Libertyville.	"
304	Eldon.	"
317	Belknap.	"
333	Unionville.	"
345	Centreville.	"
360	Seymour.	"

(Continued in Missouri.)

Indianola and Winterset Branch.

0	Des Moines.	14 b. Lower Coal Mres.
8	Avon.	"
10	Carlisle.	"

Chicago, Rock Island & Pacific Railroad.

Ms. | Indianola and Somerset Branch—*Con.*

15	Somerset Junc.	14 b. Lower Coal Mres.
18	Somerset.	"
21	Indianola.	"
15	Somerset Junc.	"
21	Spring Hill.	"
25	Lathrop.	14 c. Upper Coal Mres.
30	Bevington.	"
34	Patterson.	"
42	Winterset.	"

Oskaloosa Branch.

0	Washington.	13 b. Upper Sub-Carb.
15	Keota.	"
20	Harper.	"
28	Sigourney.	" & 14 b. L. Coal Mrs.
36	Delta.	13 b. Upper Sub-Carb.
43	Rose Hill.	14 b. Lower Coal Mres.
52	Oskaloosa.	"

Chicago, Burlington and Quincy Railroad.

Iowa Division.

0	Burlington.	13 a. Lower Sub-Carb.
9	Middletown.	13 b. Upper Sub-Carb.
13	Danville.	"
19	New London.	"
28	Mount Pleasant.	"
35	Rome.	" and 13 a.
42	Glendale.	14 b. Lower Coal Mres.
50	Fairfield.	"
55	Whitfield.	"
62	Batavia.	"
69	Agency.	"
75	Ottumwa.	" and 13 b.
83	Chillicothe.	" "
91	Frederic.	"
100	Albia.	"
108	Tyrone.	"
114	Melrose.	"
122	Russell.	"
130	Chariton.	14 c. Upper Coal Mres.
146	Woodburn.	"
156	Osceola.	"
166	Murray.	"
180	Afton.	"
190	Creston.	"
195	Cromwell.	"
211	Corning.	"
215	Brooks'.	"
225	Villisca.	"
233	Stanton.	"
241	Red Oak.	" and 18 a.
255	Hastings.	20. Bluff Deposit, (Post Tertiary.)
261	Malvern.	"
271	Glenwood.	14 c. Upper Coal Mres.
275	Pacific Junct'n.	20. Quaternary.
279	E. Plattsmouth.	"

Chicago, Burlington & Quincy R. R.—*Con.*

Ms.	Branch.	
130	Chariton.	14 c. Upper Coal Mres.
141	Derby.	"
147	Humiston.	"
154	Garden Grove.	"
	Leon.	"

Branch.

190	Creston.	14 c. Upper Coal Mres.
207	Lenox.	"
225	Bedford.	"
234	Hopkins.	"

Branch.

241	Red Oak.	14 c. U. Cl. Mrs. & 18 a.
254	Essex.	20. Quat. or Post Ter'y.
259	Shenandoah.	"
266	Farragut.	"
271	Riverton.	"
280	Hamburg.	"
291	Nebraska City.	"

Burlington and South-Western Railroad.

0	Burlington.	13 a. Lower Sub-Carb.
19	Fort Madison.	"
25	Viele.	"
31	Franklin.	"
33	Donaldson.	13 b. Upper Sub-Carb.
36	Warren.	"
44	Farmington.	" and 14 a.
50	Willits.	14 b. Lower Coal Mres.
55	Mount Sterling.	"
63	Cantril.	"
69	Milton.	"
75	Pulaski.	"
85	Bloomfield.	"
99	Moulton.	"
108	Caldwell.	"
113	Cincinnati.	"
118	Mendota.	"
122	Howland.	"
128	Unionville, Mo.	
	(Continued	in Missouri.)

Missouri, Iowa and Nebraska Railroad.

0	Centreville.	14 b. Lower Coal Mres.
7	Sedan.	"
11	Dean.	"
15	Hamilton.	"
	(Continued	in Missouri.)

Sioux City and St. Paul Railroad.

0	Sioux City.	18 a. Lower Cretaceous.
8	James.	20. Bluff Deposit, (Post Tertiary.)
25	Le Mars.	20. Glacial Drift.
30	Seney.	"
42	East Orange.	"
50	Hospers.	"
58	Sheldon.	"
67	St. Gilman.	"
74	Sibley.	"
92	Worthington.	(See Minnesota, 3.)

Ms.	Dakota Southern Railroad.	
0	Sioux City.	18 a. Lower Cretaceous.
8	McCook.	"
13	Jefferson.	18 b. Middle Cretace's.
14	Davis Junction.	"
21	Elk Point.	"
30	Burbank.	"
34	Vermillion.	"
44	Meckling.	"
50	Gayville.	"
55	James River.	"
61	Yankton.	"

14	Davis Junction.	"
19	Joy.	"
24	Westfield.	"
29	Portlandville.	"

Sioux City and Pacific Railroad.

0	Sioux City.	18 a. Lower Cretaceous.
9	Sergeant's Bluffs	"
22	Sloan.	20. Quaternary.
38	Onawa.	"
53	River Sioux.	"
60	Mondamin.	"
66	Modale.	"
71	California June.	"
77	Missouri Valley.	

Kansas City, St. Joseph & Council Bluffs.

1	Council Bluffs.	14 c. and 20. Bluff Dep.
6	Traders' Point.	20. Quaternary.
14	Pacific.	"
17	Pacific Junction	"
20	Haney's.	"
25	Bartlett.	"
30	McPaul.	"
34	Percival.	"
40	E. Nebras. City.	"
51	Hamburg.	"
	(Continued	in Missouri.)

Des Moines and Fort Dodge Railroad.

0	Des Moines.	14 b. Lower Coal Mres.
8	Ashewa.	"
15	Waukee.	"
21	Dallas Centre.	"
27	Minburn.	"
34	Perry.	"
42	Rippey.	"
50	Grand Junction.	"
59	Paton.	"
67	Gowrie.	"
73	Nesho.	"
82	Tara.	"
88	Fort Dodge.	" and 13 b.

Des Moines and Minneapolis Railroad.

0	Des Moines.	14 b. Lower Coal Mres.
7	Saylor.	"
8	Trent.	"
11	Ankeny.	"
14	Pelton.	"
18	Polk City.	"
21	Ulm.	"
25	Sheldahl.	"
31	Kelley.	"
37	Ames.	"

Central Railroad of Iowa.

Ms.		
0	St. Louis.	13 a. Lower Sub-Carb.
176	Keokuk.	13 b. and 14 b.
253	Ottumwa.	"
269	Eddyville.	14 b. L. Coal Measures.
278	Oskaloosa.	"
291	New Sharon.	"
299	Searsboro.	14 a. Millstone Grit.
311	Grinnell.	"
322	Gilman.	13 a. Lower Sub-Carb.
336	Marshalltown.	"
343	Albion.	"
349	Liscomb.	"
354	Union.	"
363	Eldora.	14 b. L. Coal Measures.
367	Steamboat Rock	13 a. Lower Sub-Carb.
374	Abbott.	"
379	Ackley.	"
384	Franklin.	"
389	Geneva.	"
395	Hampton.	"
404	Chapin.	"
412	Rockwell.	"
424	Mason City.	10 b. Hamilton.

Keokuk and Des Moines Valley Railroad.

0	Des Moines.	14 b. L. Coal Measures.
24	Prairie City.	"
35	Monroe.	"
47	Pella.	13 b. Upper Sub-Carb.
62	Oskaloosa.	14 b. L. Coal Measures.
71	Eddyville.	" and 13 b.
86	Ottumwa.	" "
98	Eldon.	"
116	Summit.	"
123	Bentonsport.	13 b. Upper Sub-Carb.
126	Bonaparte.	"
132	Farmington.	" and 14 b.
137	Croton.	" "
147	Sand Prairie.	" "
162	Keokuk.	13 a. Lower Sub-Carb.

Burlington, Cedar Rapids & Northern R. R.

0	Burlington.	13 a. Lower Sub-Carb.
9	Latty.	"
12	Sperry.	"
15	Kossuth.	"
20	Linton.	"
23	Morning Sun.	"
29	Wapello.	"
35	Long Creek.	"
41	Columbus Junc.	"
44	Port Allen.	"
47	Cone.	10 b. Hamilton.
55	Nichols.	"
61	West Liberty.	"
67	Centredale.	"
70	West Branch.	"
73	Oasis.	"
77	Morse.	"
82	Solon.	"
89	Ely.	"

Burlington, Cedar Rapids and Northern Railroad—*Continued.*

Ms.		
97	Cedar Rapids.	10 b. Hamilton.
101	Linn.	"
107	Palo.	"
111	Shellsburg.	"
120	Vinton.	"
128	Mount Auburn.	"
134	La Porte.	"
150	Waterloo.	"
156	Cedar Falls.	"
160	Norris.	"
164	Finchford.	"
171	Shell Rock.	"
178	Clarksville.	"
189	Greene.	"
195	Marble Rock.	"
202	Rockford.	"
210	Nora Junction.	"
215	Rock Falls.	"
219	Plymouth.	"
250	Lyle.	"
261	Austin.	"

Milwaukee Division.

0	Cedar Rapids.	10 b. Hamilton.
4	Linn.	"
18	Center Point.	"
25	Walker.	"
39	Independence.	"
53	Oelwein.	"
60	Maynard.	"
69	Donnan.	"
74	West Union.	5 c. Niagara.
81	Elgin.	4 a. Trenton.
89	Clermont.	"
98	Postville.	"

Muscatine Division.

0	Muscatine.	10 b. Hamilton.
11	Cedar River.	"
13	Adams.	"
16	Nichols.	"
23	Lone Tree.	"
26	River Junction.	"
31	Riverside.	"

Pacific Division.

0	Cedar Rapids.	10 b. Hamilton.
1	Epley.	"
4	Linn.	"
9	Palo.	"
14	Shellsburg.	"
22	Vinton.	"
29	Benton.	"
39	Dysart.	"
48	Traer.	"

Davenport and North-Western Railroad.

0	Davenport.	10 b. Hamilton.
5	Mount Joy.	"
8	Eldridge.	"

Davenport and North-Western Railroad— *Continued.*

Ms.		
17	Donahue.	10 b. Hamilton.
23	Dixon.	"
32	Wheatland.	5 c. Niagara.
37	Toronto.	"
40	Massillon.	"
46	Oxford Mills.	"
53	Wyoming.	"
69	Monticello.	"
77	Hopkinton.	"
85	Delhi.	"
89	Delaware.	"
94	Greeley.	"
99	Edgewood.	"
106	Enfield.	"
115	Brush Creek.	"
125	Fayette.	"
11	Eldridge.	10 b. Hamilton.
14	Long Grove.	5 c. Niagara.
	C. & N. W. Cro'g	"
24	De Witt.	"
31	Welton.	"
37	Delmar Junct'n.	"
44	Maquoketa.	"

Chicago, Dubuque & Minnesota and Chicago, Dubuque & Clinton Railroads.

Ms.		
178	La Crosse.	(See Wisconsin.)
153	New Albin.	2 b. Potsdam & 3 a. L. Magnesian l. s.
141	Lansing.	"
126	Harper's Ferry.	"
118	Yellow River.	"
115	North McGregor	"
104	Clayton.	3 a. L. Mag. limestone.
95	Guttenberg.	4 a. Trenton and 4 b. Galena limestone.
88	Turkey River.	4 a. Trenton.
84	Buena Vista.	"
80	Waupeton.	"
72	Specht's Ferry.	"
	Peru.	"
60	Dubuque.	4 b. Galena limestone.
54	Massey.	"
46	Gordon's Ferry.	"
38	Bellevue.	4 c. Cincinnati.
28	Green Island.	5 c. Niagara.
18	Sabula.	"
2	Lyons.	"
0	Clinton.	"

Turkey River Branch.

88	Turkey River.	4 a. Trenton.
103	Elkport.	"
111	Littlefort.	"
125	Volga City.	"
138	Lima.	"

Missouri.[1]

GEOLOGICAL FORMATIONS OF MISSOURI.

20. Quaternary, Alluvium, Bluff or Loess, and Drift.
19. Tertiary, in Southeast Missouri.
18. Cretaceous, " "
14. Coal Measures, 14 c. Upper.
" " 14 b. Middle.
" " 14 a. Lower.
13. L. Carboniferous or Sub-Carb., 13 e. Chestergroup.
" " 13 d. St. Louis.
" " 13 c. Keokuk.
" " 13 b. Burlington.
" " 13 a. Kinderhook or Chouteau.
10. Devonian, 10 c. Black Slate (Genesee ?)
5-7. Upper Silurian, 8. Oriskany.
5-7. Upper Silurian, 7. L. Helderberg.
" " 5. Niagara.
2-4. Lower Silurian, 4 c. Cincinnati.
" " 4 b. Galena or Receptaculite l.s.
" " 4 a. Trenton and Black River.
" " 3 a. Calcifer's. 1st Magnesian Saccharoidal s.s.
" " 2d Magnesian l. s.
" " 2d Sandstone.
" " 3d Magnesian l. s.
" " Lower Magnesian l. s. and s. s.
" " 2 b. Potsdam.
1 b. Huronian.
1 a. Laurentian.

Ms.	Hannibal and St. Joseph Railroad.	
0	Hannibal.	13 a. & b. Sub-Carbon's
6	Bear Creek.	" & 20. Quat.
10	Barkley.	"
15	Palmyra Junc'n	"
19	Woodland.	"
30	Monroe.	14 b. Coal Measures.
42	Lakenan.	"
53	Lentner.	"
59	Clarence.	20. overlies 13 c.
70	Macon.	14 b. Coal Measures.
79	Callao.	" 4 ft. coal.
90	Lingo.	" "
104	Brookfield.	"
109	Laclede.	"
121	Wheeling.	14 b. Middle Coal Mrs.
130	Chillicothe.	"
140	Mooresville.	14 c. Upper Coal Mres.
150	Nettleton.	"
156	Hamilton.	"
163	Kidder.	"
172	Cameron Junc'n	"
177	Osborn.	"
185	Stewartsville.	"
200	Saxton.	"
206	St. Joseph.	" and hills cov'd with Bluff clay.

Ms.	Hannibal and St. Joseph R.R.—*Cont.*	
0	Quincy.	13 a. Sub-Carbonifer's.
9	North River.	13 b. "
15	Palmyra.	"
206	St. Joseph.	14 c. Upper Coal Mres.
211	Lake.	20. Alluvial.
217	Halls.	"
222	Rushville.	" & 14 c. U.C.M.
226	Winthrop.	"
172	Cameron Junc'n	14 c. Upper Coal Mres.
187	Lathrop.	"
201	Kearney.	"
211	Liberty.	"
218	Arnold.	"
226	Kansas City.	"

	St. Louis, Kansas City & Northern R.R.[2]	
0	St. Louis.	13 d. St. Louis group.
6	Bartmer.	14 b. Middle Coal Mrs.
14	Graham's.	" [by 20.
22	St. Charles.	13 d. St.Lo. group,cov'd
30	Dardenne.	20. Quaternary.
38	Perruque.	13 c. and d.
48	Foristell.	13 a. & b. rests on 10 c.
58	Warrenton.	"
68	Jonesburg.	13 a. and 4 a. Trenton.
77	New Florence.	13 a.

1. By Professor G. C. Broadhead, late State Geologist of Missouri.
2. On St. L., K. C. & N. R. R., in Warren and Montgomery counties, we pass within a few miles from Carboniferous, chiefly Lower part of Sub-Carboniferous through thin outliers of Devonian to the Receptaculite (Galena limestone) and Trenton and Black River to the 1st Magnesian limestone and Saccharoidal sandstone; the latter well developed and very suitable for glass-making purposes—thick deposits and easy to crush. It is the equivalent of the St. Peter's sandstone.

St. Louis, Kansas City and Northern Railroad—*Continued.*

Ms.		
0	Wellsville.	14 a. Lower Coal Mres.
103	Benton City.	"
108	Mexico.	"
114	Thompson.	"
122	Centralia.	"
130	Sturgeon.	"
140	Renick.	" 4 ft. coal.
146	Moberly.	"
153	Huntsville.	" 4 ft. coal.
160	Clifton.	"
167	Salisbury.	"
178	Dalton.	"
185	Brunswick.	"
192	Dewitt.	" [quarry.
195	Miami.	" white s. s.
202	Wakenda.	20. Quaternary.
209	Carrollton.	14 b. Middle Coal Mrs.
219	Norborne.	20. Quaternary.
228	Hardin.	"
234	Lexington Jun.	14 b. Coal, middle ser.
239	Camden.	"
245	Orrick.	20. Quaternary.
254	Missouri City.	14 c. base of U. Cl. Ms.
265	N. Missouri Jun	"
273	Harlem.	20. Quaternary.
275	Kansas City.[3]	14 c. Upper Coal Mres.

Northern Division,

146	Moberly.	14 a. Lower Coal Mres.
153	Cairo.	"
162	Emerson.	"
169	Macon.	"
180	Atlanta.	"
189	La Plata.	"
196	Millard.	"
203	Kirksville.	14 a. and b. "
211	Sublett's.	"
218	Queen City.	14 a. "
227	Glenwood.	"
234	Coatesville.	"

St. Joseph Division.

0	Lexington Jun.	14 b. Middle Coal Mrs.
9	Swanwick.	14 c. Base of upp. coal.
19	Vibbard.	14 c. Upper Coal Mrs.
25	Lawson.	"
36	Lathrop.	"
44	Plattsburg.	"
53	Gower.	"
62	Agency Ford.	"
73	St. Joseph.	"

St. Louis, Kansas City and Northern Railroad—*Continued.*

Columbia Branch.

Ms.		
0	Centralia.	14 a. Lower Coal Mrs.
22	Columbia.	14 a. and 13 b. & c.

Glasgow Branch.

0	Salisbury.	14 a. Lower Coal Mres.
15	Glasgow.	" base.

Missouri, Iowa and Nebraska Railroad.

0	Alexandria.	20. Alluvium.
7	Wayland.	13 d. St. Louis l. s.
15	Kahoka.	14 a. Coal Measures.
24	Luray.	"
32	Arbela.	"
40	Memphis.	"
51	Downing.	"
61	Lancaster.	"
64	Glenwood.	"
70	Hamilton.	"

Deep drift deposits overlie formations.

Quincy, Missouri and Pacific Railroad.

2	West Quincy.	20. Quaternary.
11	Maywood.	13 a. Sub-Carbonifer's.
22	Tolona.	"
32	La Belle.	"
47	Edina.	13 d. Overlaid by drift.
54	Hurdland.	Deep drift.
70	Kirksville.	14 a. Lower Coal Mres.

Missouri Pacific Railroad.[4]

0	St. Louis.	13 d. St. Louis l. s. & 14 a. Coal Measures.
7	Benton.	13 d. St. Louis l. s.
13	Kirkwood.	"
19	Meramec.	13 b. Sub-Carbonifer's.
26	Glencoe.	4 a. Trenton.
30	Eureka.	"
37	Pacific.	3 a. Calcif. & 4 a. Tren.
41	Gray's Summit.	" 1st sandstone.
52	South Point.	" 2d Magn. l. s.
54	Washington.	" "
67	Miller's Landing	" " cap. with s. s.
75	Berger.	" "
81	Hermann.	" "
88	Gasconade.	" "
92	Morrison.	"
100	Chamois.	"
105	St. Aubert.	"
125	Jefferson City.	" "
140	Centretown.	lead, " 2d sandstone.
150	California.	" 2d Magnes'n.
162	Tipton.	" On hills sometimes find 13 b.
175	Otterville.	lead, " Bur'n l s. & 3 a.

3. Loess is well developed at Kansas City.

4. On Missouri Pacific R. R., from St. Louis west, we pass St. Louis group, Lower Coal Measures, St. Louis group Warsaw limestone, Burlington and Chouteau group to the Trenton, but no Devonian. At Hermann we have 2d Magnesian limestone capped in hills back with 1st or Saccharoidal sandstone, and at Jefferson we have 2d Magnesian limestone rising in a few miles south exposing in succession 2d sandstone and 3d Magnesian limestone. West of Tipton the same limestone (2d) is capped by Burlington limestone. The latter west of Sedalia having reposing on it the sandstone at top of Sub-Carboniferous (Millstone Grit?) and underlaid by Chouteau group. Then the Coal Measures appear.

Missouri Pacific Railroad—*Continued.*

Ms.		
188	Sedalia.	13 a. & b. Burlington l.s.
195	Dresden.	" & 13 a. & 14 a.
200	Lamonte.	14 a. Lower Coal Mres.
208	Knobnoster.	" iron ore & coal ms.
218	Warrensburg.	" fine s. s. quarries.
230	Holden.	14 b. Coal Measures.
237	Kingsville.	14 b. & c. U. Coal Mres.
248	Pleasant Hill.	"
259	Lee's Summit.	"
272	Independence.	"
282	Kansas City.	"

Booneville Branch.

0	Tipton.	13 b. resting on 3 a.
14	Palestine.	13 a. Kinderhook.
25	Booneville.	13 c. & 14 a. Coal Mrs.

Lexington Branch.

0	Sedalia.	13 a. Sub-Carbonifer's.
4	Georgetown.	" 13 a., b. & c. S-C.
22	Brownsville.	13 b. Upper Sub-Carb.
38	Aullville.	14 b. Coal Measures.
55	Lexington.	" coal mines.

Chicago, Rock Island and Pacific Railroad.

South-Western Division.

0	Leavenworth.	14 c. Upper Coal Mres.
5	Beverly.	"
11	Platte City.	"
21	Atchison Junc.	"
29	Grayson.	"
36	Plattsburg.	"
47	Perrin.	"
55	Cameron.	"
65	Winston.	"
76	Gallatin.	Base of "
86	Jamesport.	"
102	Trenton.	"
127	Princeton.	"
143	Lineville.	" Middle
156	Allerton.	" series in
169	Seymour.	" valleys.
	(Continued	in Iowa.)

Missouri, Kansas and Texas Railroad.

0	Hannibal.	13 a. & b. Sub-Carbon's.
12	Rensalier.	
22	Monroe.	14 a. Lower Coal Mres.
34	Stoutsville.	13 b. Sub-Carbonifer's.
44	Paris.[5]	"
57	Madison.	13 c. & d. and 14 a.
70	Moberly.	"
80	Higbee.	" 4 ft. coal.

Missouri, Kansas and Texas Railroad—*Continued.*

Ms.		
88	Burton.	14 b. Coal Measures.
95	Fayette.	"
99	Talbott.	"
108	Boonville.	"& 13. c U.S-C.
122	Harris.	13 b. Upper Sub-Carb.
131	Clifton.	13 a. Sub-Carbonifer's.
143	Sedalia.	"
155	Green Ridge.	13 b. Upper Sub-Carb.
164	Windsor.	14 a. Coal Mrs. 4 ft. coal.
172	Calhoun.	" iron ore.
183	Clinton.	" coal mines, fossil ferns, &c.
196	Montrose.	" "
202	Appleton City.	" " 4 ft. cl.
210	Rockville.	"
215	Schell City.	"
226	Walker.	"
233	Nevada.	"
	(Continued	in Kansas.)

Osage Division.

0	Holden.	14 b. Middle Coal Mres.
8	Benton.	"
16	East Lynn.	14 b. Coal Measures.
22	Harrisonville.	14 c. Upper Coal Mres.

Chicago and Alton Railroad.

Chicago, Kansas City and Denver Line.

275	Louisiana.	13 a. & b. & 10 c. & 4 c.
282	Watson.	" Cinn.
286	Bowling Green.	" good stone for buildg.
293	Curryville.	13 c. Sub-Carbonifer's.
302	Vandalia.	"
311	Laddonia.	14 a. Middle Coal Mres.
320	Littleby.	"
325	Mexico.	"

Chicago and Jefferson Division.

0	Chicago.	
325	Mexico.	14 a. Middle Coal Mres.
334	Bryans.	"
337	Auxvasse.	"
345	Callaway.	"
350	Fulton.	14 a., .3 b. and 10 c.
357	Carrington.	"
364	New Bloomfield	"
370	Hibernia.	10 c. and 3 a.
376	Jefferson City.	3 a. Calciferous.

5. Archimedes in limestone.

6. On St. Louis & San Francisco R. R., going southwest, after leaving Pacific (or Franklin) the 2d Magnesian limestone gradually rises, showing some 2d sandstone, and through Crawford, Phelps and Pulaski counties the latter is the highest rock, resting on 3d magnesian limestone, the latter well exposed along the Gasconade River. Crossing it, we are upon the highest lands in Missouri. Descending towards Springfield, we find the Lower members of the Sub-Carboniferous limestone resting on the 2d Magnesian limestone or Calciferous. In southern parts of Lawrence county we find a coarse ferruginous sandstone, probably equivalent to Millstone Grit, but more probably a member of the Chester group, resting on Lower Carboniferous limestone. Throughout Newton and Jasper, the Sub-Carboniferous limestone, with much chert is of great development, and is galeniferous. The celebrated lead mines of Joplin and Granby occur in this.

St. Louis and San Francisco, or Atlantic and Pacific Railroad.[6]

Ms.		
0	St. Louis.	20. & 13 d. St. L. l. s.
37	Pacific.	4 a. Tren. & 3 a. Calcif.
44	Calvey.	3 a. Calciferous.
49	Moselle.	"
56	St. Clair.	"
66	Stanton.	"
78	Bourbon.	"
91	Cuba.	"
104	St. James.	" iron.
114	Rolla.	" iron.
124	Ozark.	"
138	Dixon.	"
144	Hancock.	" iron.
150	Crocker.	"
163	Richland.	"
171	Stoutland.	"
178	Sleeper.	"
185	Lebanon.	"
217	Marshfield.	"
241	Springfield.	13 b. Sub-Carbonifer's.
266	Logan's.	"
278	Verona.	" and c.
291	Peirce City.	" "
306	Granby City.	13 c. Keokuk l. s. (Lead abounds.)
314	Neosho.	13 c. Keokuk l. s.
325	Dayton.	"
330	Seneca.[7]	"
	(State Line.)	850 feet above tide.
364	Vinita.	(See Kansas.)

Occasional lead & iron mines.

3d Magnesian limestone capped with 2d sandstone.

1498 feet above sea; highest point in Mo.

St. Louis, Iron Mountain & Southern R. R.[5]

Ms.		
0	St. Louis.	13 d. St. Louis l. s.
10	Jefferson Bar'ks	13 d. Warsaw l. s.
13	Cliff Cave.	13 c. Keokuk l. s.
21	Kimmswick.	13 b. Burlington l. s.
24	Sulphur Springs	"
27	Pevely.	4 a. Trenton.
29	Horine.[8]	3 a. Calcif., sandy lead mine 6 miles north.
35	Hematite.	3 a. Calciferous.
39	Victoria.	"
43	De Soto.	" Valli lead mines 10 miles south. Frumet lead mines. 10 miles north.

St. Louis, Iron Mountain and Southern Railroad—*Continued.*

Ms.		
51	Blackwell.	3 a. Calciferous.
57	Cadet.	" lead mine.
61	MineralPoint.	" many lead ms.
65	Potosi.	" "
66	Hopewell.	" "
70	Irondale.	"
75	Bismarck.	
83	Loughborough.	2 b. Potsd. & 1 b. Hur.
87	De Lassus.	" [quarry.
95	Knob Lick.	" & granite
102	Mine la Motte.	" lead, nickel, cobalt, manganese, copper and iron.
105	Fredericktown.	2 b. Potsd. & 1 b. Hur.
112	Cornwall.	2 b., 1 b. & 3 a. Calc. Iron and granite.
118	Marquand.	3 a. Calciferous, iron.
125	Bessville.	"
134	Lutesville.	"
148	Allenville.	"
158	Sylvania.	"
162	Morley.	20. Quaternary, with probably 19. Tertiary.
174	Diehlstadi.	"
178	Charleston.	"
195	Belmont.	"

Arkansas Division.

76	Bismarck.	3 a. Calciferous.
81	Iron Mountain.[9]	2 b. Pots. & 1 b. Hur. Specular iron ore in vast quantities.
86	Pilot Knob.[10]	"
88	Ironton.[11]	2 b. Potsd. & 1 b. Hur.
89	Arcadia.	"
96	Hogan.	"
104	Ozark.	"
108	Annapolis.	"
116	Des Arc.	"
127	Piedmont.	"
134	Mill Spring.	3 a. Calciferous.
145	Williamsville.	"
148	Blums.	"
166	Poplar Bluff.	" & 20. Quat.
186	Moark.	

Porphyry and magnesian limestone.

(Continued in Arkansas.)

6. Down the St. Louis & Iron Mountain R. R. we have St. Louis limestone, then Warsaw limestone, Keokuk limestone and Burlington limestone within 20 miles. Crossing the Merrimac River, we find the last for a while, then the Receptaculite, Trenton and Black River limestone, 1st Magnesian limestone, and at Horine Station the Saccharoidal sandstone, very soft, used for glass-making, and is very white and pure. Afterwards we have 2d Magnesian limestone. Crossing Big River, the 3d Magnesian limestone near Iron Mountain. De Lassus, Mine la Motte, Fredericktown, Pilot Knob, Des Arc and Annapolis are porphyry hills of Huronian age, and the adjacent limestones and lower sandstones and conglomerates are probably Potsdam. At Mine la Motte and Fredericktown are certainly Potsdam fossils, but the absolute line (if any) has not been determined between the Potsdam and Calciferous beds. Near Iron Mountain, Knob Lick and Cornwall are superior granite quarries, which may be of age of Laurentian.

7. Polishing stone.

St. Louis, Iron Mountain and Southern Railroad—*Continued.*

Ms.	Cairo Division.	
0	Cairo.	Low lands. 20. Quat. and probably 19. Tertiary.
10	Hough's.	"
15	Charleston.	"
28	Sikeston.	"
74	Poplar Bluff.	"

St. Louis, Lawrence and Western R. R.

0	Pleasant Hill.	14 c. Upper Coal Mres.
12	Raymore.	"
17	Belton.	"
25	Stanley.	(See Kansas.)

Kansas City, St. Joseph and Council Bluffs Railroad.

0	Kansas City.	14 Upper Carbonifer. Good fossil mollusca.
10	Parkville.	14 c. Upper Carbonifer.
17	Waldron.	"
25	E. Leavenworth	"
34	Weston.	"
54	Winthrop.	"
55	Rushville.	"
66	Lake Station.	20. Quaternary.
70	St. Joseph.	14 c. Upper Carbonifer.
80	Amazonia.	" fusulina abounds
99	Forest City.	" "& mollusca.
109	Bigelow.	20. Quaternary.
116	Craig.	" over 14 c.
122	Corning.	"
135	Phelps.	"
149	Hamburg.	" & 14 c. U. C.
200	Council Bluffs.	
	(Continued in Iowa.)	

Chicago Branch.

70	St. Joseph.	14 c. Upper Carbonifer.
79	Amazonia.[12]	"
85	Savannah.	"
91	Rosendale.	"

Kansas City, St. Joseph and Council Bluffs Railroad.

Chicago Branch—*Continued.*

Ms.		
101	Barnard.	14 c. Upper Carbonifer.
108	Bridgewater.	"
115	Maryville.	"
123	Pickering.	"
131	Hopkins.	"

Burlington and South-Western Railroad.

0	Laclede.	14 b. Middle Coal Mres.
7	Linneus.[13]	"
20	Browning.	"
32	Milan.	14 c. Upper Carbonifer.
37	Boynton.	14 b. Middle Coal Mres.
45	Pollock.	"
53	Unionville.	14 a. Lower Coal Mres.
181	Burlington.	
	(Continued in Iowa.)	

St. Louis, Keokuk & North-Western R. R.

0	Keokuk.	13 c. Keokuk l. s.
3	Alexandria.	"
11	Gregory.	"
22	Canton.	"
28	La Grange.	20. Quaternary.
40	Quincy.	13 b. & c. Keokuk l. s.
54	Helton.	"
60	Hannibal.	13 b. Sub-Carbonifer's.
66	Saverton.[14]	13 a. & b. " & 4 c. Cinn.
75	Ashburn.	4 c. Cincinnati.
85	Louisiana.	4 c., 10 c. and 13 a. & b. Sulphur Springs.

St. Louis, Salem & Little Rock Railroad.

0	Cuba.	3 a. Calciferous.	Lead & iron mines.
9	Steelville.	"	
16	Keysville.	"	
24	Cook's.	"	
35	Howe's.	"	
40	Salem.	"	
41	Iron Hill.	"	
46	Orchard Bank.	"	

8. Four miles southeast is Crystal City on the Mississippi River, where glass is made. The Saccharoidal or St. Peter's sandstone is here forty or fifty feet thick, and over one hundred feet thick in Warren County. It is very valuable for glass-making.

9. Iron Mountain is 228 feet high, and its base covers 500 acres.

10. Pilot Knob is a conical hill, nearly circular, 581 feet high, with a north and south diameter of about one mile at its base, which covers 360 acres.

11. Sheppard Mountain magnetic iron ore.

12. Red shales and fusulina.

13. Iron ores and paint clays.

14. Salt sulphur spring.

Kansas.*

The only geological formations found in Kansas are:

18. Cretaceous,	c. Niobrara group.
"	b. Fort Hays group.
"	a. Dakota group.
15. Permian.	
14 c. Upper Carboniferous.	
14 b. Coal Measures.	

Ms.	1 St. Joseph and Denver City.	
	St. Joseph.	14 c. Upper Carbonifer's
0	Elwood.	" "
5	Wathena.	" "
13	Troy.	" "
14	A. & N. R. J'n.	" "
18	Norway.	" "
42	Hiawatha.	" "
50	Hamlin.	" "
60	Sabetha.	" "
77	Seneca.	" "
112	Marysville.	" "
127	Hanover.	18. Cretaceous.
136	Hollenbury.	"
138	State Line.	"
141	Steele City, Neb	(See Nebraska.)
152	Fairbury, "	"
226	Hastings.	"
268	Kearney Junc.	"

	2 Atchison and Nebraska.	
0	Atchison.	14 c. Upper Carbonifer's
6	Doniphan.	" "
13	Brenner.	" "
	St. Joseph.	" "
17	Troy Junction.	" "
25	Highland.	" "
31	Iowa Point.	" "
36	White Cloud.	" "
38	State Line.	(Continued in Nebraska.)

	3 Central Branch Union Pacific.	
0	Atchison.	14 c. Upper Carbonifer's
15	Monrovia.	" "
18	Effingham.	" "
25	Muscotah.	" "
31	Whiting.	" "
37	Netawaha.	" "
42	Wetmore.	" "
62	Centralia.	" "
70	Vermilion.	" "
78	Frankfort.	" "
81	Barretts.	" "
91	Irving.	" "
95	Blue Rapids.	" "
100	Waterville.	" "

Ms.	4 Atchison, Topeka and Santa Fe.	
1	Kansas City.	14 c. Upper Carbonifer's
28	De Soto.	" "
40	Lawrence.	" "
50	Lecompton.	" "
62	Tecumseh.	" "
66	Topeka.	" "
0	Atchison.	" "
16	Nortonville.	" "
26	Valley Falls.	" "
35	Rock Creek.	" "
51	Topeka.	" "
68	Carbondale.	" Coal Mines.
72	Scranton.	14 b. Coal Measures.
77	Burlingame.	" "
85	Osage City.	" "
92	Arvonia.	" "
97	Reading.	14 c. Upper Carbonifer's
112	Emporia.	" "
132	Cottonwood.	" "
138	Elmdale.	" "
157	Florence.	" "
168	Peabody.	" "
178	Walton.	" "
185	Newton.	" "
195	Halstead.	" "
204	Burrton.	" "
218	Hutchinson.	18. Cretaceous.
237	Sterling.	"
260	Ellinwood.	"
270	Great Bend.	"
283	Pawnee Rock.	"
292	Larned.	"
300	Garfield.	"
316	Kinsley.	"
353	Dodge City.	"
454	Syracuse.	"
468	Sargent.	"
481	Granada, Col.	(See Colorado.)
532	Las Animas.	"
618	Pueblo.	"

	(Wichita Branch.)	
185	Newton.	14 c. Upper Carbonifer's
195	Sedgwick City.	" "
212	Wichita.	" "

*Revised and corrected by Prof. B. F. Mudge, late State Geologist of Kansas.

Ms.	5 Wathena and Doniphan.	
0	Wathena.	14 c. Upper Carbonifer's
13	Doniphan.	" "

	6 Kansas Central.	
0	Leavenworth.	14 c. Upper Carbonifer's
11	Pleasant Ridge	" "
16	Easton.	" "
25	Winchester.	" "
36	Valley Falls.	" "
48	Carbon.	" "
56	Holton.	" "

	7 Missouri Pacific. 44 ms.	
0	St. Louis.	14 c. Upper Carbonifer's
282	Kansas City.	" "
284	State Line.	" "
286	Wyandotte.	" "
295	Pomeroy.	" "
309	Leavenworth.*	" "
312	Ft. Leavenw'th	" "
330	Atchison.	" "

	8 Southern Kansas.	
0	Cherryvale.	14 b. Coal Measures.
10	Independence.	" "

	9 Kansas Pacific.	
	Kansas City.	14 c. Upper Carbonifer's
0	State Line.	" "
13	Edwardsville.	" "
27	Stranger.	" "
38	Lawrence.	" "
0	Leavenworth.	" "
21	Tonganoxie.	" "
26	Reno.	" "
34	Lawrence.	" "
38	Lawrence.	" "
51	Perryville.	" "
52	Medina.	" "
60	Grantville.	" "
67	Topeka.	" "
77	Silver Lake.	" "
83	Rossville.	" "
90	St. Marys.	" "
97	Belvue.	" "
104	Wamego.	" "
110	St. George.	" "
118	Manhattan.	15. Permian.
129	Ogden.	"
135	Fort Riley.	"
138	Junction City.	"
144	Kansas Falls.	"
157	Detroit.	"
163	Abilene.	"
172	Solomon.	18. Cretac's. a. Dakota.
185	Salina.	" "
200	Brookville.	" "
210	Elm Creek.	" "
223	Ellsworth.	" "
252	Bunker Hill.	18 Cretac's. b. Ft. Hays.
279	Victoria.	" "

Drab and buff magnesian lime-stone.

Ms.	Kansas Pacific—*Continued.*	
289	Hays.	18 Creta's. b. Ft. Hays.
302	Ellis.	18 Creta's. c. Niobrara.
312	Ogallah.	" "
322	Trego.	Chalk. " "
336	Cayote.	" "
364	Grinnell.	" "
376	Carlyle.	" "
385	Monument.	" "
397	Gophen.	" "
405	Sheridan.	" "
420	Wallace.	" Nos. 3 and 4.
429	Eagle Tail, Col.	(See Colorado.)
440	Monotony.	Lignitic Group.
487	Kit Carson.	" "
534	Hugo.	" "
583	Deer Tail.	" "
638	Denver.	" "
740	Cheyenne.	19 White River Tertiary.

	10 Junction City and Fort Kearney Branch.	
138	Junction City.	15. Permian.
151	Milford.	"
157	Wakefield.	"
171	Clay Center.	"

	Arkansas Valley Branch, (Colorado.)	
487	Kit Carson.	Lignitic Group.
496	Rush Creek.	" "
511	Salt Springs.	" "
533	Well No. 1.	18 Cretaci's, Nos. 3 & 4.
540	Fort Lyon.	" "
543	Las Animas.	" "

	11 Missouri, Kansas and Texas. (Neosho Division.)	
0	Parsons.	14 b. Coal Measures.
5	Ladore.	" "
26	Chanute.	" "
35	Humboldt.	" "
50	Neosho Falls.	" "
56	Le Roy.	" "
67	Burlington.	" "
81	Hartford.	" "
88	Neosho Rapids.	14 c. Upper Carbonifer's
95	Emporia.	" "
104	Americus.	" "
112	Rock City.	" "
120	Council Grove.	" "
132	Parkerville.	15. Permian.
137	White City.	"
143	Skiddy.	"
156	Junction City.	"
0	Sedalia, Mo.	- - - - - - - -
111	Fort Scott.	14 b. Coal Measures.
118	Marmaton.	" "
131	Hepler.	" "
137	Walnut.	" "
145	Osage Mission.	" "
151	South Mound.	" "

*Coal mined through a shaft 710 feet deep.

Missouri, Kansas and Texas. Ncosho Division—*Continued.*

Ms.		
0	Parsons.	14 b. Coal Measures.
9	Labette.	" "
14	Oswego.	" "
24	Chetopa.	" "
40	Bl'e Jacket, I.T	" "
53	Vinita.	" "

Coal Mines.

(Osage Division.)

0	Holden, Mo.	14 c. Upper Carbonifer's
22	Harrisonville.	" "
31	Freeman.	" "
35	West Line.	" "
41	Louisburg.	" "
46	Somerset.	" "
53	Paola, Ka.	" "

12 Missouri River, Fort Scott and Gulf.

0	Kansas City.	14 c. Upper Carbonifer's
9	Shawnee.	" "
14	Lenexa.	" "
21	Olathe.	" "
28	Ocheltree.	" "
30	Spring Hill.	" "
36	Hillsdale.	" "
43	Paola.	" "
54	Fontana.	14 b. Coal Measures.
61	Les Cygnes.	" "
67	Barnard.	" "
74	Pleasanton.	" "
82	Prescott.	" "
86	Osage.	" "
98	Fort Scott.	" "
111	Pawnee.	" "
124	Girard.	" "
135	Cherokee.	" "
141	Coalfield.	" "
148	Columbus.	" "
153	Neutral.	" "
159	Baxter.	" "

Coal Mining Region.

13 Leavenworth, Lawrence and Galveston.

0	Kansas City.	14 c. Upper Carbonifer's
21	Olathe.	" "
30	Gardner.	" "
35	Edgerton.	" "
41	Wellsville.	" "
46	Le Loup.	" "
53	K.C. & S. F. J'n	" "
0	Lawrence.	14 b. Coal Measures.
15	Baldwin City.	" "
23	Coal Siding.	" "
26	K.C. & S. F. J'n	" "
27	Ottawa.	" (Coal Mines.)*
36	Princeton.	14 b. Coal Measures.
51	Garnett.	" "
78	Iola.	" "
86	Humboldt.	" "
92	Neosho.	" "
94	Chanute.	" "
108	Thayer.	" "
124	Cherryvale.	" "
134	Independence.	" "
133	Liberty.	" "
138	Kalloch.	" "
140	Coffeyville.	" "
144	Parker.	" "

14 St. Louis, Lawrence and Western.

0	Pleas't Hill, Mo	- - - - - - - -
25	Stanley, Ka.	14 c. Upper Carbonifer's
34	Olathe.	" "
48	De Soto.	" "
54	Eudora.	" "
61	Lawrence.	" "
69	Sigel.	" "
80	Richland.	" "
92	Summit.	" "
93	Carbondale.	" "

*For a full description of the coal fields of Kansas and the other States, see "The Coal Regions of America—*their Topography, Geology and Development*—with numerous Maps and Illustrations." By James Macfarlane. Published and sold by D. Appleton & Co., New York. 8vo. pp. 700. Price, $5.00. Sent by mail, postage paid.

Colorado.*

List of the Geological Formations in Colorado:

19. Tertiary.
Lignitic Group (producing coal.)
18. Cretaceous, Nos. 2, 3, 4 and 5.
17. Jurassic.
16. Triassic.
1. Archæan. (Gold and Silver Mines)

Ms.	1 Kansas Pacific R. R. and Branches.	
420	Wallace, Kan.	18. Cretaceous Nos. 3,4.
429	Eagle Tail, Col.	" "
440	Monotony.	Lignitic Group.
462	Arapahoe.	"
452	CheyenneW'lls	"
472	First View.	"
487	Kit Carson.	"
499	Wild Horse.	"
511	Aroya.	"
523	Mirage.	"
534	Hugo.	"
562	Cedar Point.	"
566	Godfrey.	"
572	Agate.	"
588	Deer Tail.	"
595	Byer's.	"
617	Box Elder.	"
629	Schuyler.	"
636	Den. Pac. Jun.	"
638	Denver.	"
740	Cheyenne.	See Denv. to Cheyenne.

	2 Arkansas Valley Branch.	
0	Kit Carson.	Lignitic Group.
2	Sand Creek.	"
5	Bent's R. Cros.	"
9	Rush Creek.	"
24	Salt Springs.	"
46	Well No. 1.	18. Cretaceous Nos. 3,4.
53	Fort Lyon.	" "
56	Las Animas.	" "
	La Junta.	" "

	3 Denver and Pacific R. R.	
0	Denver.	Lignitic.
14	Henderson Isl.	"
19	Hughes'.	"
	Fort Lupton.	"
32	Johnson.	"
47	Evans.	"
52	Greeley.	Lignitic on E. side and Cret's. No. 5 on West side of road.
65	Pierce.	18. No. 5 Cretaceous.
85	Carr.	White River Group.
96	Summit Siding.	" Tertiary.
106	Cheyenne.	" "

	4 Denver and Boulder Valley.	
0	Denver.	Lignitic Group.
2	Junction.	"
19	Hughes.	"
34	Erie.	"

Ms.	Denver and Boulder Valley—*Con.*	
41	White Rk Mills	Lignitic Group.
43	Valmont.	"
45	C. C. Junction	"
46	Boulder.	Immediately at Boulder City, Nos. 4 & 5.

	5 Denver and Rio Grande R. R.	
0	Denver.	Lignitic Group.
10	Littleton.	"
17	Acequia.	"
25	Plum.	"
33	Castle Rock.	"
39	Glade.	"
43	Larkspur.	"
47	Greenland.	"
52	Divide.	19. Tertiary Miocene.
58	Monument.	19. Tertiary Monument Cr'k group.
67	Borstville.	"
75	Colorado Sp'gs	No. 4 Cretaceous.
83	Widefield.	
87	Fountain.	No. 3 Cretaceous.
94	Little Buttes.	"
106	Pinon.	"
118	Pueblo.	Nos. 2 and 3 Cretaceous
120	South Pueblo.	"
129	San Carlos.	18. Cretac's. Nos. 2 & 3.
133	Greenhorn.	"
146	Graneros.	"
156	Huerfano.	"
169	Cucharas.	18. Cretac's. Nos. 3 & 4.
189	Apishapa.	"
198	Chicosa.	"
206	El Moro.	"
120	South Pueblo.	Nos. 2 and 3 Cretaceous
125	Goodnight.	"
129	Meadows.	"
134	Swallows.	"
141	Carlisle Sp'ngs.	"
153	Beaver Creek.	"
155	Labran.	"
160	Canon City.	"
169	Cucharas.	18. Cretac's. Nos. 3 & 4.
176	Walsenburg.	"
183	North Veta.	Lignitic Group.
191	La Veta.	"

	6 Denver, South Park and Pacific R. R.	
0	Denver.	Lignitic Group,
16	Morrison.	16. Trias'c? or Red beds

*Prepared for this work by Professor F. V. Hayden, United States Geologist.

7 Colorado Central Railroad.

Ms.		
0	Denver-	Lignitic Group.
4	Summit.	"
8	Arvada.	"
14	Golden Junc.	"
16	Golden.	"
0	Golden.	Lignitic Group.
2	Golden Junc.	"
5	Ralston.	"
20	Coal Creek.	"
27	Davidson.	"
28	Boulder.	"
36	Ni-wot.	18. Cretaceous No. 5.
41	Longmont.	"
0	Golden.	Crosses. 18. Cretac's. 17. Juras. & Red beds.
3	Chimney Gulch	1. Archæan.
6	Guy Gulch.	"
8	Beaver Brook.	"
9	Elk Creek.	"
13	Big Hill.	"
14	Forks Creek.	"

Colorado Central Railroad—*Continued.*

Ms.		
18	Floyd's Hill. (Stages.)	1. Archæan. "
33	Georgetown.	"
16	Cottonwood.	1. Archæan.
17	Smith's Hill.	"
21	Black Hawk. (Stages.)	" "
23	Central City.	"

8 Pueblo and Arkansas Valley R. R.

0	Grenada.	18. Cretac's. Nos. 3 & 4.
18	Blackwell.	"
34	Caddoa.	"
50	Las Animas.	"
54	W. Las Animas	"
63	Robinson.	"
72	La Junta.	"
83	Rocky Ford.	"
95	Apishpa.	"
108	Nepiesta.	"
123	Chico.	"
136	Pueblo.	"

NOTE.—Along the Colorado or front range of mountains, there are many objects and places of interest; Pike's Peak (1. Archæan,) over 14,000 feet above sea level, which can be ascended on horseback, by a good road, to the summit; the Soda Springs, at Manitou; the Garden of the Gods, with the unique weathered forms of red (17. Jurassic or 16. Triassic) sandstone; and Monument Park, with modern (19.) Tertiary-capped pillars or columns. Along the railroad from Cheyenne to Trinidad, the lofty snow-clad mountain peaks are, many of them over 14,000 feet high. as Long's Peak, James', Arapahoe, Torrey's and Gray's, Evans', Sierra Blanca, Spanish Peak, and many others. See notes on page 165. F. V. H.

Nebraska.*

Ms.	Atchison and Nebraska Railroad.	
0	Lincoln.	14. Upper Carbonifer's.
9	Saltillo.	14. Carbon. Coal Mres.?
22	Firth.	" ?
36	Sterling.	"
49	Tecumseh.	"
63	Table Rock.	"
72	Humboldt.	"
86	Salem.	"
92	Falls City.	"
111	White Cloud.	"
	(Continued in Kansas.)	

	Burlington and Missouri River Railroad.	
0	Plattsmouth.	14. Carb's Up. Cl. Mres.
4	Oreapolis.	"
9	Concord.	"
19	Louisville.	"
31	Ashland.	"
43	Waverly.	"
55	Lincoln.	14. Upper Carbonifer's.
65	Denton.	"
75	Crete.	18. Cret. Dakota Group.
92	Friendville.	"
108	Fairmont.	"

* By Prof. F. V. Hayden, United States Geologist.

Burlington and Missouri River Railroad— *Continued.*

Ms.		
123	Sutton.	18. Cretaceous?
136	Harvard.	" ?
151	Hastings.	19. White River Terti'y.
166	Kenesaw.	"
176	Lowell.	"
182	Fort Kearney.	"
191	Kearney Junc'n.	"

Nebraska Railroad.

0	Brownville.	14. Carbon. Coal Mres.
8	Peru.	"
22	Nebraska City.	"
33	Dunbar.	"
45	Syracuse.	"
56	Palmyra.	"
70	Cheney's.	" ?
80	Lincoln.	14. Upper Carbonifer's.
98	Germantown.	18. Cretaceous?
105	Seward.	" ?

Omaha and North-Western Railroad.

0	Omaha.	14. Carbon. Coal Mres.
6	Florence.	"
12	Warner.	"
21	Calhoun.	"
24	Mills.	"
26	De Soto.	"
30	Blair.	"
40	Herman.	18. Cretaceous.

Sioux City and Pacific Railroad.

0	Wisner.	18. Cretaceous.
15	West Point.	"
23	Crowell.	"
35	Hooper.	"
50	Fremont.	"
59	Bell Creek.	"
68	Kennard.	14. Carbon. Coal Mres.
75	Blair.	"

St. Joseph and Denver City Railroad.

0	Kearney Junc'n.	19. White River Tert'y.
40	Hastings.	" ?
48	Glenville.	18. Cretaceous?
58	Fairfield.	"
66	Edgar.	"
75	Davenport.	"
83	Carleton.	"
90	Belvidere.	" ?
99	Alexandria.	14. Upper Carbonifer's.
114	Fairbury.	14. Carbon. Coal Mres.
124	Steele City.	"

Union Pacific Railroad.

Ms.		
0	Omaha.	14. Carb. Up. Cl. Mres.
10	Gilmore.	"
21	Millard.	"
31	Waterloo.	"
47	Fremont.	18. Cret. Dakota Group.
54	Ames.	"
69	Rogers.	"
84	Richland.	"
99	Jackson.	"
109	Silver Creek.	"
121	Clark's.	19. White River Tert'y.
132	Lone Tree.	"
142	Chapman's.	"
154	Grand Island.	"
162	Alda.	"
170	Wood River.	"
183	Gibbon.	"
195	Kearney Junc'n	"
204	Stevenson.	"
212	Elm Creek.	"
221	Overton.	"
231	Plum Creek.	"
239	Cayote.	"
250	Willow Island.	"
260	Warren.	"
268	Brady Island.	"
277	McPherson.	"
291	North Platte.	"
299	Nichols.	"
315	Dexter.	"
332	Roscoe.	"
342	Ogalalla.	"
357	Brule.	"
361	Big Spring.	"
387	Chappel.	"
396	Lodge Pole.	"
406	Colton.	"
414	Sidney.	"
423	Brownson.	"
433	Potter.	"
443	Bennett.	"
451	Antelope.	"
463	Bushnell.	"
473	Pine Bluffs.	"
479	Tracy.	"
484	Egbert.	"
496	Hillsdale.	"
503	Atkins.	"
508	Archer.	"
516	Cheyenne.	(See Wyoming.)

Notes on Geological Observations in Colorado and Utah.

FURNISHED FOR THIS WORK, BY W. M. DAVIS, JR., OF PHILADELPHIA.

COLORADO.

Denver & Rio Grande Railroad.—1. Colorado Springs. View includes a stretch of the Front or Colorado Range of the Rocky Mountains. From north to west, unnamed. West, are Pike's Peak and Cameron's Cove. Southwest, are Mount Rosa and Cheyenne Mountains; the latter is the finest point of the view. All these are *granite*, or granitic porphyry, &c. Northeast, (3 miles), is Austin's Bluff, Tertiary. Southeast, (2 miles), is Mt. Washington, named after the highest of the White Mountains, whose height it closely equals, without rising conspicuously above the plain. West and northwest, are the hogbacks of Mesozoic rocks, standing about vertical—the result of the granitic upheaval. The Garden of the Gods, Glen Eyrie and Blair Athol are among these hogbacks to northwest. The Garden Gate is very conspicuous from the mesa (of drift?) west of the town. In Glen Eyrie (private residence of Gen'l Palmer) contact of Triassic sandstone and granite well seen. West, Ute Pass, to north of Pike's Peak, over to South Park. (Stage to Fairplay, two days.) The Fontaine qui Bouille comes down from this pass, past the town of Manitou at its foot—is joined by Monument Creek, outside of the hogbacks, and flows south to the Arkansas River.

Excursions (ponies $3.00 a day) on the Plains, to Austin's Bluffs, Mt. Washington (half day), toward the mountains to Manitou and the fossiliferous Palæozoic rocks beyond, (their only exposure on Front Range!)—to Garden of Gods, Glen Eyrie, Blair Athol, Cheyenne Canon, (this latter in granite). Each half a day—better a day. To the mountains, "Cheyenne Mountain;" a good (toll) carriage-road leads up valley back of this mountain. The ascent of a characteristic granite peak can be made from end of road (carriage or saddle) in a day.

To Pike's Peak, (pony $6.00), two days, starting at 10 A. M. easily make Lake House by 4 or 5 o'clock. Good little shanty hotel. Moraine Lake shows good example of old glacial work. Leaving lake at 2 A. M., trail can easily be followed in dark to summit, in three hours, for sunrise. Signal Service station on top. View of Plains, Front Range, South Park (to west), and Arkansas Valley beyond; Sangre de Cristo, Sahwatch ranges in southwest and south, with Blanca Peak (14,480 feet highest of Rocky Mountains in United States) at left end of Sangre de Cristo. Mountains Harvard (next highest), Yale and Princeton, to west: Mount Lincoln, and Gray's and Torrey's Peaks, northwest, and many others. Descent to Colorado Springs, 6 or 8 hours. With plenty of time—three days—I should make this trip on foot.

2. Edgerton (Borstville?) station for Monument Park. Some few good specimens of monuments can be seen from railroad—Tertiary, horizontal.

3. Monument. Mesozoic rocks seen standing up at foot of mountains, four miles west.

4. Divide. Tertiary rocks reach over Mesozoics, and lie on granite in hill west of station.

5. Larkspur, Glade, Castle Rock. Fine Tertiary mesa of flat-topped hills.

Colorado Central Railroad.—6. Golden Junction to Golden City. Road runs between two volcanic mesas, (formerly one, now cut in two by Clear Creek).

7. Longmont(?) (Valmont?)—a dike near railroad station. These are the only igneous rocks occuring in the Sedimentaries along the base of Colorado range. (See Hayden's Report, 1873—figures —.)

8. Georgetown. Silver mines and reduction works. Excursion to Gray's Peak easily made in two days—(train arrives at noon and leaves at 1 o'clock.)

Denver Pacific Railroad.—9. Hughes. View of Pike's Peak in extreme south; Mt. Evans group, west-south-west; Gray's and Torrey's Peaks, up a valley (Clear Creek), with the volcanic mesas at its mouth, 12 miles west; James and Arapahoe Peaks, west; Long's Peak (double summit) west. Several snowy peaks to northwest, unnamed on maps. (Drainage Map of Colorado, Hayden, 1877, —.)

UTAH.

1. Ogden. View of Wahsatch Mountains to east, a very fine range, as seen in afternoon light, when eastern train arrives; southeast, Archæan, with Weber Canon cut in it, through which the railroad has come out into valley; east, "Fault Canon," faulted Cambrian lying on Archæan, recognized by color; Ogden Canon; northeast, Eden Pass, another fault; north and north-northeast, Palæozoic rocks on Archæan. Lake terraces show all along base of mountains, by gray horizontal line, very distinct.

Utah Central Railroad.—2. Leaving Ogden and rounding long Quaternary slope south of Weber River, a long stretch of Wahsatch range comes into view. From Fault Canon, north; Archæan, at base; Palæozoic, above; between Fault Canon and Centreville station, including Weber Canon, all Archæan. Then begins the great synclinal, as seen from along here. The north end, a little south of east from Centreville (Cambrian to Carboniferous), shows on top of mountains; and the south end, Twin Peaks (Cambrian), and Lone Peak (granite intruded through Archæan), in farthest distance, showing over lower Tertiary hills south of Centreville. The axis of the synclinal (of soft, Mesozoic rocks) being low and hidden. The old lake terrace is *very clearly* seen.

3. Centreville to Salt Lake City. Around west base of hills, formed of Palæozoic rock, dipping south, (part of synclinal), overlaid by unconformable Tertiary rocks.

4. Salt Lake City. Walk north, one hour, to Ensign Peak, (or better, an hour farther northeast, to point whence northeast can be seen also—giving fine view in all directions.) The Wahsatch range fills the east, from north to south. Other mountains are: Northwest, Antelope Island, in lake, Archæan. North-northwest, beyond Antelope Promontory Mountains and Island; west, Lakeside, Stansbury and Cedar Mountains; southwest, Qquirrh Mountain; west-southwest, Aqui Mountain; south, Pelican Mountain, (beyond Traverse)—Carboniferous, all running north and south; south, Traverse Mountains, east and west—Trachyte—cut through in middle of River Jordan, coming from Utah Lake, (fresh of course), north to Great Salt Lake. Prom Ensign Peak can be seen the city; the fertile valley of the Jordan, (fertile from irrigation); the lake; Camp Douglas (U. S. troops) on terrace east of and commanding city; Emigration Canon, through which the Mormons first came to the valley. Salt Lake is better than Colorado Springs for excursions.

Wyoming, Utah and Nevada.

By Mr. Arnold Hague, Assistant Geologist on the United States Geological Exploration of the 40th Parallel.

LIST OF GEOLOGICAL FORMATIONS IN THESE TERRITORIES,

In the region of the Union Pacific and Central Pacific Railroads.

General Table.	Wyoming.	Utah.	Nevada.
20. Quaternary.	20. Quaternary.	20. Up. Quatern'y. 20. Lower Quat'y.	20. Up. Quatern'y. "
19 c. Pliocene.		19 c. Humboldt.	19 c. Humboldt.
"	19 c. Niobrara.		
19 b. Miocene.			19 b. Truckee.
"	19 b. White River.		
19 a. Eocene.	19 a. Bridger.		
"	19 a. Green River.	19 a. Green River.	19 a. Green River.
"	19 a. Vermill'n Ck.	19 a. Vermill'n Ck.	
18. Cretaceous.	18 d. Laramie.	18 d. Laramie.	No Cretaceous in Nevada.
"	18 c. Fox Hill.	18 c. Fox Hill.	
"	18 b. Colorado.	18 b. Colorado.	
"	18 a. Dakota.	18 a. Dakota.	
17. Jurassic.	17. Jurassic.	17. Jurassic.	17. Jurassic.
16. Triassic.	16. Red Beds.	16. Red Beds.	16. Star Peak.
"			16. Koipato.
14. Carboniferous.		14-15. Perm. Carb.	
"		14 c. Up. Cl. Mres.	14 c. Up. Cl. Mres.
"	14. Coal Measures.	14 b. Weber Quart.	14 b. Weber Quart.
"		14 a. Low. Cl. Mres.	14 a. Low. Cl. Mres.
13. Sub-Carbonifer's.		13. Sub-Carbonif's.	13. Sub-Carbonif's.
9-11. Devonian.		9-11. Nevada l. s.	9-11. Nevada l. s.*
"		Ogden Quartzite.	Ogden Quartzite.
5-7. Silurian.		5-7. Ute Limestone	5-7. Ute Pog. li'ne.
2-4. Cambrian.		2-4. Cambrian.	2-4. Cambrian.
1. Archæan.	1 b. Huronian. 1 a. Laurentian.	1 b. Huronian. 1 a. Laurentian.	1. Archæan.

* Upper Helderberg to Chemung.

Wyoming.

Ms.	Union Pacific Railroad.	
463	Bushnell, Neb.	19 c. Niobrara, Pliocene.
473	Pine Bluffs, Wy.	"
484	Egbert.	"
496	Hillsdale.	"
508	Archer.	"
516	Cheyenne.[1]	"
523	Hazard.	"
531	Otto.	"
536	Granite Canon[2]	1 a. Lauren'n, Archæan.

Ms.	Union Pacific Railroad—*Continued.*	
542	Buford.	1 a. Lauren'n, Archæan.
549	Sherman.[3]	"
559	Harney.	"
564	Red Buttes.	17. Jurassic & Triassic.
570	Fort Sanders.	18 a. Dakota, Cretace's.
573	Laramie City.	"
581	Howell.	"
589	Wyoming.	18 b. Colorado, Creta's.
599	Cooper's Lake.	"
608	Lookout.	"
616	Miser.	"

1. At Chalk Bluffs, 15 miles southeast from Cheyenne, the Niobrara Pliocene and White River Miocene are both exposed, the latter resting unconformably upon the beds of the Laramie Cretaceous.

2. Both to the north and south of Granite Canon the Paleozoic beds may be seen resting against the Archæan rocks.

3. Sherman, the highest station along the line of the Union Pacific Railroad, lies 8,271 feet above sea-level, and is on the summit of the Colorado Range.

Ms.	Union Pacific Railroad—*Continued.*	
625	Rock Creek.	18 b. Colorado, Cretac's.
640	Como.[4]	17. Jurassic.
648	Medicine Bow.	18 b. Colorado, Cretac's.
657	Carbon.[5]	18 d. Laramie, Cretac's.
668	Percy.[6]	"
682	St. Mary's.	"
690	Walcott's.	18 c. Fox Hill, Creta's.
696	Fort Steele.	"
711	Rawlins.[7]	14 b. Coal Measures.
724	Separation.	18 d. Laramie, Cretac's.
739	Creston.	"
754	Wash-a-kie.	19 a. Ver'n Ck. Eocene.
764	Red Desert.	"
779	Table Rock.	"
787	Bitter Creek.	"
791	Black Buttes.	18 d. Laramie, Cretac's.
801	Hallville.	"
807	Pt. of Rocks.[8]	"
818	Salt Wells.	20. Quaternary.
826	Baxter.[9]	18 d. Laramie, Cretac's.
832	Rock Springs[10]	"
847	Green River.[11]	19 a. Green Riv. Eocene.
860	Bryan.	19 a Bridger, Eocene.
878	Granger.	"
888	Ch'rch Buttes[12]	"
905	Carter.	"
915	Bridger.	19 a. Ver'n Ck. Eocene.
930	Piedmont.	19 a. Green Riv. Eocene.
939	Aspen.	18 c. Fox Hill, Cretac's.

Utah.

	Union Pacific Railroad—*Continued.*	
957	Evanston.[13]	19 a. Ver'n Ck. Eocene.
968	Wahsatch.[14]	"
977	Castle Rock.	"
993	Echo.	"
1009	Weber.[15]	14 b. Lower Coal Mres.
1021	Devil's Gate.[16]	1. Archæan.
1026	Uinta.[17]	20. Quaternary.
1032	Ogden.[30]	"

Ms.	Central Pacific Railroad.	
0	Ogden.[30]	20. Quaternary.
10	Bonneville.	"
24	Corinne.	"
43	Blue Creek.	14 a. Lower Coal Mres.
53	Promontory.	"
78	Monument Pt.	20. Quaternary.
94	Kelton.	"
113	Matlin.[18]	Basalt.
124	Terrace.	20. Quaternary.
134	Bovine.	"
147	Lucin.	"

Nevada.

	Central Pacific Railroad—*Continued.*	
167	Montello.	20. Quaternary.
183	Toano.	19 c. Humbo't, Pliocene.
193	Pequop.	"
195	Otego.	19 a. Green Riv. Eocene.
205	Independence.	20. Quaternary.
214	Cedar.	14 c. Upper Coal Mres.
220	Wells.[19]	20. Quaternary.
227	Tulasco.	"
252	Halleck.	"
257	Peko.	"
266	Osino.[20]	"
275	Elko.[21]	"
287	Moleen.[22]	"
299	Carlin.	"
308	Palisade.[23]	Rhyolite.
326	Be-o-wa-we.	20. Quaternary.
336	Shoshone.	"
347	Argenta.	"
360	Battle Mount'n.	"
379	Stone House.	" [of station.
394	Iron Point.	16. Triassic, to the wes'd
403	Golconda.	Rhyolite.
414	Tule.	19 c. Humb't, Pliocene.
419	Winnemucca.	"
430	Rose Creek.	"

4. The railroad passes through the axis of an anticlinal fold, exposing an excellent section of Jurassic strata.

5. Carbon offers an excellent opportunity for studying the Cretaceous coals of Wyoming.

6. To the south of Percy station, Elk Mountain, which rises conspicuously above the plain, consists of Archæan crystalline schists, with Paleozoic and Mesozoic strata upon the slopes.

7. Rawling's Peak consists of an Archæan mass, surrounded by Paleozoic and Mesozoic beds. In the coal measures is an interesting body of iron ore.

8. Northeast from Point of Rocks is a remarkable outburst of leucite rocks.

9. There is exposed here an interesting section of Laramie coal rocks.

10. Near Rock Springs the coal formations are well shown.

11. Along the bluffs of Green River are seen the best exposures of the Green River Eocene.

12. On the south of the railroad, between Church Buttes and Carter, may be seen distant but good views of the Uinta Range.

13. About 3 miles north of Evanston are situated the Rocky Mountain and Wyoming coal Company's mines, where there is a good section of the Laramie beds.

14. From Wahsatch to Echo the railroad passes through Echo Canon, where are exposed both the Vermillion Creek and Laramie formations, the former lying unconformably upon the latter.

15. Passing through Weber Canon, from Lost Creek to Weber station, there is exposed a series of beds from the top of the Jurassic, through the Triassic, Upper Coal Measures, Weber Quartzite to the base of the Lower Coal Measures.

16. At the Devil's Gate the Archæan rocks of the Wahsatch Range are characteristically shown.

17. The terraces of Lake Bonneville, which stand over 900 feet above the present level of Salt Lake, may be seen from Uinta station.

18. On the north side of the railroad at Matlin the old lake terraces are distinctly cut in basalt.

Ms.	Central Pacific Railroad—*Continued.*	
440	Raspberry.	19 c. Humb't, Pliocene.
448	Mill City.[24]	" [side.
459	Humboldt.[25]	16. Triassic, on the east
471	Rye Patch.	"
481	Oreana.	19 c. Humb't, Pliocene.
488	Humbo. Bridge.	20. Quaternary.
493	Lovelocks.	"
502	Granite Point.	" [station.
509	Brown's.[26]	Rhyolite just west of the
521	White Plains.	"
528	Mirage.	19 b. Truckee, Miocene.
535	Hot Springs.[27]	Basalt on the east side.
546	Desert.	Basalt on the west side.
555	Wadsworth.[28]	20. Quaternary.
569	Clark's.	Trachyte.
581	Vista.	20. Quaternary.
589	Reno.	"
600	Verdi.	"
616	Boca.	"
624	Truckee, Cal.	"

Utah Northern Railroad.

0	Ogden.	20. Quaternary.
14	Willard.	"
22	Brigham.	"
32	Honeyville.	"
43	Hampton's.	"
53	Mendon.	"
60	Logan.	19 c. Humbo't Pliocene.
80	Franklin.	"

Ms.	Utah Central Railroad.		
0	Ogden.	20. Quatern'y.	Following the base of Wahsatch Range.
16	Kaysville.	"	
22	Farmington	"	
26	Centreville.	"	
29	Wood's Cross'g.	"	
37	Salt Lake City.	"	

Utah Southern Railroad.

0	Salt Lake City.	20. Quaternary.
17	Junction.	"
31	Lehi.	"
48	Provo.	"
66	Payson.	"
75	Terminus.	"

Eureka and Palisade Railroad.

0	Palisade.	20. Quaternary.
12	Evans.	"
28	Box Springs.	"
37	Mineral.	"
50	Alpha.	"
63	Summit.	"
78	Diamond.	"
90	Eureka.	"

Virginia and Truckee Railroad.

0	Reno.	20. Quaternary.
11	Steamboat.	"
21	Franktown.	"
30	Carson.	"
39	Eureka.	"
51	Virginia.[29]	Propylite.
	Carson City.	20. Quaternary.

19. From Wells there is a fine view of the East Humboldt Range. Mount Bonpland attains an elevation of 11,321 feet above sea-level.

20. Just east of Osino the railroad passes through Osino Canon, exposing a good section in the Weber Quartzite.

21. In the neighborhood of Elko may be seen the Green River Eocene, Humboldt Pliocene, characteristic outbursts of rhyolite and the "Chicken Soup" hot springs.

22. In Moleen Canon the Carboniferous formations are well shown.

23. Palisade Canon cuts through rhyolites; there are also exposed andesites and trachytes.

24. Mill City is the most convenient place to leave the railroad in order to study the characteristic Triassic formations of the West Humboldt Range.

25. From Humboldt there is a fine view of the West Humboldt Range. In the neighborhood are some interesting outbursts of basalt and a deposit of sulphur.

26. In the Montezuma Range, west of Brown's station, the volcanic rocks are well shown. It is an interesting place to study rhyolites and basalts.

27. The Hot Springs, a short distance east of the station, reach the surface near the base of basaltic hills.

28. The Truckee Canon, just east of Wadsworth, offers remarkable outbursts of a great variety of volcanic rocks. There may be seen here basalts, rhyolites, trachytes, andesites and propylites.

29. Propylite is the characteristic volcanic rock, which carries the Comstock Lode. A. H.

30. The last rail completing the Pacific railroads, from Omaha to San Francisco, was laid May 10th, 1869.

See notes on page 165.

California.*

Ms.	Central Pacific Railroad.		
	State Line.		20. Quaternary.
616	Boca.		"
624	Truckee.		"
638	Summit.		"
644	Cascade.	1	"
648	Tamarack.		"
651	Cisco.		"
660	Emigr't Gap.		"
668	Blue Canon.		"
675	Alta.		"
677	Dutch Flat.		"
679	Gold Run.	2	"
689	Colfax.		"
701	Clipper Gap.		"
707	Auburn.		"
712	Newcastle.		"
718	Pino.	3	"
721	Rocklin.		"
725	Junction.		19 c. Pliocene & 20. Quaternary above
728	Antelope.		Granite (Archæan ?)
736	Arcade.		20. Quater'y, Alluvial.
743	Sacramento.		"
748	Brighton.	4	"
753	Florin.		"
769	Elk Grove.		"
770	Galt.		"
779	Lodi.		"
791	Stockton.[5]		20. Quaternary.
807	Lathrop.		"
808	Bantas.		19. Terti'y, Pliocene, 19 b. Miocene and Lignitic, 19 a. Eocene ?
813	Ellis.		
819	Midway.		
827	Altamont.		
835	Livermore.		20. Quatern'y, Alluvial.
841	Pleasanton.		"
853	Niles.		20. Quaternary.
856	Decoto.	6	"
862	Haywards.		"

Ms.	Central Pacific Railroad—*Continued.*	
865	Lorenzo.	20. Quaternary.
867	San Leandro.	"
871	Melrose.	"
876	Brooklyn.	20. Quat'ry and 19 c. Tertiary, Pliocene.
879	Oakland.	
883	San Francisco.	18. Lignitic & Metamorphic Cretaceous.

San Jose Branch.

0	San Francisco.[7]	18 Lign. & Metam. Cret.
4	Oakland.	20. Quaternary.
7	Brooklyn.[8]	20. Quaternary & 19 c. Tertiary Pliocene.
12	Melrose.	"
16	San Leandro.	"
18	Lorenzo.	"
27	Decoto.	"
30	Niles.	"
34	Washington.[9]	"
37	Warm Springs.	"
42	Milpetas.	"
48	San Jose.	"

Visalia Division.

0	Lathrop.		20. Quaternary.
6	Morrano.		"
10	Stanislaus.		"
20	Modesto.		"
33	Turlock.		"
50	Atwater.		"
57	Merced.	10	"
67	Plainsburg.		"
83	Berenda.		"
94	Borden.		"
102	Sycamore.		"
112	Fresno.		"
122	Fowler.		"
146	Goshen.		"

* By Dr. J. G. Cooper, late Assistant State Geologist.

1. Volcanic and glacial, with 1. Archæan (granite) and metamorphosed rocks of uncertain age. Metalliferous but not rich. Mt. Stanford, northward, is 9,500 feet high.

2. Glacial, and detrital above 16. Triassic and 17. Jurassic sandstones, containing most of the gold mined on the western slopes.

3. Detrital above 1. Archæan (granite). Surface mining.

4. The mountains to the east produce lime, marble, copper ore and some lignite (19 c. Pliocene).

5. Mt. Diablo, 3,876 feet high, is in full view and easily ascended from near the coal mines.

6. Follows the 20. Quaternary (alluvial) nearly after passing through Alameda Canon 10 miles, traversing 19. Tertiary, 19 c. Pliocene and 19 b. Miocene, then lignitic, with little coal.

7. The islands visible are all like S. F. in geological structure.

8. Redwood Peak, 1,635 feet high, is the highest in the range opposite S. F. Mission Peak, 34 miles southeast, is 2,566 feet high.

9. Mountains on the east side rise to 4,443 feet and on the west side to 3,780 feet in height.

10. The "High Sierra," 14,000 to 15,000 feet, can be seen on clear days. The mountains eastward have the same general character as on the line from Boca to Sacramento, with the addition of some 18. Cretaceous uplifts near base.

Southern Pacific Railroad.

Ms.	Tulare Division.	
146	Goshen.	20. Quaternary.
157	Tulare.	"
167	Tipton.	"
179	Alila.	"
187	Delano.	"
199	Posa.	"
207	Lerdo.	"
220	Sumner.	"
242	Caliente.	"

Oregon Division Central Pacific Railroad.

0	Sacramento.	20. Quaternary.
8	Arcade.	"
15	Antelope.	"
18	Junction.	19. Tertiary, Pliocene,
29	Lincoln.	with workable lign'e.
33	Ewing's.	20. Quaternary.
40	Wheatland	"
46	Reed's.	"
50	Yuba.	"
52	Marysville.	"
70	Gridley.	"
83	Nelson.	"
90	Durham.	"
96	Chico.	"
105	Anita.	"
110	Soto.	"
122	Sesma.	"
123	Tehama.	"
135	Red Bluff.	"
170	Redding.[13]	" Volcanic.

Alameda Branch.

	San Francisco.	18 c. Lign. & Metamorphic Cretaceous.
	Oakland Wharf.	20. Quaternary.
	Oakland.	"
	Alameda Stat'n.	"
	Fruit Vale.	20. Quatern'y and 19 c. Tertiary Plioc.
	Fernside.	"

California Pacific Railroad.

0	San Francisco.	18 c. Lign. & Metam. Cretaceous.
25	Vallejo.[14]	20. Quaternary & 18. Cretaceous.
31	Napa Junction.	"

California Pacific Railroad—*Continued.*

Ms.	Napa Branch.	
31	Napa Jun'n	20. Quaternary.
39	Napa.	"
45	Oak Knoll.	"
52	Oakville.	"
58	St. Helena.	"
66	Calistoga.	"

Main Line.

31	Napa Junct'n.[16]	20. Quaternary.
39	Bridgeport.[17]	"
44	Fairfield.	"
55	Elmira.	"
59	Batavia.	"
63	Dixon.	"
71	Davis.	"
84	Sacram'to.	"

Marysville Branch.

0	San Francisco.	(As before.)
71	Davis.	20. Quaternary.
81	Woodland.	"
85	Curtis.	"
90	Knight's Land'g.	"

Stockton & Visalia and Stockton & Copperopolis Railroads.[19]

0	Stockton.	20. Quaternary.
6	Charleston.	"
11	Holden.	"
15	Peter's.	"

15	Peter's.	20. Quaternary.
22	Waverly.	"
30	Milton.	"

15	Peter's.	20. Quaternary.
20	Farmington.	"
28	Clyde.	"
34	Oakdale.	"

Southern Pacific Railroad of California.

0	San Francisco.	18 c. Lign. & Metam. Cretaceous.
6	San Miguel.	"

11. The mountains westward are like those from Pleasanton to Niles, with more 19. Tertiary, 19 b. Miocene and 18. Cretaceous. Also 20. Quaternary, volcanic and granite in places. The only coal now worked is north of Mt. Diablo and south of Livermore. The granite, of the coast ranges at least, is eruptive, and belongs rather to the Quaternary than the Archæan.

12. The mountains eastward resemble those farther to the south, but with more 18. Cretaceous, some 13. Sub Carboniferous near the middle, and a vast 20. Quaternary volcanic field northward.

13. Mt. Shasta, 14,400 feet high, is in view.

14. The fossil forest is on this route.

15. The hills on both sides are metamorphic (18. Cretaceous?), with volcanic outbursts increasing toward the northeast, and with quicksilver deposits.

16. St. Helena Mountain is 4,343 feet high.

17. Tunnel through 18. Cretaceous and 19. Tertiary hills.

18. The coast range westward, 5,000 to 8,000 feet high, is little explored, but resembles that south of San Francisco Bay, with much more volcanic, and towards the north auriferous, but only granitic or metamorphic rocks, containing the gold quartz, underlie the cretaceous, as far as now known.

19. The most northern group of "Big Trees" is approached by this route.

20. Passing into 19. Tertiary, 19 c. Pliocene and 1. Archæan (granite) below it.

Southern Pacific Railroad of California— *Continued.*

Ms.		
12	Baden.[21]	20. Quaternary.
17	Millbrae.[22]	"
21	San Mateo.	"
25	Belmont.	"
28	Redwood City[23]	"
33	Menlo Park.	"
38	Mountain View.[24]	"
44	Lawrence's.	"
50	San Jose.	"
63	Coyote.	"
73	Tennant.[25]	"
80	Gilroy.[26]	"
83	Carnadero.	"
86	Sargent's.	"
96	Vega.[27]	"
99	Pajaro.	"
110	Castroville.[28]	"
118	Salinas.	"
128	Chualar.	"
134	Gonzales.	"
143	Soledad.	"
80	Gilroy.[29]	20. Quaternary.
94	Hollister.	"
100	Tres Pinos.[30]	"

Los Angeles Division.

0	Los Angeles.[31]	20. Quaternary.
22	San Fernando.	"
0	Los Angeles.	20. Quaternary.
6	Florence.	"
13	Downey.	"
17	Norwalk.	"
23	Costa.	"
27	Anaheim.	"

Southern Pacific Railroad of California.

Ms. | Los Angeles Division—*Continued.*

0	Los Angeles.	20. Quaternary.
5	Florence.	"
10	Compton.	"
15	Cerritos.	"
20	Wilmington.[32]	"
0	Los Angel's	20. Quaternary.
9	San Gabriel	"
13	Monte.	"
29	Spadra.	"
42	Cucamon'a. [33]	"
57	Colton.	"
61	Mound City	"
72	El Casco.	"
80	San Gorgonia[34]	"
93	Jacinto.	"
101	Whitewater.	"
104	Seven Palms.	"
130	Indian Wells.	"

San Francisco & Northern Pacific R. R.

0	San Francisco.	18 c. Lign. & Metam. Cretaceous.
34	Donahue.	20. Quater'y, Volcanic.
42	Petaluma.	"
49	Page's. [35]	"
57	Santa Rosa.	"
61	Fulton.	"
70	Grant's.	"
82	Geyserville.	"
90	Cloverdale.	"

21. A ridge of marine 19 c. Pliocene Tertiary, full of shells, &c., lies west of the road for five miles.

22. Metamorphic Cretaceous hills west of road, and granite (1. Archæan?) below.

23. 19 b. Miocene (Tertiary) hills come near on the west.

24. 18. Metamorphic Cretaceous hills on the west, mostly capped by 19 c. Miocene Tertiary (marine.)

25. The celebrated New Almaden Quicksilver Mines are not far west.

26. Some Lignitic (19 a. Eocene and later) exists to the west, but has not yet been found workable.

27. Passes through the 18. Cretaceous hills, flanked by 19. Tertiary (19 a. Miocene and 19 b. Pliocene) on the west. Some lignite in it.

28. The hills to the southwest are metamorphic and granitic, with 19. Tertiary on their flanks as before.

29. Much 19. Tertiary on the slopes of hills around, with very fine marine fossils (19 b. Miocene and 19 c. Pliocene).

30. The New Idria Quicksilver Mine lies to the southeast in the highest part of this range of mountains, near 5,000 feet elevation.

31. The hills northward are metamorphic (18. Cretaceous?), with a great 19. Tertiary (19 b. Miocene and 19 c. Pliocene) basin between them and the range north of San Fernando. To the east more metamorphic and granitic, with auriferous quartz, copper, &c. The 19. Tertiary contains much petroleum.

32. A metamorphic (18. Cretaceous) hill north of this harbor. The islands visible are similar, with some 20. Quaternary sandstone and Paleozoic rocks.

33. About half way the metamorphic and granitic hills approach the road. Much 19 b. Miocene Tertiary, with poor lignite, caps these on the west.

34. Metamorphic auriferous rocks (secondary) overlying granite, chiefly on the west side. San Barnardino Mountain is 11,600 feet high.

35. The foothills are full of Tertiary fossils (Miocene and Pliocene). The metamorphic and volcanic mountains contain valuable quicksilver mines.

36. Some indications of quicksilver in the hills. Chromic iron and pyrolusite are also found in large quanties.

37. Mt. Tamalpais, 2,604 feet high, may be ascended here. Gives a magnificent view of the country near San Francisco Bay.

Ms.	Northern Pacific Coast Railroad.	
0	San Francisco.	18 c. Lign. & Metam. Cretaceous.
11	San Quentin.[36]	"
15	San Rafael.[37]	"
17	Junction.	"
0	San Francisco.	18 c. Lign. & Metam. Cretaceous.
6	Saucelito.	"
10	Lyford's.	"
15	Tamalpais.	"
17	Junction.	"

Ms.	Northern Pacific Coast R. R.—*Cont.*[38]	
17	Junction.	18 c. Lign. & Metam. Cretaceous.
19	Parker's.	"
25	Nicasio.	"
31	Taylorville.	"
35	Garcia.	"
42½	Millerton.	"
47½	Marshall's.	19 b. Tertiary, Miocene.
55	Tomales.	"

38. The only groves of the celebrated "Redwood" tree, accessible by railroad, are on this route and northward. J. G. C.

Washington Territory.[1]

Ms.	Northern Pacific Railroad.	
0	Kalama.	Basalt hills.[2]
5	Carroll's.	"
8	Monticello.	"
11	Cowlitz.	"
28	Olequa.	"
37	Winlock.	"
48	Newaukum.	19. Tertiary hills.
60	Skookum C'k	19. Cretace's, with coal.
66	Tenino.	Mound Prairie, a strange grouping of natural mounds.
96	Lake View.	
105	New Tacoma.	19 c. Pliocene deposits, overlaid with glacial drift.
	Down Puget Sound.	"
	Seattle.	18. Cretaceous coal.

Portland to Canyon City—River and Stage Line—Lewiston River and Railroad.
(Among the finest scenery of the continent.)

Portland.	On the left Basalt Mts., on the right Alluvial.
Vancouver.	Alluvial and Post Pliocene gravels.
Sandy.	"
Cascades.	Basalt Mts. overlying fossil leaf-beds and petrified wood—whole trees, stumps & roots in place.
Up. Cascades.	Conglomerate, &c.
Rock Creek.	Abundance of silicified oak in Tertiary conglomerates.
Collin's.	Buried forests.
Hood River.	Sight of Mt. Hood and Mt. Adams.
Dalles City.	Pliocene sandstone, with fossil leaves and Post Pliocene fossil beds.

Hence to Lewiston by Railroad or River.
To Canyon City by Stage.

The Dalles to Canyon City.	Through wonderful beds of mammalian fossils of 19 b. Miocene age, corresponding with the "Mauvaises Terres," or bad lands of Nebraska and Dakota.

1. Furnished by Prof. Condon, the State Geologist of Oregon.
2. *Basalt* is an igneous rock occurring in the volcanic and trap series. The 18. Cretaceous era, and still more the 19. Tertiary and 20. Quaternary, were remarkable for the extent of the eruptions over the western part of this continent in Oregon, Washington, &c. Basalt being an intrusive rock is not here distinguished by any number denoting its age, as that can only be known by the formation on which it rests, or that resting upon it, if there be any.

Oregon.*

Oregon and California Railroad.

Ms.	(Up the Willamette Valley.	
0	Portland.	Hills on west. Basalt alluvial gravel plain east. 19 b. Miocene fossils in the river bed.
7	Milwaukee.	Basalt hills.
11	Clackamas.	
16	Oregon City.	Bed of river and hills on both sides columnar basalt.
20	Rock Island.	A transverse dike of trap, with amygdaloid. Hills of basalt. The bed of the river and the now widening valley of 20. Post Pliocene contain
25	Canby.	abundant fossil remains of bos, latifrous, elephas, mastodon and
29	Aurora.	horse.
33	Hubbard.	The streams here to right and left expose
40	Gervais.	this 20. Post Pliocene mud.
53	Salem.	The river bed is 20. Post Pliocene. The
61	Turner.	hills are rich with 19
67	Marion.	b. Miocene marine fossils.
72	Jefferson. (Exposure a mile above the town on the Santiana River.)	A ridge of dark colored 19. Tertiary crosses the line of travel here—rich in fossils.

Ms.	**Oregon and California R. R.**—*Cont.*	
81	Albany.	The above rock seen across the river.
87	Tangent.	An extended bed of an ancient inland sea,
98	Halsey.	named by Prof. Con-
106	Harrisburg.	don "The Willamette
110	Junction.	Sound," with abund- ance of 20. Ter. fossils.
124	Eugene.	The hills again with abundant 19 b. Miocene fossils.
135	Creswell.	Volcanic tufas and por-
145	Latham.	[phyries.
148	Divide.	Carbonace'us shale, with
156	Comstock.	coal 18. Cretaceous.
161	Rice Hill.	
181	Oakland.	Metamorphic.
200	Roseburg.	

Oregon Central Railroad.

0	Portland.	Hills of basalt, overlying 19 b. Miocene.
6	Summit.	Basalt.
9	Ross Landing	
11	Beaverton.	To Forest Grove over the bed of the 20. Post
16	Readsville.	Miocene inland sea,
24	Hillsboro.	connected with the
29	Cornelius.	main one of Willamette Valley, through the
	Forest Grove.	Twalatin and Chehalem Valley.
32	Gaston.	Hills of fossil rock right and left, 19 b. Miocene.
48	St. Joseph's.	

* Furnished for this work by Prof. Thomas Condon, of the Oregon State University, Eugene City, Oregon, the State Geologist.

Delaware and the Eastern Shore of Maryland.

Delaware Railroad.

(Operated by the Philadelphia, Wilmington and Baltimore Railroad,)

Ms.		
0	Wilmington.	18. Cretaceous? 17. Jurassic.
6	New Castle.	18. Cretaceous.
16	Kirkwood.	19 a. Eocene?
21	Mt. Pleasant.	"
25	Middletown.	"
29	Townsend.	19 b. Miocene.
37	Clayton.	18. Cretaceous.
37	Clayton.	18. Cretaceous.
39	Smyrna.	20. Post Pliocene.
37	Clayton.	18. Cretaceous.
48	Dover.	19 b. Miocene.
51	Wyoming.	"
56	Canterbury.	"
58	Felton.	"
64	Harrington.	"
68	Farmington.	"
76	Bridgeville.	"
84	Seaford.	20. Post Pliocene.
90	Laurel.	"
97	Delmar.	"

Eastern Shore Railroad.

0	Delmar, Del.	19 b. Miocene Tertiary.
6	Salisbury, Md.	20. Post Pliocene.
10	Eden.	"
19	Princess Anne.	"
24	Westover.	"
28	Kingston.	"
32	Marion.	"
38	Crisfield.	"

Junction, Breakwater, Franklin and Worcester Railroad.

	Wilmington.	
0	Harrington.	19 b. Miocene Tertiary.
9	Milford.	"
12	Lincoln.	"
17	Ellendale.	"
25	Georgetown.	"
25	Georgetown.	19 b. Miocene Tertiary.
31	Harbeson.	20. Post Pliocene.
33	Cool Spring.	"
36	Nassau.	"
40	Lewes.	" (Modern.)
25	Georgetown.	(As before.)
41	Frankford.	20. Post Pliocene.
54	Berlin.	"
68	Snow Hill.	"
77	Stockton.	"
81	Franklin.	" (Modern.)

Ms.	Maryland and Delaware Railroad.	
0	Clayton.	18. Cretaceous.
5	Kenton.	"
14	Marydell.	"
20	Goldsboro.	"
24	Greensboro.	"
32	Hillsboro.	"
44	Easton.	"

Queen Anne's and Kent Railroad.

0	Townsend.	19 b. Miocene.
10	Massey's Junct.	"
14	Millington.	"
26	Tilghman's.	"
36	Centreville.	"

Kent County Railroad.

	Wilmington.	(As before.)
0	Clayton.	18. Cretaceous
10	Massey's Junct.	"
20	Kennedyville.	"
31	Chestertown.	"
36	Parsons.	"

Dorchester and Delaware Railroad.

0	Seaford.	20. Post Pliocene.
10	Federalsburg.	"
14	Williamsburg.	"
20	EastNewmarket	"
33	Cambridge.	"

Wicomico and Pocomoke Railroad.

0	Salisbury.	20. Post Pliocene.
10	Pittsville.	"
19	St. Martin's.	"
23	Berlin.	"
29	Newark.	"
37	Snow Hill.	"

Wilmington and Western Railroad.

0	Wilmington.	18. Cretaceous. 17. Jurassic.
12	Ashland.	2–8. Silurian.
17	Southwood.	"
20	Landenberg.	"

Wilmington and Northern Railroad.

0	Reading, Pa.	(See Pennsylvania.)
39	Coatesville.	"
57	Chadd's Ford.	1. Azoic.
61	Smith's Bridge.	"
63	Centre.	"
65	Dupont.	"
66	Greenville.	"
68	Lancaster Road.	"
72	Wilmington.	18. Cretaceous. 17. Jurassic.

* By Prof. P. R. Uhler, of the Peabody Institute, Baltimore.

Maryland and District of Columbia.*

Philadelphia, Wilmington and Baltimore Railroad.

Ms.		
0	Philadelphia.	(See Pennsylvania.)
28	Wilmington.	18. Cret. & 17. Jurassic.
30	Delaware Junc.	"
32	Newport.	"
34	Stanton.	"
40	Newark.	"
46	Elkton.	"
52	Northeast.[1]	"
55	Charlestown.	"
61	Perryville.	" & Archæan.
	(Susquehanna River.)	
62	Havre-de-Grace.	18. Cret. & 17. Jurassic.
67	Aberdeen.	"
74	Bush River.[2]	"
77	Edgewood.	"
79	Magnolia.	"
89	Stemmer's Run.	"
94	Bay View.	"
98	Baltimore.	"

Philadelphia and Baltimore Central R. R.

0	Philadelphia.	(See Pennsylvania.)
36	Kennett.	"
52	Oxford.	"
60	Rising Sun.	1 a. Laure'n, Serpentine.
67	Rowlandville.	"
71	Port Deposit.[3]	" Granite.
75	Perryville.	"
112	Baltimore.[7]	

Baltimore and Potomac Railroad.

0	Baltimore.[7]	17. Jurassic & 1 a. Laur.
19	Odenton.[9]	" and recent.
21	Patuxent.	"
26	Bowie.	"
34	Wilson's.	" 18. Cret. near.
41	Navy Yard.[9]	" "
43	Washing'n, D. C.	" "

Pope's Creek Branch.

0	Baltimore.[7]	
26	Bowie.	17. Jurassic
40	Marlboro.	19 a. Miocet.
46	Linden.	"
55	Beantown.	"
65	La Plata.	"
69	Cox.	"
75	Pope's Creek.	"

Baltimore and Ohio Railroad.

Washington Branch.

Ms.		
0	Baltimore.[7] Camden Sta'n	17. Jurassic.
9	Relay House.[9]	1 a. Lauren'n, Granite.
19	Annapolis Jun.	17. Jurassic.
22	Laurel.	"
28	Beltsville.	"
34	Alexandria Jun.	"
34	Bladensburg.	"
40	Washington.[9]	" 1. a. Lauren.

Alexandria Branch.

0	Baltimore.	(As before.)
34	Alexandria Jun.	17. Jurassic.
40	Banning's.	"
42	Uniontown.	"
46	Shepherd.	Cretaceous & Jurassic.

Annapolis and Elk Ridge Railroad.

0	Annapolis Junc.	19. Cret. & 17. Jurass.
3	Patuxent.	"
6	Odenton.	20. Recent 17. Jurassic.
9	Gambrill's.	"
10	Millersville.	Cretaceous.
12	Waterbury.	"
14	Crownsville.	"
16	Iglehart.	"
18	Camp Parole.	"
21	Annapolis.[1]	" &1 a. Lauren'n ? Eocene in vicinity.

Northern Central Railroad.

0	Baltimore.	17. Jurassic and 1 a. Laurentian.
2	Mount Vernon.	"
7	Green Springs Junction.[4]	2–4. Siluro-Cambri'n, Serpentine.
12	Timonium.	"
15	Cockeysville.	" large quarries of white marble.
20	Sparks'.	2–4. Siluro-Cambrian.
23	Monkton.	1 a. Laurentian, Mica Schists.
29	Parkton.	1 a. Laure'n, Granite and Serpentine.
35	Freeland's.	1 a. Laurentian.
42	Glenrock.	"
47	Hanover Ju., Pa.	2–4. Siluro-Cambrian.
57	York, Pa.	"
	(Continued in Pennsylvania.)	

* By Prof. P. R. Uhler, of the Peabody Institute, Baltimore, except B. & O. R. R. west.

1. Kaolin occurs near Annapolis, near Northeast, and near the Metropolitan Railroad in Montgomery county.

2. Harford county, a few miles northwest of the Philadelphia, Wilmington & Baltimore Railroad, yields a fine green serpentine in vast blocks, equal to verd-antique in splendor and polish, besides the common building sort. In the Jurassic beds on the same railroad, also on the Washington branch of the Baltimore and Ohio Railroad, vast beds of nodular carbonates of iron occur, rich in metal.

3. The Woodstock, Ellicott's City and Port Deposit granites are superior of their kind.

4. Bare Hills mineral region. It has chrome and copper ores, asbestos, serpentine and magnesian rocks.

Ms.	Western Maryland Railroad.[5]	
0	Baltimore.[7]	17. Jurassic and 1 a. Laurentian.
3	Fulton Station.	"
5	Oakland.	"
6	Arlington.	"
9	Howardsville.	"
10	Pikesville.	" Serpentine.
11	Greenwood.	"
14	Owing's Mills.	"
19	Reisterstown.	" Granite.
22	Finksburg.	" Copper.
31	Tannery.	"
34	Westminster.	" Marble.
41	New Windsor.	"Var'gd Marble.
45	Union Bridge.	"
48	Middleburg.	" "
49	Frederick.	16. Triassic.
51	Rocky Ridge.	" Trap.
61	Emmitsburg.	16. Triassic.
59	Mechanicstown.	2 b. Potsdam, (Marble.)
69	Blue Ridge.	"
71	Waynesboro.	
77	Smithsburg.	4 a. Trenton limestone.
86	Hagerstown.	"
93	Williamsport.	4 c. Hudson River.
106	Martinsburg.	3 a. & 4 c. Cal. & Huds.

	Baltimore and Ohio Railroad.[6]	
0	Baltimore.[7]	17. Upp. Jur.? & Azoic.
15	Ellicott City.[3]	1 a. Laur'n, Gran. quar.
20	Elysville.[8]	"
25	Woodstock.[3]	"Gran. & Steat. qu.
27	Marriottsville.	"
32	Sykesville.	"
43	Mount Airy.	1 b. Huronian.
50	Monrovia.	" Slate quarries.
58	Frederick Junc.	" Triassic near.

Ms.	Baltimore & Ohio Railroad—*Continued.*	
62	Frederick.	1 b. Huron'n limestone.
69	Point of Rocks.	16. Triassic. Pot. marb.
0	Washington.[9]	17. Upp. Jur.? & Azoic.
7	Silver Spring.	"
11	Knowles'.	"
16	Rockville.	1 b. Huronian.
22	Gaithersburg.	" Serpentine.
27	Germantown.[1]	"
29	Boyd's.	" Talc. schists.
33	Barnesville.	"
36	Dickerson's.	16. Triassic?
43	Pt. of Rocks.[10]	" Potomac Marble.
69	Point of Rocks.	16. Triassic, Pot. Marb.
75	Berlin.	1 b. Huronian.
79	Weverton.	"
80	Sandy Hook.	"
81	Harper's F'ry[11]	"
87	Duffield's, Va.	3 a. to 4 c. Sil.-Cam. l. s.
92	Kearneysville.	"
95	Vanclievesville.	"
100	Martinsburg.	"
107	Nor. Mount'n.[12]	5–12. Silu. & Devonian.
117	Sleepy Creek.	"
122	Hancock.[13]	10. Ham. & 7. L. Held'g.
128	Sir John's Run.	8–12. Devonian.
138	Orleans Road.	"
153	Paw Paw.	"
163	Green Spring.	7. L. Held. & 8. Oris.
170	Patterson's Ck.	10. Hamilton.
178	Cumberland, Md	8. Oriskany. 7. Lower Heldb'g to 13 a. Vespertine.

See note 11

See note 13.

5. The Western Maryland Railroad has copper mines, chrome, serpentine, talc, steatite, asbestos, carbonate of iron, and most beautiful marbles of every color, from black, dark red, salmon, &c., to pure white—even statuary marble—besides the breccias of every degree of size in their component pebbles or pieces, both round and angular. P. R. U.

6. By Prof. William M. Fontaine, of Morgantown, West Virginia.

7. Baltimore is situated near the junction of the Azoic metamorphic rocks, with a series of clays and sands, underlying the cretaceous beds. The age of these clays has not been fixed. Some consider them to be Lower Cretaceous, others Upper Jurassic. They are probably Upper Jurassic, and not far distant in age from the Fredericksburg sandstones of Virginia. The surface clays in South Baltimore are probably of Post Pliocene age.

8. The rocks of the eastern portion of the Azoic area in Maryland, as in Virginia, are granites, gneisses and hornblendic rocks, probably of Laurentian age. This belt extends to near Parr's Ridge, where it is succeeded by Argillites, with some metamorphic limestone, probably of Huronian age. This latter belt extends to some one and a half miles west of Harper's Ferry, where it is succeeded by the Primordial and overlying strata.

9. The Azoic area passes some distance to the west of the railroad from Baltimore to Washington, consequently this road runs entirely in formations similar to those found at Baltimore. Washington has a geological position similar to that of Baltimore, but here the subjacent rocks are plainly similar in age to the Fredericksburg sandstones, and are probably Upper Jurassic.

10. On the west side of the Monocacy River a belt of Triassic rocks occurs, extending to near the east base of the Catoctin Range. Along the west margin of this belt occurs the remarkable limestone breccia called the Potomac Marble. This is well exposed near Point of Rocks. This Triassic belt is flanked immediately on the northeast and east by a belt of rather impure slaty limestone, belonging to the Azoic area.

11. The gorge at Harper's Ferry is cut through metamorphic rocks, of probably Huronian age. One and a half miles west of the station, a fault brings down the Potsdam and Calciferous rocks against the Azoic. From this point, 83 miles, to near North Mountain, 107 miles, a wide belt of Lower Silurian limestone occurs, with occasional bands of slate, embracing the rocks from the 3 a. Calciferous to and including the 4 c. Hudson River. These have never been separated in this region. The limestone predominates by far, and will be spoken of as the 2-4. Siluro-Cambrian.

Cumberland and Pennsylvania Railroad.		
0	Cumberland,	10. Hamilton.
		8. Oriskany.
		7. Lower Helderb'g.
	to	5 b. Clinton.
		5 a. Medina.
		5 a. Oneida.
2	Will's Gap.	4 c. Hudson River.
4	C. & P. Junct'n	
7	Patterson's.	4 c. up to 14 b. Low.
8	Barrelville.	Coal Measures.
10	Mount Savage.	

Cumberland and Pennsylvania Railroad—*Continued.*		
Ms.		
13	Morantown.	14 c. Upper Coal Mres.
17	Frostburg.	"
20	Borden Shaft.	"
22	Ocean Mines.	"
25	Jackson.	"
29	Barton.	"
34	Piedmont, W.V.	"

The great Cumberland coal region.—Coal bed 14 feet thick.

12. On the west side of this limestone belt, a great fault brings down in North Mountain, the various Silurian and Devonian formations from the 5 a. Medina to the 13 a. Vespertine or No. X, which are to be seen in North Mountain and its immediate vicinity.

13. From North Mountain to Cumberland a wide belt of highly disturbed strata occurs. Owing to the close compression of the folds in which the strata are thrown, many of the formations contained in this belt are always to be seen at any given locality, and hence when any formation is given for a station it must not be inferred that this alone occurs there.

In this belt the following formations are to be found: The 5 a. Oneida, 5 b. Clinton, 7. Lower Helderberg, 8. Oriskany, 10. Hamilton, 11 a. Portage, 11 b. Chemung, 12. Catskill, and 13 a. Vespertine. These have never been clearly separated from each other. The hard sandstones, such as the 5 a. Oneida and 8. Oriskany, usually form the crests of the ridges, and the softer strata, more commonly the Hamilton, compose the valleys and foot hills. W. M. F.

West Virginia.

For the List of Formations see that of Virginia, page 179.

Baltimore and Ohio Railroad.		
Ms.	From Cumberland, West.[1]	
178	Cumberland.[2]	13 a. Vesper'ne s.s. & 11 b. Chemung.
185	Brady's Mill.[3]	7. Lower Helder. s.s.
		8. Oriskany.
201	Keyser.[4]	10. Hamilton.
		11 a. Portage.

Ms.	Baltimore & Ohio Railroad—*Continued.*	
		14 b. Low. Barren Mrs.
206	Piedmont.[5]	and Low. Coal Mres.
		13 b. Umbral red s. s.
208	Bloomington.	14 a. Conglome.
214	Frankville.	"
220	Swanton.	"
223	Altamont.	"

Ascent in 17 ms. 1700 feet

1. Compiled from information furnished by Professors J. J. Stevenson and Wm. M. Fontaine.

2. In the gorge where Will's Creek cuts through Dan's Mountain there is a fine exposure of the Lower 13 a. Pocono or Vespertine grey sandstone, resting on the brown sandstone of the Upper 11 b. Chemung, in lofty cliffs. F.

3. The 7. Lower Helderberg limestone is here exposed, and on the Virginia side of the Ohio River a great mass of limestone and shales is seen, the latter being probably composed of the Waterlime beds and the Onondaga marls. Somewhat further east the conglomerate is seen in the top of the mountain, with an underlying coal bed. F.

4. Here the railroad enters the East Front Ridge of the Allegheny, in which the Oriskany sandstone shows a high bluff, and where there are extensive exposures of the 10. Hamilton, 11 a. Portage and other Devonian groups. F.

5. Here the conglomerate is near the water level. The hills are composed of the Lower Coals and the Lower Barren Measures. A small remnant of the Pittsburg seam is found high up in the hills on the west side of the river, and is worked. From Piedmont, which is 919 feet above tide, the railroad ascends, by a grade 17 miles long, to the height of 2,620 feet, at Altamont. From Cumberland to Piedmont great quantities of very large, rounded stones occur, having much the appearance of glacial drift, and often rising to the height of 80 feet on the hill sides. F.

Ms.	Baltimore & Ohio Railroad—*Continued.*	
226	Deer Park.[6]	14 a. Cong. On a broad
232	Oakland.	" flat topped
242	Cranberry.	" mountain.
253	Rowlesburg.	13 b. Umbral, 13 a. Vespertine and 11 b. Chemung.
260	Tunnelton.	14 b. L. Coal Mrs. &
(Preston Cl. Basin.)		14 a. Conglomerate.
267	Newburg.[7]	14 c. Pittsburg Coal, 14 b. Lower Barren.
274	Thornton.	14 b. L. Coal & L. Barr.
280	Grafton.	14 b. Lo. Barren Series.
284	Webster's.	"
287	Simpson's.	14 b. & c. Lower Barr.
290	Flemington.[8]	& Upp. Prod. C. Series.
297	Bridgeport.	"
302	Clarksburg.[9]	"
306	Wilsonburg.[10]	"
316	Salem.	14 c. Upper Barren Ser.
321	Long Run.[11]	14 c. Upp. Barr. & Upp. Productive Coal Series.
326	Smithton.	"
328	West Union.	"
332	Central.	14 c. Upp. Bar. Series.
342	Pennsboro.	"

Ms.	Baltimore & Ohio Railroad—*Continued.*	
347	Ellenboro.[12]	14 b. Low. Bar. Series.
352	Cornwallis.	"
355	Cairo.[12]	"
362	Petroleum.[12]	"
364	L. F. Junct'n[12]	14 b. L. Prod. Coal Ser.
369	Walker's.	14 b. Low. Barr. Series.
374	Kanawha.[13]	"
377	Davisville.	14 c. Upp. Bar. Series?
384	Parkersburg.	" ?
280	Grafton.	14 b. Low. Barr. Series.
294	Texas.	14 b. L. Prod. Coal Ser.
297	Benton's F'ry[14]	"
302	Fairmont.	14 c. Up. Pro. Coal Ser.
304	Barrackville.	14 c. Upp. Prod. C. and Upper Barren Series.
312	Farmington.	14 c. Upper Barr. Ser.
319	Mannington.	"
330	Barton.	"
337	Littleton.[15]	"
344	Bellton.	"
351	Cameron.	"
362	Roseby's Rock.	"
375	Benwood.[16]	14 c. Up. Pro. C. Series.
379	Wheeling.	"

6. West of Altamont the railroad continues on a broad, undulating plateau, the Savage and Allegheny Mountains of Pennsylvania having here coalesced into one. This remarkable flat mountain top, from 2,400 to 2,600 feet in height above tide, has always attracted much attention from the comparative softness of the outlines of the topography, giving a park-like character to its topography. F.

7. Here the Lower Coals and Lower Barren Measures are shown, with a small remnant of the Pittsburg bed in the tops of the hills, it being the seam worked there. F.

8. At this station is the eastern outcrop of the Pittsburg coal bed, west from the anticlinal of Laurel Hill, (Chestnut Ridge of Pennsylvania.) From this locality the coal and the railroad level constantly approach, until at Wolf's Summit, a little west from Wilsonburg, the coal is under the track. S.

9. The Pittsburg seam is extensively worked here. F.

10. Just before reaching Wolf's Summit, the Pittsburg coal bed is at the railroad level, and is worked near the track at the Summit. The Redstone coal bed is seen two inches thick in the Summit cut. Between the Summit and the Brandy Gap Tunnel the Waynesburg coal bed is seen, and is worked just south from the railroad, the opening being visible from the track. At the west end of the tunnel the Washington coal bed is exposed above the track. This is in the Upper Barren Measures. S.

11. Here the track comes down to the Waynesburg bed, which is rudely mined here and at several localities between this and West Union station. S.

12. About one-fifth of a mile east of this station, a fault crosses the railroad, which brings up the Lower Barren Series against the Upper Barren Series. Thence, from Ellenboro to within a short distance of Petroleum station, the rocks are nearly horizontal, and the Upper Freeport coal bed is exposed in several of the cuts. But, near Petroleum, there is a most remarkable upheaval, which has brought up the lower coals, the strata suddenly rising within a few yards to an angle of 80 degrees. Just west of Laurel Fork Junction the rocks dip down again, the conditions being here on the west side similar to those at Petroleum on the east. After passing the first cut west from the station, the dip is suddenly reduced from 50 degrees to nearly horizontal. This forms the so-called "Oil Break," as all the productive oil wells are found along the line of this belt. This belt is about one and a half miles wide, running in a direction a little east of north and gradually flattening out towards each extremity, and forms one of the most remarkable geological features in this State. This curious disturbance is well worth a visit. Near it, a few miles off by a branch road from Cairo, is the vertical chasm, 4 feet wide, which was filled with the mineral Grahamite, now worked out. S. AND F.

13. There is a fault here, forming the western boundary of the disturbed region, as that at Ellenboro is the eastern. The distance between the two faults at Ellenboro and Kanawha is 37 miles. From Ellenboro to the east side of the "Oil Break" is 15 miles, the belt being two miles wide, and from the west side of the break to Kanawha is 10 miles, so that the upheaval at the "Oil Break" is between the two faults. The geology from this point to Parkersburg has not been determined, as the vertical extent of this fault has not been ascertained. S.

14. Between Grafton and Benton's Ferry the railroad passes through the arch of Laurel Hill. At the Valley Falls, above Nuzum's Mills, the conglomerate is exposed alongside of the track, and in the bed of the river. The lower coals are well shown for some distance below Nuzum's Mills. S.

15. The road at these stations crosses some of the highest strata to be found in the Appalachian coal field. F.

16. Between Benwood and Wheeling the openings in the Pittsburg coal bed are numerous, and the Sewickley and Redstone coal beds are exposed in the bluffs at many places. S.

Virginia and West Virginia.[23]

By Prof. William B. Rogers.

List of the Geological Formations Found in Virginia and West Virginia.

	General Groups.	Sub-Divisions in Virginia and West Virginia.	Numbers marking the Paleozoic Formations of Penn. and Va., as used in the Annual Reports of W. B. and H. D. Rogers.	Names adopted by H. D. and W. B. R. for the Paleozoic Formations of Pennsylvania and Virginia and used in H. D. Rogers' Final Report of the Geology of Pennsylvania.
Cenozoic.	Quaternary.	20. Quaternary.		
	Tertiary.	19 c. Pliocene. 19 b. Miocene. 19 a. Eocene.		
Mesozoic.	Upper and Lower Mesozoic.	(18 & 17.) Jurasso-Cretac's.[1] Upper Secondary s. s. (17, 16.) Jurasso-Triassic.[2] Mid. Secondary Sandstones and Coal Measures.		
Paleozoic.	Upper Carboniferous.	14 c. Upper Barren Group.	XVI.	Seral.
		14 c. Upper Coal Group.	XV.	Seral.
		14 b. Lower Barren Group.	XIV.	Seral.
		14 b. Lower Coal Group.	XIII.	Seral.
		14 a. Great Conglomerate and Conglo. Coal Group.	XII.	Seral.
	Mid. Carboniferous. (Upper Sub-Carb.)	13 b. Greenbriar Shales.	XI.	Umbral Shales.
		13 b. Greenbriar Limestone. (Carb. Limestone.)	XI.	Umbral Limesto.
	Lower Carboniferous. (Lower Sub-Carb.)	13 a. Montgomery Grits and Coal Measures. (Tuedian ?)	X.	Vespertine Sandstone and Coal.
	Devonian.	Names of N. Y. Survey chiefly:		
		12. Catskill.	IX.	Ponent.
		11 b. Chemung.	VIII.	Vergent.
		11 a. Portage.	VIII.	Vergent.
		10 c. Genesee.	VIII.	Cadent.
		10 b. Hamilton.	VIII.	Cadent.
		10 a. Marcellus.	VIII.	Cadent.
	Silurian.	8. Oriskany.	VII.	Meridian.
		7. Lower Helderberg.	VI.	Pre-Meridian.
		6. Salina.	V.	Scalent.
		5 c. Niagara.	V.	Scalent.
		5 b. Clinton.	V.	Surgent.
		5 a. Medina.	IV.	Levant.
	Siluro-Cambrian[3] or Upper Cambrian.	4 c. Hudson River.	III.	Matinal.
		4 b. Utica.	III.	Matinal.
		4 a. Trenton.	III.	Matinal.
	Middle[4] and Lower Cambrian.	3 c. Chazy.	II.	Auroral.[4]
		3 b. Levis.	II.	Auroral.
		3 a. Calciferous.	II.	Auroral.
		2 b. Potsdam Group.[5]	I.	Primal.[5]
	Archæan.	Archæan. A, B, C, D.[6]		

Virginia.

Baltimore and Ohio Railroad.

Ms. | Harper's Ferry and Valley Branch.

Ms.		
0	Harper's Ferry.	Altered Cambrian (b) or Archæan B, followed west by Cambrian, 2 b., 3 a.
1	Shenandoah	
6	Halltown.	Cambrian, 3 a., b.
10	Charleston.	" 3 b., c.
14	Cameron.	" "
23	Wadesville.	Siluro-Cam., 4 a. & 4 b.
27	Stephenson's.	Siluro-Cam. & Camb. 4 a. and 3 c.
32	Winchester.	The road runs close to boundary of Cambrian 3 c., and Sil.-Cambrian, 4 a., of the belt lying east, composed largely of 4 c.
36	Kernstown.	
39	Newtown.	
42	Vaucluse.[7]	
44	Middletown.	
46	Cedar Creek.	
50	Capon Road.	
51	Strasburg Junc.	Siluro-Cambrian, 4 a. and 4 b., on switch track.
55	Tom's Brook.	Cambrian, 3 b., c.
57	Maurertown.	" "
61	Woodstock.	" "
66	Edinburg.	" "
74	Mount Jackson	Camb. & Siluro-Cam. 3 c. and 4 a.
81	New Market.	"
88	Broadway	"
94	Linville.	"
100	Harrisonburg.[8]	"
105	Pleasant Valley.	Cambrian, 3 b., c.
117	Fort Defiance.[9]	" "
126	Staunton.	Camb. & Siluro-Cam. 3 c. and 4 a.

Ms. | **Chesapeake and Ohio Railroad.**

Ms.		
0	Richmond.	W. outcrop of Tert'y and Upper Mesozoic, all resting on Arch. C.
9	Atlee's.	19. Tertiary.
18	Hanover C. H.	"
28	Hanover Junct.	Upper Mesozoic, Jurasso-Cretaceous.
33	Noel's.	1. Archæan, C.
40	Beaver Dam.	Gneiss & Mica Slates, with veins of Granite.
45	Bumpass.	1. Archæan, A.
50	Frederick's Hall	"
56	Tolersville.[10]	Mic. Hornb. & Hydro. Mic. Slates, with Aurif. quartz. The gold belt.
62	Louisa.	1. Archæan, C.
76	Gordonsville.	" B.
81	Lindsay's.	Argil. Mic. & Hydro. Mic. Slates, with patches of Slaty Limest. and Steatite Epidotic, Chlor. and Sil. Grits and Slates of S. W. Mt. followed west by Gneissoid Sandstone.
83	Cobham.	
90	Keswick.	
97	Charlottesville.	
104	Ivy.	1. Archæan, D.
107	Mechum's River	Horn. & Chl. Gnei. Syen.
115	Greenwood.	1. Arch., B, Bl. Ridge Epid. Chlor. Argil. Slates, &c., flanked W. by Camb. I, 2 b. Pots.
124	Waynesboro.	Cambrian, 3 a., adjoining slates of 2 b.
129	Fishersville.	Sil-Camb., 4 a. & 4 b. Edge of slate belt.
136	Staunton.	Camb. & Sil.-Camb., 3 c. and 4 a.
144	Swoope's.	"

1. The term Jurasso-Cretaceous is chosen to designate the Upper Secondary sandstones of the Virginia reports and the associated sands and clays which in their prolongation, northeast through Maryland, Delaware and New Jersey, are found to underlie the Cretaceous green-sand formation of those States, because the fossils found in the vicinity of Fredericksburg, &c., in Virginia, as well as near Baltimore, suggest the upper stage of the Jurassic period; while it is stated that the sands and clays of this belt in New Jersey are referable to the base of the Cretaceous. The whole group would seem in the main to be one of transition, and it is probably best comparable to the European Wealden.

2. The name Jurasso-Triassic is preferred for the Mid-Secondary rocks of the Virginia reports, as it is thought to correspond best with the fossil indications thus far furnished by the several belts included in it. Of these, the most western area is in part continuous with the so-called Triassic belt of Maryland and Pennsylvania, and in part with the coal bearing rocks of Dan River, North Carolina. The middle belt is in the line of prolongation of the Deep River coal rocks of North Carolina; and the eastern belt, including the Grits and Coal Measures of Chesterfield, Henrico, &c., is topographically without a counterpart. The middle and eastern belts in Virginia, and the western tract in North Carolina, show a close agreement in their fossil flora, which in many particulars has a decidedly Jurassic character, and all three belts are connected by certain species of Estheria, Candona, &c., held in common. Collectively these beds represent most probably a group of deposits ranging through Upper Triassic and Lower Jurassic time, and are in large measure of a transitional character.

3. In grouping the Lower Paleozoic formations, Sedgewick's classification is used, including as *Cambrian* and *Siluro-Cambrian*, all the formations from the base of the Paleozoic to the top of the Trenton period (4 c.), and as *Silurian* the succeeding formations to the top of the Oriskany (8.); these corresponding in limits to the Lower and Upper Silurian periods of the table.

4. The Middle Cambrian, or Auroral group, occupying much of the surface of the great valley west of the Blue Ridge, and exposed in numerous anticlinals and faults in the mountain belt farther west, is marked by a great preponderance of magnesian limestones in the lower two-thirds of its mass, passing below in many cases into Arenaceous and Argillaceous limestones, and followed above by oolitic and by cherty and sandy beds, these latter giving place still higher to the

Ms.	Chesapeake & Ohio R. R.—*Continued.*	
150	North Mountain	Devonian, 10 a., adjoining Silurian of the Gap, 5 a., 5 b. to 8., inverted.
159	Craigsville.	Silurian, 7., Encrinal Marble. 8. Oriskany.
168	Goshen.[11]	Devonian, 10 a. & 10 b., between ridges of Silurian, 5 a. to 8.
175	Millboro.[12]	Devonian, 10 a., near 8. of Sideling Hill.

Ms.	Chesapeake & Ohio R. R.—*Continued.*	
195	Jackson's River[13]	Devonian, 10 a., west side of Rich Patch Anticlinal Silurian, 5 a. to 8.
205	Covington.[14]	Devonian, 10 a. & 10 b., between southwest end of Warm Spring Anticlinal, & northeast end of Peter's Mountain.
221	Alleghany.	Devonian, 10. to 12., enclosing, near tunnel, belt of Sub-Car. 13 a. Vespertine.

more purely Calcareous and Argillo-Calcareous strata appertaining to the base of the Siluro-Cambrian, Trenton or Matinal group. The frequent faults, inversions and repetitions of the beds in the great valley, and the rarity of fossils in the Auroral rocks, have interfered with a precise demarcation of formations; but there can be little doubt, from fossil and other evidence, that they cover the period of the formations 3 a., 3 b., 3 c., assigned to them in the Table. Hence, and as indicating the formations *near* as well as *at* the localities, the designation 3 a. b. will be used for these rocks up to the top of the magnesian, without distinguishing between Calciferous and Quebec (or Levis), and 3 b. c., for the remaining strata up to the well defined base of the Siluro-Cambrian, Trenton or Matinal group, 4 a. b. and c.

5. The Potsdam, or Primal group, includes in Virginia, where complete, besides the Potsdam proper, the ferriferous shales next above, and the slates, shaly grits and conglomerates, below this formation. It is exposed in varying mass and completeness on the western slope and in the west flanking hills of the Blue Ridge throughout much of its length, often, by inversion, dipping to the southeast, in seeming conformity beneath the older rocks of the Blue Ridge, but often, also resting uncomformably upon or against them. These older rocks, comprising masses referable probably to Huronian and Laurentian age, include also a group of highly altered beds, corresponding apparently to the copper-bearing or Keweenian series of northern Michigan, and perhaps to the lately described Dimetian rocks of Wales.

6. The letters A, B, C, D mark four rather distinct groups of Archæan rocks found in Virginia, of which the first three may probably be referred to the Laurentian, Huronian and Montalban periods respectively, and the fourth to an intermediate stage—the Norian or Upper Laurentian.

7. This belt of Siluro-Cambrian slates extends continuously from the Potomac River to a point about ten miles south of Staunton, a distance of 140 miles, beyond which it becomes narrow and discontinuous. In the tract corresponding to the interval, from Strasburg to Harrisonburg, it encloses the complex synclinal of the Massanutten Mountains, consisting of massive ranges of Silurian rocks 5 a., 5 b., with some bands of 7 and a few traces of Devonian 10 a., all resting in the wide undulated trough of the slates. From Strasburg southwest, the railroad keeps generally a distance of from one half to one mile west of the edge of the slates, but sometimes impinges upon it, affording ready access to fossiliferous beds of 4 a., b. and c.

8. About 13 miles west-by-north from this are the Rawley Springs, and a few miles farther the remarkable fissured rocks known as Moravian Town, both in Ponent 12. West-by-south, about 20 miles, are the Dora coal mines, in Vespertine 13 a., of Narrowback Mountain—anthracite, faulted and crushed. The irregular fault which, with many interruptions, extends from near the Potomac River along the northwest edge of the Great Valley in the line of the Little North Mountain for about 120 miles, is seen near these localities to bring the Siluro-Cambrian 4. of the valley into juxtaposition with the Devonian 10. to 12.

9. About eight miles east of this are Weyer's and Madison's caves, situated in a ridge of steep dipping limestone, 3 a. b , near the South River.

10. In this part of the gold belt are situated the old workings known as Tinder's, Boxley's, Baker's, Triple Fork and Walton's Mines.

11. This is a good point of departure for examining the rock structure of Panther Gap, 5 a. b., mostly inverted, and the wild passage of the North River through the same formations at Streckler's Gap, "The Goshen Pass." About 10 miles southwest are the Rockbridge Alum Springs, in 10 a. b.

12. About three miles north of this, on the Cow Pasture River, is the Blowing Cave of Bath County, in an anticlinal of 8. Oriskany; and twelve miles farther north-by-west, near the same river, is the noted intermitting stream called the Ebbing Spring, in a ridge of 7 and 8, on east side of Tower Hill, east of Warm Spring Axis. 12 miles southwest to Bath Alum Springs, in 10 a., and thence 5 miles to Warm Springs, 3 c–4 a.

13. Where traversed by the Jackson's River, this anticlinal shows itself as a great arch built up of the successive concentric beds of 5 a. b. c., and flanked by 7. and 8., followed by 10 a., and having a span, as measured by the highest sandstone bed, of about 3,300 feet. The main arch, 5 a. Levant, or Medina, white sandstone, is regular and unbroken, but the outer concentric belts, made up of the hard members of 5 b. c., are distorted and in part inverted on the west side of the axis, where by a slight fault the beds of 7. pass suddenly from a nearly vertical to a horizontal position. Towards the southwest, this axis opens, to form the Rich Patch Valley, bringing to view the Siluro-Cambrian 4 a, b, c, and still farther southwest becomes the closed anticlinal known as the Pott's Creek Mountain. Heavy beds of iron ore (Hematite) have been opened on both sides of this axis, as at Roaring Run, Callie's, Low Moor, and Kayser's near Clifton Forge, associated with formation 8. Oriskany. The fossil ore of 5 b. is also mined at several points.

West Virginia.

Chesapeake & Ohio Railroad—*Continued.*

227	White Sulphur Springs.	Devon., 10 a. & 10 b. Spring issues from 8.
238	Ronceverte.	Lower Sub-Carb., 13 a. Vespertine.
244	Fort Spring.	Upper Sub-Carb., 13 b. Umbral limestone.
251	Alderson.	Upper Sub-Carb., 13 b. Umbral shale.
263	Talcott.	"
272	Hinton.[15]	Upper Sub-Car., overlaid west by Conglo. Coal group, 14 a.
294	Quinnimont.	Upper Sub. Carbon. shales, overlaid by Conglo. Coal group 14 a. The shales disappear west near Buffalo Creek.
324	Hawk's Nest.	Congl. Coal group, 14 a.
326	Cotton Hill.	"
333	Kanawha Falls.	Great Conglom, overlaid by Lower or main Coal group, 14 a. and 14 b.
352	Coalburg.	Main Coal group, 14 b.
359	Brownstown.	"
368	Charleston.	"
381	St. Albans.	Low. barren group, 14 b.
395	Hurricane.	"
401	Milton.	"
409	Barboursville.	"
416	Guyandotte.	"
421	Huntington.	"

Virginia.

Washington City, Virginia, Midland and Great Southern Railroad.

Ms.		
0	Alexandria.	20. Quat. drift on denud.
5	Alex. & Fredbg. Crossing.	Upper Mesozoic, Jurasso-Cretaceous.
9	Springfield.	1. Archæan, C.
14	Burke's.	" A.
18	Fairfax.	" A.
21	Clifton.	" A.
27	Manassas Junc.	Mes., 17-16. Juras.-Tri.
31	Bristoe.	"
34	Nokesville.	"
39	Catlett's.	"
41	Warrenton Jun.	"
44	Midland.	"
47	Bealeton.	"
51	Rappahannock.	"
56	Brandy.	"
62	Culpepper.	" W. margin.
69	Mitchell's.	"
74	Rapidan.	" S. margin.
79	Orange.	1. Archæan, B.
83	Madison.	Argil. Mic. & Hydro. Mic. Slates, with patches of Limestone & Steaschist E. of S.W.
89	Gordonsville.	
93	Lindsay's.	
96	Cobham.	Mt., followed by Epidotic and Chloritic Quartzites and Slates of S.W. Mt. & thence W. by Gneissoid Grits.
102	Keswick.	
105	Shadwell.	
110	Charlottesville.	
111	Lynchburg Jun.	1. Archæan, D.
119	Red Hill.	"

14. The Anticlinal Valley, which includes the group of thermals known as the Warm, Hot, Healing, &c., Springs, closes up about ten miles northeast of this, and its axis subsides towards the southwest in broad spurs which reach the river a few miles below Covington, in low arches of 7. and 8., overlaid by 10. The heated waters issue at numerous points throughout a distance of thirty miles; from Cambrian and Siluro-Cambrian rocks, 3 c., 4 a., usually inverted and often faulted along the west side of the valley, the eastern boundary of which is formed by the massive Warm Spring Mountain, 5 a., 5 b., dipping east, while its western limit consists of a narrow, broken ridge of the same formations in a vertical or inverted position. Stages to Healing, Hot and Warm Springs, severally 15, 19 and 22 miles. Near the first is the Cascade (200 feet) of Falling Spring Creek, which, cutting through the west wall of the anticlinal, flows over a mass of calcareous tufa, deposited from the waters.

The anticlinal of Peter's Mountain, rising a few miles northwest of Covington and exposing at the tunnel 7. and 8., expands towards the southwest, until it opens out into the valley of the Sweet Springs, containing another group of thermals of lower temperature than the preceding. This anticlinal, extending southwest, does not close up, but passes into the great Peter's Mountain and East River Mountain fault, which for a distance of fifty miles brings the Cambrian in contact with the Vespertine and Umbral formation, Sub-Carb., 13 a., 13 b.

15. The Upper Subcarboniferous, or Umbral shales, here include a considerable thickness of brown and gray flaggy sandstone, the same which forms the hard rock of Swope's Knobs.

16. About 20 miles northwest of this point (by canal or road) we enter the gorge by which the James River traverses the Blue Ridge, where are exposed fine sections of Archæan rocks, A and B, and of the Cambrian, Primal 2 a., resting unconformably on the western slope of the former, and occupying the flanking ridges, which adjoin the valley. The Natural Bridge, the remnant of a former tunnel or cave in 3 a. b., is about 8 miles northwest from the upper end of the gap.

17. A few miles east of this, between Bannister and Dan Rivers, is a small patch of Jurasso-Triassic rocks, 18–17., corresponding to the Farmville or middle belt, (see note 2), and containing Estheria, &c.

18. This deposit, made up largely of Diatoms, lies near the base, but within the limits, of the Miocene Tertiary. It contains occasional casts of Miocene shells, and is generally overlaid by beds of this formation, and rests either upon or but little above the top of the Eocene. Having formerly traced this deposit from the Patuxent River in Maryland to the Meherrin in Virginia, I have lately found by an examination of the artesian borings at Fortress Monroe, that a similar

Washington City, Virginia, Midland & Great Southern Railroad—*Continued.*

Ms.		
121	North Garden.	From one and a half miles west of Charlottesville to near Lynchburg the prevailing rocks are Syenite, Granite, Protogine, Mic. & Chlor. Gneiss. Near base of S.W. Mt. are belts of Gneissoid sand and steaschist. Mic. & Hor. Sl. & Trap.
127	Covesville.	
131	Fabus.	
133	Rockfish.	
137	Elmington.	
140	Lovingston.	
145	Arrington.	
149	Tye River.	
152	New Glasgow.	
157	Amherst.	
163	McIvor's.	
166	Burford's.	1. Archæan, C.
171	Lynchburg.[16]	" B.
177	Lucado.	Micaceous and Argil. Slates, including patches of Limestone & Steatite, Epidotic and Chloritic Quartzites.
182	Lawyer's Road.	
188	Evington.	
192	Otter River.	1. Archæan, C.
195	Lynch's.	"
199	Staunton River.	"
205	Sycamore.	"
209	Ward's Springs.	"
215	Whittles.	"
220	Chatham.	Mesozoic, 17-16. Jurasso-Triassic, W. mar.
226	Dry Fork.	"
230	Fall Creek.	"
236	Danville.	1. Archæan, C.
237	Dundee.	"

Manassas Division of W. C., Va., Mid. and Great Southern Railroad.

0	Alexandria.	(As before.)
27	Manassas Junc.	Mes., 17-16. Juras-Tria.
36	Gainesville.	"
38	Haymarket.	"
40	Thoroughfare.	1. Archæan, B, Slaty Quartzite, Epid. Chlo. Argil. & Mic. Slates of
44	Broad Run.	Bull Run and Pond Mountains.
49	Plains.	1. Archæan, C.
54	Salem.	"
60	Rectortown.	" B.
63	Delaplane.	"
67	Markham.	"
72	Linden.	"
76	Happy Creek.	"
79	Front Royal.	Cambrian, 3 a. Calcifer.
81	River.	Sil-Camb. 4 a. & b. Tr. &
85	Buckton.	Ut. 4 c. Hudson Riv.
86	Water Lick.	Fort Mt. Synclinal, (5 a. & b.) ends near.
90	Strasburg.	" 4. a & b. Tr. & Ut.
91	Strasburg Junc.	" "

Richmond, Fredericksburg and Potomac Railroad.

Ms.		
	Washington. (Steamboat.)	
0	Quantico.	Upper Mesozoic, 17-18. Jurasso-Creta.
5	Richland.	"
12	Brooke's.	" Patches of 19. Tertiary on denuded surface.
14	Potomac Run.	"
21	Fredericksburg.	" Resting on gneiss at Falls.
33	Guinea's.	19. Tertiary.
42	Milford.	"
47	Penola.	"
53	Ruther Glen.	Jurasso-Creta's, 17-18.
58	Junction.	"
60	Taylorsville.	"
65	Ashland.	20. Quaternary, gneiss coming to surface, Archæan, C.
82	Richmond.	(Same as before.)
84	Manchester Crossing.	20. Quaternary, on decomposing Gneiss, Archæan, C.
87	Temple's.	"
90	Drewry's Bluff.	"
93	Halfway.	"
95	Chester.	W. limit of Upp. Mesozoic and 19. Tertiary.
98	Port Walthall J.	"
105	Petersburg.	E. outc. of Gne. Arch. C
115	Reams.	"
127	Stony Creek.	Gneiss higher up, on crk
135	Jarratt's.	Gneiss short distance W. Tertiary ditto E.
147	Bellfield.	19. Terti. short dist. E.
154	Greensville Jun.	"
164	Pleasant Hill.	"
168	Weldon.	E. outc. of Gn. in Riv., C

Piedmont Air Line Railroad.

0	Richmond.	(Same as before.)
2	R. F. & P. Junct.	"
22	Powhatan.	W. edge of Mes. cl. field
36	Amelia C. H.	1. Archæan, A.
58	Burkeville.	"
73	Keysville.	"
90	Roanoke.	"
101	Scottsburg.	"
109	Boston.[17]	1. Archæan, C.
127	Barksdale.	"
135	Ringgold.	"
141	Danville.	"
156	Ruffin, N. C.	"

deposit exists in that region at the depth of 558 feet below the surface, overlaid by Miocene and Pliocene beds, and resting upon an Eocene deposit identical with that which underlies it at Richmond. [17] We are thus assured of the great extension seaward of this deposit, and have the means of estimating the thickness of the Tertiary formations as far east as the mouth of the James River.

Richmond, York River and Chesapeake Railroad.

Ms.		
0	Richmond.[18]	(Same as before.)
7	Fair Oaks.	At Richmond tunnel cuts Tert'y Infusorial bed, 19 b. Miocene.
13	Dispatch.	In this interval both Lower and Upper 19.
15	Summit.	Tertiary are accessible above tide level.
20	Tunstall's.	Eocene and Miocene.
24	White House.	In this interval, only
26	Fish Hand.	Upper 19. Tertiary is
31	Sweet Hall.	accessible above tide
38	West Point.	level. 19 b. Miocene.

Atlantic, Mississippi and Ohio Railroad.

0	Norfolk.	20. Quaternary, resting on Upper Tertiary 19 c. Pliocene.
23	Suffolk.	Up. 19. Ter. & 19 b. Mio.
34	Windsor.	"
41	Zuni.	"
45	Ivor.	"
52	Wakefield.	"
60	Waverly.	Lower 19. Tertiary here probably above tide level.
68	Disputanta.	"
81	Petersburg.	E. margin of 19. Tertiary & U. 17-18 Mes. resting on Gneiss, C.
96	Church Road.	1. Archæan, C.
101	Ford's.	"
108	Wilson's.	"
112	Wellsville.	1. Archæan, A.
118	Blacks & Whites	"
124	Nottoway C. H.	"
133	Burkeville.	"
141	Rice's.	"
149	Farmville.	16. Mesozoic, 17–16. Jurasso-Triassic.
161	Prospect.	1. Archæan, A.
169	Pamplin's.	"
181	Appomattox.	"

Atlantic, Mississippi and Ohio Railroad—Continued.

Ms.		
191	Concord.	1. Archæan, B.
204	Lynchburg.	"
215	Forrest.	1. Archæan, A.
229	Liberty.	"
241	Buford's.	2-4. Cambrian, 3 a. Cal.
246	Blue Ridge.	" 3 a. b.
251	Ronsack's.	" "
254	Gish's.	" "
252	Big Lick.	" & Sil-Cambrian.
264	Salem.[19]	"3 c & 4 a Ch. & Tr.
277	Big Spring.	" "
281	Alleghany.	" 3 b. c.
285	Big Tunnel.	" "
290	Christiansb'g.[20]	" "
301	Central.	" "
302	New River.	" "
309	Dublin.	" "
316	Martin's.	Fault of Draper's Mt. Silurian & Devonian against Sub-Carbonif.
329	Max Meadows.	
337	Wytheville.[21]	2-4. Cambrian, 3 b. c.
350	Rural Retreat.	" "
364	Marion.	"& Sil-Cam. 3 c, 4 a.
380	Glade Spring.[22]	" "
393	Abingdon.	" "
408	Bristol.	" "

Continued as East Tennessee, Virginia & Georgia Railroad.

Seaboard and Roanoke Railroad.

0	Portsmouth.	20. Quat. on 19. Ter. and 19 c. Pliocene.
17	Suffolk.	20. Quat. on 19 b. Mioc.
31	Carrsville.	"
37	Franklin.	"
42	Nottoway.	"
50	Newson's.	"
55	Boykin's.	"
63	Margaretsville.	"
68	Seaboard.	"
78	Gary's.	"
80	Weldon.	Outcrop of Gneiss.

19. From this point, for many miles towards the southwest, the railroad runs near to and almost parallel with the broken synclinal, (about 25 miles long), of which the lofty Catawba and Fort Lewis Mountains are the principal parts. The former, composed of southeast dipping 4 a. b., &c., forms the farther or northwest rim of the synclinal, and bending abruptly around at its northeast end, becomes the Tinker Mountain, which closes the basin in that direction. A shorter and gentler bend at the southwest end, terminates in a fault. The corresponding rocks of the southeast, or near side of the synclinal, are only partially preserved in a narrow inverted ridge at either end, the remainder of this rim of the synclinal having been engulfed in the prolonged fault, which, for many miles along the margin of the basin, has brought the Siluro-Cambrian rocks (4 a. c.) of the valley to abut against, and over-ride the Devonian 10. to 12. and the Vespertine 13 a., of which the Fort Lewis Mountain, the central mass of the synclinal, is mainly composed.

20. A few miles west-by-north of this is an area of Vespertine rocks 13 a., including one or more workable beds of coal, mined on Stroubler Run and elsewhere. This area, once probably continuous with the Vespertine of Fort Lewis Mountain, is almost encompassed by faults. Farther to the northwest, and separated from the above by a belt of Cambrian and Siluro-Cambrian rocks 3 c., 4 a., &c., the Vespertine beds of the southeast slope of the Brushy Mountain, contain a similar coal, mined on Tom's Creek, &c., all these seams being more or less affected by the neighboring faults. The dislocation which, southeast of Brushy Mountain, brings Vespertine and Umbral in apposition with Siluro-Cambrian Matinal, is part of the great fault which, with some changes of direction and character, extends along the northwest edge of the great valley, from near the James River to the end of the Brushy Mountain, northeast of Abingdon, a distance of about 125 miles.

Ms.	Washington and Ohio Railroad.	
0	Alexandria.	(Same as before.)
7	Carlin's.	"
11	Fall's Church.	1. Archæan, C.
15	Vienna.	1. Archæan, A.
18	Hunter's.	"
21	Thornton.	1. Archæan, B.
23	Herndon.	Mesozoic, 17–16. Jurasso-Triassic.

Ms.	Washington & Ohio Railroad—*Cont.*	
27	Guilford.	Mesozoic, 17–16. Jurasso-Triassic.
31	Farmwell.	"
38	Leesburg.	" W. mar. Cong.
42	Clark's Gap.	1. Archæan, B.
45	Hamilton.	"
49	Purcellville.	"
52	Round Hill.	"

At a distance of 23 miles, in a northwest direction, is the sheet of water called "Mountain Lake," situated near the top of Salt Pond Mountain, at a height of 4,000 feet above tide. Here the Potts and Johns Creek Mountains and the other ridges of 5 a. b. coalesce at their southwest termination, into a lofty rugged table-land, overlooking the New River, and commanding wide views.

21. A few miles south, the Lick Mountain range divides the valley for some miles into two, and in the southern of these belts, on the New River, below the mouth of Cripple Creek, are the Austenville lead mines, in 3 b., near the Primal 2 b. of Poplar Camp Mountain, and about 15 miles distant from Wytheville.

22. From this point a short branch railroad leads north into the valley of the north fork of the Holston River, between Walker's Mountain, 5 a., &c., and Poor Valley ridge, Vespertine 13 c., &c., which flanks the Clinch Mountain on the southeast side. Here, near Saltville, are the remarkable salt wells, which penetrate into a thick mass of rock-salt; and in the same vicinity, and at various points higher up the valley, for a distance of 20 miles, beds of gypsum have been opened and extensively wrought. These deposits are found near and in a line of fault, along which the Siluro-Cambrian 3 c. 4 a., of the southeast side of the valley, has been made to abut against and sometimes over-ride the Umbral 13 b., which, with the Vespertine 13 a. of the Poor Valley Mountain, form a belt on the northwest side of the valley. Both deposits are most probably referable to the Subcarboniferous period. The fault here spoken of extends, with some local changes of character and direction, in a west-by-southwest course, from a point in Giles county to the Tennessee line, a distance of 125 miles, and is prolonged many miles into Tennessee. WILLIAM B. ROGERS.

23. So few details have been published on the geology of Virginia, that no chapter in this volume will be more welcome to geologists than this, which has been wholly and very carefully prepared by Professor William B. Rogers, late State Geologist of Virginia. J. M.

North Carolina.[1]

Wilmington and Weldon R. R.—162 miles; N. and S. This road runs throughout its whole length from Wilmington to Weldon on the (20) Quaternary formation, with occasional small exposures of the Tertiary (19 a.) Eocene and (19 b.) Miocene and of the (18) Cretaceous in the banks of the streams.

Atlantic and North Carolina R. R.—95 miles; E. and W. From Morehead to Goldsboro, 95 miles; also on (20) Quaternary, with (19) Tertiary and (18) Cretaceous in the banks of the streams.

Ms.	Piedmont Air Line.	
00	Richmond, Va.	
141	Danville, Va.	Upper Laurentian, 42 m.
156	Ruffin.	" "
165	Reidsville.	" "
183		- - - - - - - -
189	Greensboro.	Lower Laurentian, 6 ms.
	N. C. Div. East. Greensboro to Goldsboro.	
00	Greensboro.	1 a. Laurentian, 30 ms.
21	Comp'y's shops	"
30		- - - - - - - -
32	Mebanesville.	1 b. Huronian, 20 ms.
41	Hillsboro.[2]	"
55	Durham.	16. Triassic, 22 ms.
69	Morrisville.[3]	"
72		- - - - - - - -
73	Cary.	1 b. Huronian, 6 ms.
78		- - - - - - - -
81	RALEIGH.	1 a. Laurentian, 28 ms.
96	Clayton.	"
106	(Neuse River.)	20. Quaternary, 24 ms.
109	Selma.	"
118	Princeton.	"
130	Goldsboro.	"

N. W. Nor. Car. R. R. Greensboro to Salem, W. 29 ms. This road runs wholly on Laurentian.

189	GREENSBORO.	1 a. L. Laurentian, 113 m.
204	High Point.	"
211	Thomasville.	"
222	Lexington.	"
238	SALISBURY.	"
261	Concord.	"
282	CHARLOTTE.	"
302		- - - - - - - -
312	S. C. State Line	1 a. Laurentian, 25 ms.

Raleigh and Gaston R. R. 97 miles.
All on Upper (1 a.) Laurentian.

Tarboro Branch R. R. 14 miles, E.
All on the (20) Quaternary.

Ms.	Carolina Central R. R. 229 ms.	
0	WILMINGTON.	20. Quaternary, 117 ms.
117	Rockingham.	20. Quat'y & 1 b. Hur'n.
123	Pedee River.[4]	1 b. Huronian, 6 ms.
128	Lilesville.	1 a. Laurentian, 5 ms.
135	Wadesboro.	16. Triassic, 19 ms.
147		- - - - - - - -
163	Monroe.	1 b. Huronian, 25 ms.
172		- - - - - - - -
187	CHARLOTTE.	1 a. L. Laurentian, 57 m.
199	Catawba River	"
229	Shelby.	1 a. Laurentian.

Western North Carolina R. R. W. 114 miles.

00	Salisbury.	1 a. Laurentian, 106 ms.
102	Marion.[5]	"
106		- - - - - - - -
114	Blue Ridge.	1 b. Huronian, 8 ms.

Western R. R. of North Carolina. S. E. 45 m.

0	Egypt.	16 Trias. & Quatr'y, 9 m.
9	Jonesboro.	"
13	Little River.	1 b. Hur. & Quat'y, 3 ms.
45	Fayetteville.	20. Quaternary, 33 ms.

Raleigh and Augusta Air Line R. R.

0	Raleigh.	1 a. Laurentian, 3 ms.
3		- - - - - - - -
13		1 b. Huronian, 10 ms.
14	Apex.	16. Triassic, 20 ms.
26	Merry Oaks.	"
33	Lockville.	"
44	Sanford.	16. Tria. & Quatr'y, 11 m.
57	Cameron.	16. Tria. & Huro'n, 13 m.

Wilmington, Columbia and Augusta.
64 miles, W. in N. C.

00	Wilmington.	20. Quaternary.
64	Fair Bluff.	"
	Line of So. Car.	"

1. Revised and the notes added by W. C. Kerr, State Geologist of N. C.
2. At Hillsboro depot a good exposure of typical N. Carolina Huronian slate, hydromicaceous.
3. At Morrisville depot a dike of dolerite visible. 1½ miles east of station beds of very coarse incompacted conglomerate, the bottom beds of the Triassic, and probably glacial.
4. On both sides of the Pedee River are high dikes of dolerite for more than a mile, and 2 miles east a very coarse porphyritic granite, as well as between Lilesville and Wadesboro.
5. From Statesville west in the numerous deep cuts are seen fine examples of the *frost* drift, characteristic of sub-glacial regions. Also from Hickory to Morgantown many sections of the purple paragonite schists, which are peculiar to this region.

South Carolina.*

Ms.	Savannah and Charleston Railroad.	
0	Charleston.[1]	20. Post Plio. (Phosph.)
16	Rantowles.	"
29	Jacksonboro.	"
43	Whitehall.	"
53	Yemassee.	"
70	Grahamville.	"
104	Savannah.	"

	Port Royal Railroad.	
0	Port Royal.	20. Post Pliocene, 80 m.
4	Beaufort.	"
18	Sheldon.	"
25	Yemassee.	"
50	Bronson's.	"
59	Allendale.	"
90	Ellenton.	19 a. Eocene, (buhrstone)
112	Augusta.	" 32 ms.

	South Carolina Railroad.	
0	Columbia.	1. Granite, 3 miles.
6	Hampton's.	20. Post Pliocene, 22 m.
20	Gadsden.	"
25	Kingsville.	"
31	Fort Motte.	19 a. Eocene, 12 miles.
38	Lewisville.	"
51	Orangeburg.	20. Post Pliocene.
68	Branchville.	"
82	George's.	"
108	Summerville.[2]	" Phosphate.
130	Charleston.	" "
68	Branchville.	20. Post Pliocene, 33 m
96	Blackville.	"
105	Williston.	19 a. Eocene, 44 miles.
113	Windsor.	"
126	Aiken.	"
145	Augusta.	"

	North-Eastern Railroad.	
0	Florence.	19. Pliocene, 10 miles.
9	Effingham.	20. Post Pliocene, 92 m
20	Scranton.	"
23	Graham's.	"
38	Kingstree.	"
57	St. Stephen's.	"
83	Mount Holly.[3]	" Phosphate.
102	Charleston.	" "

Ms.	Wilmington, Columbia and Augusta Railroad.	
0	Wilming'n, N.C.	20. Post Pliocene, 102 m
45	Whiteville.	"
64	Fair Bluff.	"
87	Marion, S. C.	"
94	Pee Dee.	"
108	Florence.	19 c. Pliocene, 20 ms.
120	Timmonsville.	"
129	Lynchburg.	20. Post Pliocene.
138	Marysville.	"
147	Sumter.	"
166	Acton.	"
175	Grovewood.	"
197	Columbia.	Granite, 3 miles.

	Cheraw and Darlington Railroad.	
0	Florence.	19 c. Pliocene, 20 miles.
	Darlington.	"
	Cheraw.	20. Pt. Pli. & Hur. 2 m.

	Charlotte, Columbia and Augusta Railroad.	
0	Charlotte.	1 a. Laurentian, 37 ms.
45	Chester.	Trap, 15 miles.
57	Blackstock's.	1. Gneiss, Laurentian.
64	White Oak.	"
72	Winnsboro.	"
84	Ridgeway.	1. Gneiss, 2 miles, and Slate, Huron., 18 ms.
107	Columbia.	Granite, 3 miles.
124	Lexington.	19 a. Eocene.
141	Leesville.	"
169	Pine House.	"
184	Graniteville.	Granite, 4 miles.
186	Augusta.	19 a. Eocene.

	Chester and Lenoir Railroad.	
0	Chester.	Trap, 1 mile.
	Yorkville.	1. Gneiss, Laurentian.
	Atlanta & Charl. Air L.	"
	Gastonia.	"
50	Dallas, N. C.	"

* Prepared by Professor W. C. Kerr, of Raleigh, State Geologist of North Carolina.

1. This road lies along and on the lower margin of the phosphate bed, from Charleston to the Ashepoo, except about 5 miles on either side of the Edisto River, and crosses it again for 5 miles just east of the Combahee. The bed extends continuously from a point a few miles south of the crossing of Coosawhatchie, in a direction a little north of east to a point some thirty miles north of Charleston. The bed is widest in the neighborhood of Charleston. These points were obtained from a map by Professor F. S. Holmes, of Charleston.
2. The last 20 miles of this road lies on the phosphate beds.
3. The last 30 miles of this road is on the phosphate beds.

Ms.	Greenville and Columbia Railroad.	
0	Columbia.	1. Gran. 5 m., Hur. 20 m
25	Alston.	1 a. Gneiss, Laurentian.
32	Pomaria.	"
47	Newberry.	"
48	Helena.	"
75	Ninety-Six.	"
85	Greenwood.	"
94	Hodges or Cok'y	"
103	Donnald's.	"
109	Honey Path.	"
118	Belton.	"
125	Williamston.	"
135	Golden Grove.	"
144	Greenville.	"
94	Cokesbury.	1 a. Gneiss, Laurentian.
106	Abbeville.	"

Ms.	Greenville & Columbia R.R.—*Cont.*	
118	Belton.	1 a. Gneiss, Laurentian.
127	Anderson.	"
	Pendleton.	"
	Perryville.	"
	Walhalla.	"

	Spartanburg and Union Railroad.	
25	Alston.	1 a. Gneiss, Laurentian.
	Unionville.	"
	Spartanburg.	"

	Atlanta and Charlotte Air Line Railroad.*	
312	N. C. State Line.	1 a. Huron. Slates, 8 m
337	Gaffney's, S. C.	1 a. Gneiss, Laurentian.
357	Spartanburg.	"
387	Greenville.	"
427	Seneca City.	"
454	Tuccoa City, Ga.	"

* Prof. F. H. Bradley considers this as all Lower Silurian (mostly Quebec group) metamorphic.

Georgia.[1]

Ms.	Atlantic and Gulf Railroad.	
0	Savannah.	19 c. Tertiary.
24	Fleming.	"
39	Walthourville.	"
53	Doctortown.	"
57	Jesup.	"
86	Blackshear.	"
122	Homersville.	"
130	Dupont.	"
139	Stockton.	"
157	Valdosta.	"
174	Quitman.	19 a. Tertiary.
188	Boston.	"
200	Thomasville.	"
214	Cairo.	"
226	Climax.	"
236	Bainbridge.	"
200	Thomasville.	19 a. Tertiary.
232	Camilla.	"
258	Albany.[2]	"
130	Dupont.	19 c. Tertiary.
151	Statensville.	"
163	Jasper, Fla.	"
179	Live Oak, Fla.	"

Ms.	Brunswick and Albany Railroad.	
0	Brunswick.	19 c. Tertiary.
13	Hazlehurst.	"
24	Waynesville.	"
60	Waycross.	"
67	Waresboro.	"
78	Millwood.	"
93	Kirkland.	"
101	Willicoochee.	
151	Isabella.	19 a. Tertiary.
171	Albany.[2]	"

	Macon and Brunswick Railroad.	
0	Brunswick.	19 c. Tertiary.
40	Jesup.	"
70	Baxley.	"
93	Lumber City.	19 a. Tertiary.
100	Town's.	"
140	Dubois.	"
148	Cochran.	"
161	Buzzard Roost.	"
171	Bullard's.	"
186	Macon.	Metamorphic & Quat'y.
148	Cochran.	19 a. Tertiary.
	Hawkinsville.[3]	"

1. Revised and the notes added by Dr. George Little, State Geologist of Georgia.
2. Buhrstone groups.
3. Northern limit of the open pine and wire grass section.

Central Railroad of Georgia.

Ms.		
0	Savannah.	19 c. Tertiary.
50	Halcyondale.[2]	19 a. Tertiary.
62	Ogeechee.	"
79	Millen.[3]	"
134	Tennille.	19 a. Tertiary.
154	Toomsboro.	"
170	Gordon.	"
192	Macon.[4]	Metamorphic & Quat'y.
79	Millen.	19 a. Tertiary.
100	Waynesboro.	"
132	Augusta.[4]	Metamorphic & Quat'y.
179	Gordon.	19 a. Tertiary.
187	Milledgeville.	20. Quat'y & Metamorp.
208	Eatonton.	2–4. Low. Silu. Metam.
0	Macon.[4]	Metamor. & 20. Quat'y.
25	Forsyth.	" 3-4. Low. Silur.
41	Barnesville.	" "
59	Griffin.	" "
67	Fayette.	" "
76	Lovejoy's.	" "
80	Jonesboro.	" "
96	East Point.	" "
103	Atlanta.[5]	" "

South-Western Railroad.

0	Macon.[4]	Metamorphic & Quat'y.
8	Seago.	20. Quaternary.
29	Fort Valley.	19 a. Tertiary.
49	Montezuma.	"
60	Anderson.[6]	"
71	Americus.	"
83	Smithville.	"
96	Leesburg.	"
107	Albany.[2]	" Buhrstone.
	Walker's.	" "
	Ducker.	" "
	Arlington.	" "
29	Fort Valley.	19 a. Tertiary.
50	Butler.	20. Quaternary.
70	Geneva.[4]	"
75	Box Spring.	"
78	Upatoi.[4]	Metam. 3-4. Low. Silur.
100	Columbus.[7]	Metam. and Quaternary.
29	Fort Valley.	19 a. Tertiary.
42	Perry.	"
83	Smithville.	19 a. Tertiary.
98	Dawson.	"
118	Cuthbert.	"
133	Hatchie Station.	18 c. Cretaceous
142	Georgetown.	"
144	Eufaula, Ala.	"
157	White Oak, Ala.	"
165	Clayton, Ala.	"
120	Junction.	19 a. Tertiary.
128	Coleman.	"
132	Fort Gaines.	"

Central Railroad of Georgia—*Continued.*

North and South Railroad.

Ms.		
100	Columbus.[4]	Metamorphic & Quat'y.
108	Cleghorn.	Metamor. & Low. Silur.
120	Kingsboro.	"

Upson County Railroad.

0	Macon.[4]	Metamorphic & Quat'y.
43	Barnesville.	Metamor. & Low. Silur.
51	The Rock.	"
59	Thomaston.	"

Georgia Railroad.

0	Augusta.	
38	Thomson.	Metamor. & Low. Silur.
47	Camak.	"
57	Barnett.	"
65	Crawfordville.	"
76	Union Point.	4 c. Cincinnati & Metam.
84	Greensboro.	2-4. Lower Silurian.
104	Madison.	"
130	Covington.	"
141	Conyers.	"
147	Lithonia.	"
156	StoneMountain[8]	"
165	Decatur.	"
171	Atlanta.	Asbestus, 3 miles.
0	Camak.	2-4. Lower Silurian.
	Warrenton.	"
	Sparta.	"
	Milledgeville.	"
78	Macon.	3 miles Artope's quarry, Lyell's Eocene fossils and Quaternary.
57	Barnett.	2-4. Lower Silurian.
75	Washington.	"
76	Union Point.	2-4. Lower Silurian.
	Lexington.	"
116	Athens.	State University and Agricultural College.

Atlanta and West Point Railroad.

0	Atlanta.	Metamor. & Low. Silur.
6	East Point.	"
18	Fairburn.	"
25	Palmetto.	"
40	Newnan.	"
52	Grantville.	R. R. to Carrollton.
		Gold mine, 3 miles.
		Metam. & Low. Silur.
58	Hogansville.	"
72	La Grange.	"
		Asbestus & Chromic Iron, 7 miles.
87	West Point.	Metam. & Low. Silur.
		Asbest. & Corundum.

4. Located on the line of Metamorphic and Quaternary.
5. Strangers should visit the Geological Collection Room in Capitol Building, Office in room 12.
6. View of old Prison Stockade and U. S. Cemetery east of railroad.
7. Fine falls, Lover's Leap and rapids, on Chattahoochee River.

Ms.	Piedmont Air Line Railroad.	
312	N. C. State Line.	Metam. & 2-4. Low. Silu.
337	Gaffney's, S.C.	"
357	Spartanburg.	"
387	Greenville.	"
454	Tuccoa City, G.[9]	"
	Mt. Airy.[10]	"
	Bellton.	"
481	Lula City.	" N. E. R. R. to Athens, 39 miles.
492	New Holl. Spgs.	Limestone & Tremolite.
494	Gainesville.[11]	3 b. Quebec, flexibl. s.s.
	Flowery Branch	3 b. Quebec.
	Buford.	"
	Suwanee.	"
	Duluth.	" Pine tree visible 4 ms. in center of R.R. track.
527	Norcross.	3 b. Quebec.
540	7 Mile Tank.	" Granite quarry.
547	Atlanta.[5]	"

	Rome Railroad.	
0	Rome.	5-8. Upper Silurian.
20	Kingston.	2-4. Lower Silurian.

	Cherokee Railroad.	
48	Cartersville.[12]	2-4. Lower Silurian.
	Rockmart.	"

	Selma, Rome and Dalton Railroad.	
0	Dalton.	2–4. Lower Silurian.
6	Stark's.	"
	Barnett's.	"
15	Sugar Valley.	
21	Skelley's.	
39	Rome.	4 a. Trenton.
45	Six Miles.	"
56	Cave Springs.	"
63	Pryor's.	5 b. Clinton.
76	Amberson's, Ala.	4 b. Quebec or Knox.

Ms.	Western and Atlantic Railroad.	
0	Atlanta.	Metam. & Low. Silurian.
23	Marietta.	"
34	Acworth.	" Gold mines.
40	Allatoona.	" "
48	Cartersville.	2-4. Lower Silurian.
68	Kingston.	"
78	Adairsville.	"
84	Resaca.	"
90	Tilton.	"
99	Dalton.	" Red Marble.
107	Tunnel Hill.	" Black "
115	Ringgold.	"
120	Graysville.	" Lime quar's.
125	Chickamauga.	"
130	Boyce.	"
137	Chattanooga, Tn	5 b. Clin. iron ores & 3 b. Quebec Limesto.

	North-Eastern Railroad of Georgia.	
0	Athens.	3 b. Quebec and Metam. & Low. Silu.
12	Nicholson.	"
18	Harmony Grove.	"
26	Maysville.	"
39	Lula City.	4 c. Cincinnati & Metam.

	Savannah, Griffin and North Alabama R. R.	
0	Macon.	Metam. & Low. Silurian.
60	Griffin.	"
70	Brooksville.	"
78	Senoia.	"
86	Sharpsburg.	"
96	Newnan.	" Snake Creek Factory, m.
	Whitesburg.	Metam. & Low. Silurian.
123	Carrollton.	"

0	Tennille.	19 a. Tertiary.
4	Sandersville.	"

8. Stone Mountain—a mass of granite—height 1,686 feet.
9. Toccoa Falls, 2 miles, 185 feet. Tallulah Falls, 15 miles distant, nearly 400 feet high.
10. From this point a fine view of Yonah Mountain and the Blue Ridge chain. Clarkesville, 8 miles; Nacoochee Valley, 15 miles; Nacoochee gold mines, 20 miles.
11. Point of departure for Dahlonega gold mines and Porter's Springs.
12. Ladd's lime kiln, 3 miles; Rockmart slate quarries, 20 miles; Ward's ferro manganese furnace, 11 miles; Bear Mountain, fine view, 18 miles; Etowah rolling mill site at Falls, 5 miles. Ocoee Conglomerate here and at Rowland Springs, also 5 miles from Cartersville. Flexible sandstone 13, and manganese 3 and 10, and iron ore beds 3, 5, 7 and 10 miles.

Kentucky.[1]

GEOLOGICAL FORMATIONS FOUND IN KENTUCKY.[2]

20 b. Alluvium and Bluff.
20 a. Gravel, (equivalent of Orange Sand of Tennessee).
19. Tertiary,(its details not yet studied).
14 c. Upper Coal Measures.
14 b. Lower Coal Measures.
14 a. Millstone Grit.
13 c. Chester.
13 b. St. Louis l. s. (Warsaw at base).
13 a. Keokuk and Waverly.
10 c. Black Shale.
9 c. Corniferous or Upper Helderberg.
9 a. Cauda Galli.
5 c. Niagara.
4 c. Cincinnati.
4 a. Trenton.

Louisville, Cincinnati and Lexington Railroad.

Ms.		
0	Louisville.	10 c. Genesee. / 9 c. Corniferous. / 5 c. Niagara. — Falls.
7	Woodlawn.	9 c. Corniferous.
10	Ormsby's.	5 c. Niagara.
13	Shelbyville Jun.	"
16	Pewee Valley.	"
27	Lagrange.	"
28	Lexington Jun.	"
33	Pendleton.	4 c. Cincinnati.
36	Sulphur.	"
41	Campbellsburg.	"
51	Carrollton.	"
55	Worthville.	"
59	Eagle.	"
62	Liberty.	"
65	Sparta.	"
70	Glencoe.	"
78	Zion.	"
84	Verona.	"
89	Walton.	"
93	Bank Lick.	"
98	Independence.	"
102	Maurice.	"
105	South Covington	"
109	Newport.	"

Louisville, Cincinnati and Lexington Railroad—*Continued.*

Ms.	Mount Sterling Line.	
28	Lexington Jun.	5 c. Niagara.
32	Jericho.	4 c. Cincinnati.
35	Smithfield.	"
40	Eminence.	"
44	Pleasureville.	"
49	Christiansburgh	"
52	Bagdad.[3]	"
60	Benson.	"
65	Frankfort.[4]	" / Town. River runs in 4 a. Trenton.
73	Ducker's.	4 c. Cincinnati.
80	Midway.	"
83	Payne's.	"
87	Yarnallton.	"
90	Georgetown.	"
94	Lexington.	"
102	Athens Depot.	"
107	Pine Grove.	"
112	Winchester.	"
120	Hedges.	"
127	Mt. Sterling.[5]	"

1. By Mr. John R. Procter, assistant of Prof. N. S. Shaler, State Geologist of Kentucky.
2. The geological survey is in progress, and the formations of the State are not fully determined.
3. Bagdad. To the south of Bagdad can be seen an isolated knob, which is capped with the Niagara group.
4. Frankfort. The Kentucky River runs in Trenton at this point. It reaches up the bank of the river above the town, as high as the railroad tunnel.
5. Mount Sterling. From here can be seen to the eastward, hills capped with St. Louis limestone, and the Conglomerate sandstone at base of Coal Measures.
6. Shepherdsville. Salt River at this point probably cuts down to the Corniferous limestone.
7. Colesburg, at base of Muldraugh's Hill. This hill extends around Central Kentucky, from the mouth of Salt River on the west to the confines of Lewis and Mason counties on the east, retaining nearly for entire length of the great circle the same geological formations, viz; Black shale at base; Keokuk or Waverly shales; Keokuk limestones, becoming more silicious to the eastward, until merged into the shales and sandstones of the Waverly group in Eastern Kentucky; and on to the St. Louis limestone. Excepting in Madison County, where the hill attains its greatest height (1650 feet above sea), it is capped with the Conglomerate sandstone, with a workable sub-conglomerate coal.

Louisville, Cincinnati and Lexington Railroad—*Continued.*

Ms.	Shelbyville Division.	
0	Louisville.	(As before).
12	Anchorage.	5 c. Niagara.
17	Taylor's.	4 c. Cincinnati.
23	Simpsonville.	"
31	Shelbyville.	"

Louisville, Nashville & Great Southern and North & South Alabama Railroad.

Louisville and Memphis Division.

0	Louisville.	9 c. Corniferous.
6	Strawberry.	10 c. Black shale.
9	Old Deposit.	"
14	Brooks.	13 a. Lower Sub-Carb.
18	Shepherdsville [6]	5 c. Niagara.
22	Bardstown Jun.	"
25	Belmont.	" & 9 c. Cornif.
30	Lebanon Junc.	10 c. Black shale and 13 a. L.Sub-Carbonif.
34	Colesburg. [7]	13 a. Lower Sub-Carb.
42	Elizabethtown.	13 b. St. Louis group & Upper Sub-Carbon.
50	Glendale.	"
59	Upton.	"
66	Bacon Creek.	"
73	Munfordville.	"
82	Horse Cave.	"
85	Cave City.	"
91	Glasgow Junc. [8]	"
96	Rocky Hill.	"
100	Smith's Grove.	"
109	Bristow.	"
114	Bowling Green.	"
118	Memphis Junc.	"
123	Rockfield.	"
132	Auburn.	"
136	McLeod.	"
143	Russellville.	"
148	Cave Spring.	"
157	Allensville.	"
164	Guthrie.	"
	(Continued in Tennessee).	

Louisville and Montgomery Division.

0	Louisville.	(As before).
118	Memphis Junc.	13 b. Upper Sub-Carb.
125	Woodburn.	"
134	Franklin. [9]	"
144	Richland.	"

Louisville, Nashville & Great Southern and North & South Alabama Railroad—*Cont.*

Knoxville Division.

Ms.		
0	Louisville.	(As before).
30	Lebanon Junc.	10 c. Black shale and 13 a. Lower Sub-Carboniferous.
35	Boston.	10 c. Blk. shl. & 9 c. (?)
45	New Haven.	" Cor.
50	New Hope.	"
55	Chicago. [10]	9 c. Corniferous and 10 c. Black shale.
62	St. Mary's.	4 c. Cincinnati, 9 c. Corniferous and 10 c. Black shale.
67	Lebanon.	"
73	Penick's.	"
81	North Fork.	"
89	Parksville.	4 c. Cincinnati, 9 c. Corniferous and 10 c. Black shale.
96	Danville Station	"
104	Stanford. [10]	"
105	Richmond Jun.	4 c. Cincinnati.
115	Crab Orchard [11]	9 a. Cauda Galli, 9 c. Corniferous and 10 c. Black shale.
122	Broadhead.	13 a. Lower Sub-Carb.
129	Mount Vernon.	13 b. Upper Sub-Carb.
135	Pine Hill.	" Hill around 14 a. and 14 b.
140	Livingston.	14 a. and 14 b. River runs in 13 b.

Bardstown Branch.

0	Louisville.	9 c. Corniferous.
22	Bardstown Jun.	5 c. Niagara.
27	Big Spring.	"
33	Samuel's.	"
39	Bardstown.	"

Richmond Branch.

105	Richmond Jun.	4 c. Cincinnati.
113	Lancaster.	"
122	Lowell.	"
128	Silver Creek.	"
133	Duncannon.	"
139	Richmond.	"

The Chester group is also represented in this portion of the hill. Muldraugh's Hill represents the retreating escapement of the rocks extending over Central Kentucky.

8. Glasgow Junction. Cavernous limestone of the St. Louis group. The nearest station to the Mammoth Cave. This celebrated cavern and all the other Kentucky caves are in the 13 b. St. Louis division of the Sub-Carboniferous limestone. The knobs seen to the northward are composed of St. Louis limestone, capped with the sandstone of the Chester group, known in Kentucky Geological Reports as the "Big Clifty Sandstone," so named from Big Clifty Creek (Paducah & Elizabethtown Railroad), where it has its greatest development. Glasgow, near the division between the Lower St. Louis and Keokuk groups. Near Glasgow are profitable oil wells.

9. Franklin, near the division between the Lower St. Louis and the Keokuk limestone.

10. From 55 Chicago to 104 Stanford all the formations, from the top of the 4 c. Cincinnati, 9. Corniferous, 10 c. Genesee, and 13. Keokuk, are represented. The Niagara is wanting. The railroad runs on the Cincinnati and Black shales, and the Keokuk knobs strike it on the south. Knobs to right of road (going from Louisville), outliers from Muldraugh's Hill. See Note 7 (Colesburg) on Louisville and Memphis division. Also see Note 8.

Ms.	Paducah and Memphis Railroad.	
0	Paducah.[12]	20. Post Tertiary.
5	Bond's.	"
9	Florence.	"
14	Boaz.	"
20	Hickory.	"
26	Mayfield.	"
32	Pryor's.	"
37	Wingo.	"
44	Morse.	"
50	Fulton.	"
	(Continued in Tennessee).	

	Kentucky Central Railroad.	
0	Covington.	4 c. Cincinnati.
7	Culbertson.	"
14	Canton.	"
21	Mullin's.	"
25	Demossville.	"
31	Boston.	"
39	Falmouth.	"
47	Morgan.	"
53	Berry's.	"
58	Garnett.	"
66	Cynthiana.	"
70	Lair.[13]	"
73	Shawhan.	"
80	Paris.	"
89	Lowe.	"
99	Lexington.	"
106	Providence.	"
112	Nicholasville.	"

	Maysville and Lexington Division.	
0	Maysville.	4 c. Cincinnati.
9	Marshall.	"
13	Helena.	"
16	Johnson.	"
18	Elizaville.	"
20	Ewing.	"
28	Myers.	"
33	Carlisle.	"
41	Millersburg.	"
50	Paris.	"

	Evansville, Owensboro and Nashville R. R.	
0	Owensboro.	14. Carboniferous.
7	Sutherland.	"
15	Riley's.	"
21	Livermore.	"
27	Strouds.	"
35	Owensboro Jun.	"

Ms.	St. Louis & South-Eastern Railroad.	
0	St. Louis.	(See Missouri).
171	Henderson.	14. Carboniferous.
181	Busby's.	"
188	Sebree.	"
198	Slaughtsville.	"
209	Madisonville	"
221	Nortonville.	"
232	Crofton.	13 b. Upper Sub-Carb.
245	Hopkinsville.	"
255	Pembroke.	"
261	Trenton.	"
269	Guthrie.	"

	Chicago, St. Louis & New Orleans Railroad.	
0	Cairo.	19. Tertiary (?).
7	Fort Jefferson.	"
20	Arlington.	"
28	Clinton.	"
36	Alexander.	"
42	Fulton.	"
	(Continued in Tennessee.)	

	Mobile and Ohio Railroad.	
0	Columbus.[14]	19. Tertiary (?).
8	Clinton.	"
13	Moscow.	"
16	Cayce's.	"
	(Continued in Tennessee.)	

	Louisville, Paducah & South-Western R. R.	
0	Louisville.	9 c. Corniferous.
8	Pleasant Ridge.	13 b. Upper Sub-Carb.
18	River View.	"
26	Muldraugh.	"
46	Cecilian Junc'n.	" Chester.

	Paducah & Elizabethtown Railroad.	
0	Elizabethtown.	13 b. St. Louis & 13 a.
6	Cecilian Junc'n.	"
10	Stephensburg[15]	13. Sub-Carbon. l. s.
13	East View.	"
21	Big Clifty.[16]	" Chester & S.L.
27	Grayson Springs	"
31	Litchfield.[17]	" Chester.
37	Millwood.	" and 14.
43	Caneyville.	14. Carboniferous.
47	Spring Lick.	"
50	Horse Branch.	"
60	Rosine.	"
63	Elm Lick.	"
68	Beaver Dam.	"
70	Hamilton.	"

11. Muldraugh's Hill crossed before reaching Crab Orchard. See Note 7. Cauda Galli fossils were found at Crab Orchard by Mr. Procter. There are fine specimens in the State cabinet.

12. Paducah. At this point is an extensive deposit known as the Paducah Gravel Beds, affording, perhaps, the most superior road metal to be found in this country. This gravel is composed of the waste from the degraded beds to the eastward, and is principally quartz pebbles from the Conglomerate, and rounded fragments of chert from the Keokuk and St. Louis groups, with coarse angular sand—all quite ferruginous. When properly put down on streets or roads it soon cements, and does not yield to the heaviest hauling, needing little after repairs, and affording a smooth, hard street. It also affords a superior material for concrete.

13. Lair Station. Near the road, half mile south of station, to west of road, there is an opening in a fissure vein, 20 inches wide, well filled with baryta, containing Galena, and zinc.

Paducah and Elizabethtown Railroad— *Continued.*

Ms.		
76	Rockport.	14 c. Upper Coal Mres.
77	Green River.	" Mines.
80	Nelson Creek.	"
86	OwensboroJn[18]	"
88	Muhlenberg.	" Mines.
93	Greenville.	"
98	Gordon.	"
103	Bakersport.	"
110	Norton Junc.[19]	"
117	Woodruff.[20]	"
125	Tradewater.[21]	14 a. Millstone Grit.
134	Scottsburg.[22]	13 b. Sub-Carb. St. Los.
139	Princeton.	"
145	Dulaney.	"
151	Eddyville.	"
152	Kuttawa.[23]	13 a. Keokuk?
158	Cumberland Riv	"
163	St. Bernard.	"
168	Calvert City.	20. Post Tertiary.
176	Lawton's Bluff.	"
179	Clark's River.	"
187	Paducah.[12]	"

Eastern Kentucky Railroad.[24]

0	Riverton.[25]	14 b. Lower Coal Mres.
3	Three Miles.	"
5	Worthington.[26]	"
6½	Argillite.[27]	"
9	Laurel.	"

Eastern Kentucky Railroad— *Cont.*

Ms.		
10½	McAllister's.	14 b. Lower Coal Mres.
12½	Hunnewell.[28]	"
15½	Deming's.	"
16½	Hopewell.[29]	"
18½	Anglius.	"
21	Pactolus.[30]	"
23	Grayson.[31]	"
26	Vincents.	"
28	Mt. Savage.[32]	"
29½	Reedville.	"
34	Willard.[33]	"

Cincinnati Southern Railroad.

	Cincinnati.	4 b. Cincinnati.
0	Ludlow.	"
5	Kenton Heights.	"
6	Greenwo'd Lake	"
11	Dixon.	"
14	Richwood.	"
17	Walton.	"
21	Bracht.	"
25	Crittenden.	"
28	Sherman.	"
32	Dry Ridge.	"
35	Williamstown.	"
39	Mason.	"
44	Blanchet.	"
46	Corinth.	"
49	Hinton.	"

14. Columbus. Interesting point. Bluffs 200 feet high, composed of clays and sands. At base of bluff is a pure white sand, extending to about high water mark. Also excellent glass sand above this, and superior fire and potters' clay. Near top of bluff quite a thickness of gravel, equivalent of the Paducah gravel. (See Paducah, Note 12).

15. Stephensburgh. About 1½ miles west of this place St. Louis limestone comes to the surface and continues, determining the topography and character of the soil to Elizabethtown.

16. Big Clifty. The bluffs at Big Clifty Creek are composed of thick sandstone, base of the Chester, resting on top of the St. Louis group of Sub-Carboniferous limestone.

17. Litchfield. Sandstone here, base of the Chester group. Near this point are to be found the Litchfield marls, rich in potash and phosphoric acid.

18. Owensborough Junction. Coals A and B near level of road bed.

19. Norton. Fault here. Coal D (No. 9) west and Coal A (No. 12) and B (No. 11) east of Norton.

20. Woodruff Station. St. Charles Mines. Coal D (No. 9).

21. Tradewater Station. Coal L. (No. 1, B), about 25 feet above road bed.

22. Scottsburg. The hills around Scottsburg are capped with sandstone, base of the Chester group; 2½ miles east of Scottsburg the cuts through which the road runs expose the Chester group, limestones and marly shales, the latter rich in potash; 3½ miles east of Scottsburg the Conglomerate sandstone, base of the Coal Measures, is seen.

23. Kuttawa. Three miles west of this station the road cuts through a thick deposit of excellent limonite iron ore: to be seen on north side of cut.

24. This railroad runs through the heart of the Kentucky division of the Hanging Rock Iron Region. On the line of the road all of the coals are to be found, from No. 1 to No. 11, and most of the iron ores.

25. No. 1 Coal near water level.

26. No. 3 Coal in the hills, about 150 feet above grade of road.

27. Near site of Old Argillite Furnace, probably the oldest furnace in the Hanging Rock Iron Region, erected in 1822. About 3 miles east of station is the Pennsylvania Furnace, and 3 miles west the Buffalo Furnace.

28. Hunnewell Furnace located here; also the machine and repair shops of the railroad. Mines of No. 3 and No. 4 Coal, the latter known as the Hunnewell Cannel Coal.

29. The former site of an old furnace of that name.

30. The former site of an old furnace of that name.

31. The county seat of Carter County. Coals No. 2 and No. 3 are found here. Iron Hills Furnace, the largest charcoal furnace in this section, is situated about 8 miles northwest from Grayson, where also is the celebrated Lambert Ore Bank, a local deposit, 14 feet 10 inches thick—of great value. Thirteen miles west of Grayson are the celebrated Carter Caves, situated in the St. Louis group of the Sub-Carboniferous limestone. These caves and the wild scenery of Tigart Valley, surrounding them, are well worth visiting.

32. Near here is Mount Savage Furnace, and fine veins of Coals No. 3 and No. 7, the latter known as the Coalton Coal.

Ms.	Cincinnati Southern Railroad—*Cont.*	
54	Sadieville.	4 b. Cincinnati.
60	Rogers' Gap.	"
63	Kinkaid.	"
67	Georgetown.	"
74	Donerail.	"
75	Greendale.	"
78	Lexington.	"
85	Providence.	"
90	Nicholasville.	"
95	Scott's.	"
100	Tower's.[34]	"
106	Durgin.	4 b. Cincinnati.
107	Harrodsburg Ju	"
113	Danville.	"
118	Danville Jun.[35]	" and 5 c.
123	Moreland.	10 c. and 13 a.
128	McKinney.	"
128	South Fork.	"
136	King's Mt.[36]	13 a. Upper Sub-Carb.
143	Eubanks.	13 b. Lower Sub-Carb.
150	Science Hill.	"
158	Somerset.	"

	Nashville, Chattanooga and St. Louis Railroad.	
0	St. Louis, Mo.	(See Missouri.)
177	Hickman, Ky.[37]	19. Tertiary and 20. Post Tertiary.
184	State Line.	"
	(Continued	in Tennessee).

Ms.	Lexington and Big Sandy Railroad. Eastern Division.	
0	Ashland.	14 b. Coal Measures. Iron Works. Coal vein No. 6.
2	Bellefonte.	14 b. Coal Measures. Furnace 2 miles.
5	Summit.	14 b. Coal Measures.
7	Clinton.	"
9	Russell.	"
10	Stewart's Tunnel.	" Prince's Furnace. Coal vein No. 7.
11	Coulton.	14 b. Coal Measures. R. R. Co.'s mines, vein No. 7.
13	Kilgore.	14 b. Coal Measures.
14	Rush.	"
13	Kilgore.	"
14	Star.	" " Coal vein No. 7. Norton's Iron Works.

33. At Willard are the ores and coal mines of the Bellefonte & Etna Company of Ironton, Ohio. Most of the coals are represented in this vicinity.

34. Crossing of Kentucky River, said to be the highest railroad bridge in the world, being 270 feet above the water. The scenery is very grand. The base of the hills is 4 a. Trenton limestone, affording fine building stones known as Kentucky River Marble, a fine grained magnesian limestone, of soft buff color, susceptible of a high polish, easily wrought, and of great strength and durability.

35. Probably the top of 4 b. changes rapidly here; bluffs near here, composed principally of 13 a., with 10 c. at the base.

36. Tunnel 4,000 feet, through a continuation of Muldraugh's Hill. Tunnel in 13 a. Keokuk fossils in the shales, hills capped with 13 b. See Note 7.

37. See Notes 12 and 14.

Tennessee.[1]

List of Geological Formations found in Tennessee:

DANA'S TABLE OF FORMATIONS.	TENN. DIVISIONS, By Prof. Safford.	DANA'S TABLE OF FORMATIONS.	TENN. DIVISIONS, By Prof. Safford.
20. Quaternary.	20 c. Alluvium.	7. Lower Helderberg.	7. Lower Helderberg.
"	20 b. Bluff loam.	5. Niagara.	5 d. Niagara limestone
"	20 a. Orange s. or dft.	" Clinton.	5 c. Dyestone Group.
19. Tertiary Eocene.	19 b. La Grange sand.	" Medina.	5 b. White Oak Mt. ss.
"	19 a. Flatwoods s. & c.	" "	5 a. Clinch Mt. s. s.
18. Cretaceous.	18 c. Ripley Group.	4 b. Cincinnati.	4 b. Nashville.
"	18 b. Rotten l. s.	4 a. Trenton.	4 a. Trenton.
"	18 a. Coffee sand.	3. Canadian. Quebec.	3 c. Knox dolomite.
14. Carboniferous.	14. Coal Measures.	" "	3 b. Knox shale.
13. Sub-carbonifer's	13 c. Mount'n l. s.	" Calcifer's.	3 a Knox sandstone.
"	13 b. Coral or St. L. l.s.	2. Primord'l. Potsd'm	2 b. Chilhowe s. s.
"	13 a. Barren Group.	" Acadian.	2 a. Ocoee Group.
10. Hamilton.	10 c. Black Shale.	1. Archæan.	1. Metamorphic?

1 Paducah and Memphis R. R.

Ms.		
0	Paducah, Ky.	20 Quaternary.
5	Bond's.	"
9	Florence.	"
14	Boaz.	"
16	Viola.	"
20	Hickory.	"
26	Mayfield.	"
32	Pryor's.	"
37	Wingo.	"
44	Morse.	"
50	Fulton.	"
53	Pierce, Tenn.	19 b. La Grange sand.
56	Harris.	"
59	Paducah Jun.	"
63	Troy.	"
68	Polk's.	20. Quaternary. Bluff.
74	Obion.	"
78	Trimble.	"

Probably resting on sub. carb. l. s. (Chester?)

2 Mobile and Ohio R. R.

0	Columbus, Ky.	20. Quaternary. 20 b. Bluff loam 10 m.
7	Clinton.	"
43	Moscow.	19. Tertiary, or
16	Cayce's.	19. b. La Grange group.
20	Jordan, Ky.	"
26	Union City, Tn.	"
31	Troy.	"
45	Crockett.	"
43	Kenton.	"
48	Rutherford.	"
52	Dyer.	"
59	Trenton.	"
70	Humboldt.	"
79	Carroll.	"

Mobile and Ohio—*Continued.*

87	Jackson.	19 b. La Grange group.
89	Pinson.	"
103	Henderson.	19 a. Flatwoods.
114	McNairy.	"
120	Bethel.	18. Cretaceous. 18 c. Ripley group.
132	Ramer, Tenn.	"
143	Corinth, Miss.	"

3 New Orleans, Louisville and Chicago R.R.

0	New Orleans.	
382	Lamar, Tenn.	
394	Grand Junct'n.	19. Tertiary, or 19 b. La Grange group
413	Bolivar.	"
441	Jackson.	"
455	Medina.	"
464	Milan.	"
475	Bradford.	"
481	Greenfield.	"
487	Sharon.	"
495	Frost.	"
550	McConnellville	"
506	Fulton, Ky.	"

4 Louisville and Nashville and Great Southern Railroad.

0	Louisville, Ky.	
164	Guthrie, Tenn.	13 a. Lower carb. (silic.)
168	Hampton's.	"
171	Dudley's.	"
177	Clarksville.	"
184	Steele's.	"
189	Palmyra.	"
190	Carbondale.	"

1. Revised and the notes added by Prof. James M. Safford, the State Geologist of Tennessee, and the portion in Kentucky by Prof. N. S. Shaler, the State Geologist of Kentucky.

Ms.	Louisville and Nashville and Gt. S.—*Con.*	
198	Cumberland.[2]	13 a. Lower car. (silic's)
205	Erin.	"
210	Tenn. Ridge.	"
214	Stewart's.	"
220	Tenn. River.	5. Niagara, and 7. lower Heldrb. 12 m.
230	Big Sandy.	"
235	Springville.	18. Cretaceous, and 19. Tertiary, 11 miles.
241	Porter's.	
246	Paris.	"
	(Memphis Division.)	
256	Henry.	19 b. La Grange Group.
264	McKenzie.	"
274	Trezevant.	"
284	Milan.	"
296	Humboldt.	"
301	Gadsden.	"
308	Bell's.	"
312	Jones's.	"
321	Brownsville.	"
329	Shephard.	"
333	Stanton.	"
341	Mason.	"
349	Galloway.	"
352	Withe	20 b. Quarternary. (Bluff loam) 24 miles.
358	Shelby.	"
366	Bartlett.	"
377	Memphis.	"
	(Division to Nashville and Montgomery.)	
0	Louisville, Ky.	
114	Bowling Green	13 a. Lower sub-carb'fs.
118	Memphis Jun.	"
122	Rich Pond.	"
125	Woodburn.	"
134	Franklin.	"
141	Mitchellville, T.	13 a. lower sub-carb'f. (Silicious.)
144	Richland.	
146	Fountain Head	"
149	Buck Lodge.	"
153	(Tunnel.)[3]	4 b. Cincinnati or Nashv.
159	Gallatin.	"
164	Pilot Knob.	"
166	Saundersville.	"
170	Hendersonville	"
175	Edgefield Jun.	4 b. Cincin't. or Nashville, and 4 a. Tren.
178	Madison.	4 b. Cincinnati or Nashv.
184	Edgefield.	"
185	NASHVILLE.	4 b. Cincinnati or Nashv.
189	N. and C. Jun.	"
197	Brentwood.	"
206	Franklin.	"
215	Thompson's.	"
219	Ewell's.	"

3. At this Tunnel is a good section of the (10 c.) Black Shale, with the strata above and below.

Ms	Louisville and Nashville and Gt. S.—*Con.*	
223	Carter's Creek.	4 a. Trenton.
233	Columbia.	"
243	Pleasant Grove	"
246	Campbell's.	"
251	Lynnville.	"
254	Buford's.	"
256	Reynold's.	"
261	Wales.	"
266	Pulaski.	"
272	Harwell.	"
273	Aspen Hill.	"
275	Lester's.	"
278	Prospect.	"
280	State Line.	4 b. Cincinnati.
286	Elkmont, Ala. (Continued in Alabama.)	13. Sub-carboniferous.

5 Memphis and Charleston R. R.

0	Memphis, Ten.	20 b. Bluff loam or Q'rt.
5	Buntyn.	" "
9	White s.	" "
15	Germantown.	" "
19	Bailey.	" "
23	Collierville.	" "
31	Rossville, or La Fayette.	19 b. La Grange.
39	Moscow.	"
52	Somerville.	"
49	La Grange.	"
52	Grand Junc.	"
58	Saulsbury.	"
64	64 mls. Siding.	19 a. Flatwoods.
69	Middleton.	18. Cretaceous.
74	Pocahontas.	"
79	Big Hill.	"
84	Chewalla.	"
93	Corinth, Miss.	"
107	Burnsville, "	"
115	Iuka. "	"
124	Marguren, Ala.	13. Sub-carboniferous.
127	Dickson.	"
129	Cherokee.	"
	(Continued in Alabama.)	

6 St. Louis and South-Eastern R. R.

0	St. Louis.	
261	Trenton.	
269	Guthrie.	13. Sub-carboniferous.
274	Forts.	"
280	Cedar Hill.	"
287	Springfield.	"
299	Baker's.	5 a. Niagara, with blk. shale above. A good section here.
303	Goodlett's.	4 b. Nashville.
306	Edgefield Jun.	4 b. Nashv. & 4 a. Trent.
309	Madison.	4 b. Nashville.
315	Edgefield.	"
316	NASHVILLE.	"

2. Very soon after leaving Cumberland, the road enters the *Wells Creek Basin* and crosses the 10 c. Black Shale, also 7 Lower Helderberg, 5 d. Niagara, 4 a. Trenton, 4 b. Nashville, and 3 c. Knox Dolomite strata, which have been brought to the surface by an uplift. In the bluff on the river just below Cumberland are good presentations of the 10 c. Black Shale, as well as the 5 Niagara and 7 Lower Helderberg rocks.

Ms.	7 Nashville, Chatanooga and St. Louis.	
0	CHATANOOGA.	4 a. Trenton, and 3 c. Knox dolomite or Quebec.[4]
6	Wauhatchie.	4 b. Nashville.
13	Ætna Cl. Mines	13 c. Upper sub. carb.
14	Whitesides.	14. Coal Measure Mts. near by.
22	Shellmound.	Alluvium (Ten. R. Bot'm)
28	Bridgeport.	3 c. Knox dolm. or Queb.
39	Stevenson.	3 b. Knox shale—sub-carboniferous near by.
49	Anderson.	13. Sub-carboniferous.
62	(Tunnel.)	"
64	Cowan.	"
69	Decherd.	"
82	Tullahoma.	"
89	Normandy.	4 b. Nash. or Cincinnati.
96	Wartrac.	4 b. Nash. and 4 a. Trent.
101	Belle Buckle.	4 a. Trenton.
109	Christiana.	"
119	Murfresboro.	"
126	Florence.	"
131	Smyrna.	"
136	Lavergne.	"
142	Antioch.	"
150	Nash. & Dec. J.	4 b. Nashville.
151	NASHVILLE.	"
158	Bellemeade, or Harding's.	"
164	Bellevue.	"
168	Newsom's.[5]	"
176	Kingston Sprg.	13. Sub-carboniferous.
189	Burns.	"
193	Dickson.	"
208	McEwen.	13 a. Lower sub-carbonf.
218	Waverly.	"
229	Johnsonville.	10 c. Black shale, and 13. Lower sub-carb'fs.
238	Camden.	13. Sub-carboniferous.
258	Huntingdon.	19 a. Flatwoods Tertiary
270	McKenzie.	19 b. La Grange Tertiary
278	Gleason.	"
285	Dresden.	"
303	Paducah Jun.	"
307	Union City.	20 b. Bluff loam.
314	STATE LINE, Tn. (Continued in Kentucky.)	"
321	Hickman, Ky.	"
333	Columbus, "	
499	ST. LOUIS, Mo.	

4 Upper Silurian beds, the Black Shale and the lowest carboniferous strata, may also be seen in the high hill on the West side of the city.

Ms.	8 Tennessee and Pacific R. R.	
0	NASHVILLE.	4 b. Nashville.
2	Mt. Olivet.	4 b. Nash. and 4 a. Tren.
8	Donelson.	4 a. Trenton.
12	Hermitage.	"
18	Mt. Juliet.	"
24	Leeville.	"
26	Tucker's Gap.	4 b. Nashville.
31	LEBANON.	4 a. Trenton.

9 Shelbyville Branch.

0	Chattanooga.	
96	WARTRACE.	4 b. Nash. and 4 a. Tren.
	SHELBYVILLE.	4 a. Trenton.

10 McMinnville and Manchester R. R.

0	Chattanooga.	
82	Tullahoma.	13 a. Lower sub-carb'fs.
116	McMinville.	"

11 Winchester and Alabama R. R.

0	DECHERD.	13 b. low. carb. (silic's.)
3	Winchester.	"
10	Belvidere.	"
16	Hunt's.	"
26	Cunningham.	4 b. Cincin. or Nashville
28	Brighton.	"
32	Kelso.	"
37	FAYETTEVILLE.	"

12 Jasper Branch.

28	Bridgeport.	3 c. Knox dolm. or Tren.
	Jasper.	13. Sub-carboniferous.

13 Tennessee Coal and R. R. Co.'s R. R. 6

0	Chattanooga.	
62	Tunnel, near Cowan.	13 b. Sub-carboniferous. Mountain limestone.
83	Tracy City.	14. Coal Measures. Sewanee coal mines.

6 This R. R., 21 miles long, ascends the Cumberland Mountain table land in a few miles, presenting a fine section of the sub-carboniferous limestone. Near the top of the mountain it intersects the sandstones, shales, &c., of the base of the coal measnres. Then, for many miles, it runs on the conglomerate. At Tracy City is a good bed of coal, extensively mined. In this vicinity a good section of the coal measures of this part of Tennessee can be obtained. See "The Coal Regions of America," p. 351 to 373.

14 Knoxville and Ohio R. R.

This Railroad presents fine sections of the formations of E. Tennessee.

0	Knoxville.	Knox dolm. and Trenton
40	Careyville.	14. Coal Measures. Coal beds of the Cumberland Mountain.[7]

5. At Newsom's a section may be conveniently seen extending from the upper part of the 4 b. Nashville to the 13 sub-carboniferous.

7. For a full description of the Coal Fields of Tennessee and those of the other States, see "THE COAL REGIONS OF AMERICA, *their Topography, Geology and Development*, with numerous maps and illustrations." By James Macfarlane. Published and sold by D. Appleton & Co., New York: 8 vo. pp. 700; $5.00, sent by mail post paid.

15 E. Tennessee, Va. and Georgia S.W.

Ms.		
0	Bristol, at Va. Line.	3 c. Knox Dolomite, or Quebec.
11	Union.[8]	"
20	Carter's.[8]	"
25	Johnson's.[8]	"
32	Jonesboro.	"
43	Limestone.	"
47	Fuller's.	"
56	Greenville.[9]	"
65	Midway.	"
74	Rogersville J.	4 b. Nashville.
82	Russelville.	3 c. Knox Dolomite, or Quebec.
88	Morristown.	"
97	Talbot's.	"
101	Mossy Creek.[10]	"
105	Newmarket.	"
114	Strawberry Pls	"
120	McMillan's.	"
130	Knoxville.	3 c. Knox Dolomite and Trenton.[11]
135	Erin.	4 a. Trent. and Nash.
145	Concord.	3 c. Knox Dolomite.
154	Lenoirs.	"
159	Loudon.	"
165	Philadelphia.	"
175	Sweetwater.	"
180	Reagan's.	3 b. Knox Shale.
186	Athens.	3 c. Knox Dolomite.
193	Riceville.	3 b. Knox Shale.
201	Charleston.	3 c. Knox Dolomite.
213	Cleveland. State Line.	3 c. Knox Dolomite and Shale.

(Continued in Georgia.)

E. Tenn., Va. and Georgia S.W.—*Con.*

Ms.		
240	Dalton.	3 c. Knox Dolomite.
213	Cleveland.	"
227	Ooltawah.[12]	4 a. Trenton.
232	Tyner's.	3 b. Knox Shale.
242	Chattanooga.	See N. C. and S. and S. R. R.

16 Cincinnati, Cumberland Gap and Charleston R. R.

0	Morristown.	3 c. Knox Dolomite, or Quebec.
4	Sulphur Spr'gs.	3 b. Knox Shale and Dolomite.
6	Witt's Found'y	"
19	Dandridge R'd.	"
12	Leadsville.	4 b. Shales of Cincinnati, or Nash. age.
15	Rankin's.	"
26	Bridgeport.	3 c. Knox Dolomite.
33	Big Creek,	3 c. Knox Dolomite, and 2 a. Ocoee Conglomerate & Shales.
39	Wolf Creek.	2 a. Ocoee Conglomer. and Shales.

17 Knoxville and Charleston R. R.

0	Knoxville.	3 c. Knox Dolomite, and 4 a. Trenton.
	Bruce's.	Unknown.
	Little River.	"
16	Marysville.	3 c. Knox Dolomite.

8. Within a few miles of these Stations, are ridges and knobs made up of dark shales of Cincinnati or Nashville age. At Johnson's a point of one of these ridges is very near the Station.

9. The high mountains so conspicuous from the depot at Greenville are made up of 2 b. Chilhowee (Potsdam) sandstone and of 2 a. Ocoee slates and conglomerates.

10. Veins of zinc ore are found at this point in the 3 c. Knox dolomite.

11. The high portion of the city on the former, the Depot on the latter. Shales of Nashville just west of Depot. On the side of the Holston River opposite Knoxville high knobs covered with deep red soil are conspicuous, which are made up in good part of a dark ferruginous limestone called Iron Limestone, and belonging to the 4 b. Nashville (Cincinnati) group.

12. About one mile east of Ooltawah the Railroad passes through a gap of the White Oak Mountains, in which is an interesting section embracing 4 b. Nashville, 5 d. Niagara, Devonian (10 c. Black Shale) and 13 sub-carboniferous rocks.

Alabama.[1]

Dana's Table of Formations.	Alabama Divisions by Prof. Gesner.	Dana's Table of Formations.	Alabama Divisions by Prof. Gesner.
20. Quaternary.	20 c. Alluvium.	10 c. Genesee.	10 c. Black Shale.
"	20 b. Bluff Loam.	7. Low. Helderb'g.	7. Lower Helder'g.
"	20 a. Orange s. or dt.	5. Niagara.	5 d. Niagara l. s.
19. Tertiary.	19 c. Pliocene.	5. Clinton.	5 c. Dyestone Group
"	19 b. Miocene.	5. Medina.	5 b. Wh. Oak Mt. s.s.
"	19 a. Eocene.	"	5 a. Clinch Mt. s. s.
18. Cretaceous.	18 c. Upper Cretac's.	4. Trenton.	4 b. Cincinnati.
"	18 b. Middle Creta's.	"	4 a. Trenton.
"	18 a. Lower Creta's.	3. Canadian.	3 c. Chazy.
17. Jurassic.	17 b. Marlstone.	"	3 b. Quebec Knox dolomite.
"	17 a. Lower Lias.	"	
14. Carboniferous.	14 c. Upp. Coal Mrs.	2. Primordial or Cambrian.	3 a. Calciferous.
"	14 b. Low. Coal Mrs.	"	2 b. Potsdam s. s.
"	14 a. Millstone Grit.		
13. Sub-Carbonif's.	13 b. Mountain l. s.	1. Archæan.	2 a. Acadian.
"	13 b. Coral or St.L. ls	"	1 b. Huronian.
"	13 a. Barren Group.		1 a. Laurentian.

South and North Alabama, or Louisville and Great Southern Railroad.			South and North Alabama, or Louisville and Great Southern Railroad—*Continued.*	
Ms.			Ms.	
0	Decatur.	13 b. U. Carb. or Mt. l.s.	90	Grace's Gap.[5] (See foot note.)
7	Flint.	"	93	Oxmoor.* 14 c. Cahawba coal field.
13	Hartsell's.	"	95	Shade Creek. "
18	Falkville.	"	99	Brock's. "
23	Wilhite's.	"	102	Cahaba Mines.[6] "
28	Summit.[2]	14 b. War'r coal field. Plateau of Sand Mount'n.	104	Helena.[7] 3 a. Calcifer'us fault. 14 b. Coal Measures.
31	Milner's.	"		
33	Cullman's.	"	109	Siluria. 3 c. Chazy & Tren. (Lime
35	Phelan's.	"	112	Whiting's. " Wks.)
42	Hanceville.	"	119	Calera Hills. 13 Sub-Carbon., 3 c. Chazy & 4 a. Tren.
49	Bangor.	"		
52	Blount Springs[3]	13 b. Up. Sub. Carb. 13 a. Low. Sub. Carb. 10 c. Black Shale.	125	Clear Creek. 1 b. Metamorphic.
			130	Jemison. "
			135	Strasburg. "
57	Reid's.	14 b. Warrior coal field.	139	Lomax. "
63	Warrior.[4]	"	141	Clanton. "
68	Morris.	" Jeffer. Cl. Co.	148	Cooper's. "
74	Cunningham.	" [Co.	151	Verbena. "
76	New Castle.	"N. C. Coal & I.	155	Mountain Creek 20. Quaternary.
79	Black Creek.	Coalburg Co.'s colliery.	164	Deatsville. "
81	Boyle's.	14 b. Warrior coal field.	170	Elmore. "
86	Birmingham.[5]	4 a. Trenton. 3 c. Chazy. 3 b. Quebec. 3 a. Calcifer. An. Jones Valley.	174	Coosada. "
			179	Alabama River. 18. Cretaceous.
				Commerce St. Ju "
			182	Montgomery. "

1. Prepared expressly for this work by Prof. William Gesner, of Birmingham, Ala., Geologist and Analytical Chemist, and by Prof. Eugene A. Smith, the State Geologist.

2. Ascending the mountain from Wilhite's to Summit, Flint Creek shows looming above it cliffs of millstone grit, sandstone and shales, as seen from the car windows. W. G.

3. White and red sulphur and Chalybrate waters of great sanitary value at Blount Springs are much resorted to, particularly in the summer season, from all the States; and the Jackson House, by S. D. Holt, is a well kept hotel. The 10 c. Black Shale gives rise to the sulphur springs. The mountains on each side are 14 a. Carboniferous. W. G.

4. The Pierce Coal Mine Company and Alabama M. & M. Company's mines here. W. G.

* Eureka furnaces and coke ovens.

Selma, Rome and Dalton Railroad, or, Blue Mountain Route.

Ms.		
0	Selma.	18. Cretaceous.
9	Burnsville.	"
22	Plantersville.	20. Quaternary.
32	Maplesville.	"
40	Randolph.	"
49	Ashby.	
51	Briarfield.[8]	3 b. Knox Dolomite.
55	Montevallo.[9]	3 a. Calciferous, 1 mile.
		3 b. Quebec, 5 miles.
62	Calera.	3 c. Chazy, Trenton & ridge of 13 a. Sub-Car.
	Gardner's.	14. Coosa coal field.
67	Shelby Spr'gs[10]	"
72	Columbiana.[11]	3 b. Quebec or Knox.
82	Wilsonville.	"
	Coosa River.[12]	"
	Coosa Station.	"
90	Childersburg.	"
99	Alpine.[13]	"
109	Talledega.	"
	(Alabama Furnace.)	"
126	Munford.	"
	Silver Run.[14]	"
130	Oxford.[15]	"
131	Anniston.	" Woodstock
139	Weaver's.	" Iron Wks.
145	Jacksonville.	"
156	Patona.	"
	Cross Plains.	"
	Ladiga.	" Tecumseh
160	Amberson.	" Iron Co.
164	State Line.[16]	" Stonewall Ir.
168	Pryor's, Ga.	5 b. Clinton. Works.
170	Cave Springs.	4 a. Trenton.
172	Rome, Ga.	"

Alabama and Chattanooga Railroad.[18]

0	Chattanooga, Tenn.[19]	4 a. Trenton.
6	Wauhatchie, "	4 b. Cincinnati.
9	Wildwood, Ga.	4 a. Trenton.
12	Morganville, "	"
18	Trenton, "	"
23	Dademon, Ala.	"

Alabama and Chattanooga Railroad—*Continued.*

Ms.		
26	Rising Fawn.	4 c. Cincinn. & 4 a. Tren.
28	Cloverdale.	"
32	Sulphur Springs	"
34	Eureka.	14 b. Warrior coal field.
40	Valley Head.	"
46	Hollman's.	"
51	Fort Payne.	"
56	Brandon's.	"
61	Porterville.	"
65	Collinsville.	"
74	Greenwood.	"
82	Reases.	"
87	Attalla.	"
95	Steele's.	"
102	Whitney or Ashville.	"
115	Springville.	3 b. Quebec or Knox.
131	Trussville.	"
137	Irondale.	"
143	Birmingham.	4 a. Tren. & 3 c. b. & a. of Canadian anti. axis.
155	Jonesboro.	3 c. and 3 b. Canadian.
167	Tannehill.[18]	3 b. or 3 a. Canadian.
170	Green Pond.	3 b. Quebec or Knox.
174	Bibbville.	14 b. Warrior coal field.
178	Vances.	"
183	Clement's.	"
191	Kennidale.	"
198	Tuscaloosa.	20. Quaternary.
204	Maxwell's.	"
213	Carthage.	"
	Stewart's or Havanna.	"
223	Akron.	18 b. Cretac. rotten l.s.
233	Eutaw.	"
239	Haysville.	"
243	Boligee.	"
250	Epps.	"
259	Livingston.	"
263	Hooks.	19 a. Tertiary, 36 miles.
269	York.	"
274	Cuba.	"
279	Kewanee.	"
283	Toomsuba.	"
290	Russell's.	"
295	Meridian.	"

From Valley Head the R. R. follows the great anticlinal valley on the Silurian and Devonian formations. Above Attalla the precipitous bluffs of the Millstone Grit may be seen for many miles to the west of the R. R. The stations are on 4 a. Trenton, 4 c. Cincinnati and 3a. Calciferous.

5. The prosperous city of Birmingham is in Jones' Valley. The railroad then passes through Red Mountain by Grace's Gap. The rocks of the anticlinal axis show, at the junction of the Lower Carboniferous with the 5 c. Clinton, an exposure of fossiliferous hematite iron ore, 28 feet thick, which is being used in the production of an excellent quality of iron by the Eureka Company, at Oxmoor, at the next station. This bed of iron ore extends from a few miles below Pratt's Ferry on the Cahaba River, in Bibb County, through St. Clair, Cherokee and De Kalb counties, into Tennessee, a distance of 120 miles. W. G.

6. S. D. Holt and Davis and Carr's collieries. W. G.

7. Eureka Company's colliery and Central Iron Works Company at Helena. W. G.

8. Branch railroad to Briarfield Rolling Mills and Furnaces. W. G.

9. Cahawba coal field on the west, with branch railroad to the Montevallo coal mines of Dr. T. H Aldrich. W. G.

10. Shelby Springs, Chalybrate and sulphuretted Hydrogen water of great renown, and much frequented. W. G.

11. Columbiana branch to Shelby Iron Works. W. G.

12. From Coosa River to Childersburgh, mountains of 2 b. Potsdam sandstone are seen to the southeast from car windows. E. A. S.

13. From Alpine to Telladega, 2 b. Potsdam sandstone mountains on the west, and 2 a. Acadian slate hills toward the east. E. A. S.

14. At Silver River, 2 a. Acadian on the east, and 2 b. Potsdam on the west. E. A. S.

Ms.	Memphis and Charleston Railroad.	
0	Memphis.	20. Quat'ry, bluff loam.
5	Buntyn.	"
9	White's.	"
15	Germantown.	"
19	Bailey's.	19. Tertiary, orange sand LaGrange group.
23	Collierville.	"
31	La Fayette.	"
39	Moscow.	"
52	Somerville.	"
49	La Grange.	"
52	Grand Junction.	"
58	Saulsbury.	"
64	Mile Siding.	19. Tert', Porter's Creek
74	Pocahontas.	" group.
79	Big Hill.	18. Cretac's, green sand
84	Chewalla.	" group.
93	Corinth, Miss.	18 c. Ripley group.
107	Burnsville.	"
115	Iuka.	13 b. & a. Sub-Carbon.
124	Margerum, Ala.	"
127	Dickson.	"
129	Cherokee.	"
133	Barton.	
139	Pride's.	13 b. & a. Sub-Carbon.
145	Tuscumbia.	13 a. Lower Carbonifer.
156	Leighton.	"
163	Town Creek.	"
169	Courtland.	"
176	Hillsboro.	"
182	Trinity.	"
188	Decatur.	13 b. Lower Carbonifer.
195	Mooresville.	"
203	Madison.	"
212	Huntsville.	3 b. Chazy and 3 b. Quebec, hills 14 a. Sub-Carbonifcrous.
223	Brownsboro.	"
229	Gurley's.	"
233	Paint Rock.	13 a. Sub-Carbonifer.
237	Woodville.	"
248	Larkinsville.	"
254	Scottsboro.	"
259	Bellefonte.	"
265	Fackler's.	"
271	Stevenson.	3 b Quebec or Knox shale, with hills of Sub-Carboniferous.

Ms.	Nashville and Chattanooga Railroad.	
	Stevenson Junc.	3 b. Quebec or Knox.
	Bass Station.	"
49	Anderson.	13 a. Sub-Carbonifer.
39	Stevenson.	3 b. Quebec or Knox.
29	Bridgeport.	3 c. Canadian.
22	Shellmound.	20. Quat'ry, Alluvium.
14	Whiteside.	14 b. Coal Mrs. & 13 c.
	(Etna Coal	Mines.)
6	Wauhatchie.	4 b. Cincinnati.
0	Chattanooga.[19]	4 a. Tren. & 3 c. Canad.

	Nashville and Decatur Railroad.	
0	Decatur.	13 b. Lower Carbonifer.
3	Harris Station.	"
13	Athens.	"
22	Elkmont.	"
	Pittensville.	"
27	State Line.	3 b. Quebec or Knox.

	Western Railroad of Alabama.	
0	West Point.	1 b. Huronian.
11	Cusseta.	"
13	Mt. Jefferson.	"
18	Rough & Ready.	"
22	Opelika.	"
28	Auburn.	" & 20. Quat'ry.
35	Loachapoka.	20. Quaternary.
42	Notasulga.	"

	Fisher Branch—(Narrow Gauge to Tuskegee.)	
48	Chehaw.	20. Quaternary.
	(To Tallahassee	Factory), 1 b. Huronian.
56	Cowles' Station.	20. Quaternary.
65	Shorter's.	18. Cretaceous.
75	Mt. Meigs.	"
88	Montgomery.	"
101	Manack.	"
107	Lowndesboro.	"
113	Whitehall.	"
119	Benton.	"
127	Alabama River.	"
138	Selma.	"

	Columbus Branch.	
0	Columbus.	1 b. Huronian.
4	Smith's or Dover	"
6	Mott's Mill.	20. Quaternary.
8	Salem.	"
19	Hollis.	1 b. Huronian.
25	Yonges.[17]	"
29	Opelika.	"

15. At Oxford, the railroad crosses through a gap of 2 b. Potsdam, and thence to Cross Plains the mountains of 2 b. Potsdam are on the east side. Beyond Cross Plains, to the State line, these mountains can be seen from the cars. E. A. S.

16. The railroad is built on 3 b. Quebec or Knox dolomite almost all the way from Montevallo to the State line, crossing 3 c. Chazy and 4 a. Trenton near Calera and the Coosa coal field above Calera. E. A. S.

17. Yongesborough narrow gauge railroad, 2¾ miles to Chewackla Lime Company's kilns, southeast. The limestone of this company's quarries is a highly crystalline dolomite. W. G.

18. The hills on the west of the railroad consist principally of limonite, and their detritus constitutes the bright red banks of the cuts and fills for many miles. The Thomas ore bank is on east side, close to the main track, nearly opposite the station house. The hills seen beyond these belong to the Warrior coal field. W. G.

19. In addition to the 4 a. Trenton, there are within the limits of the city of Chattanooga the 3 a. Calciferous, 4 b. Cincinnati, 5 Clinton, 10 a. Black shale, and 14. Carboniferous formations. [J. SAFFORD.

Mobile and Girard Railroad.

Ms.		
0	Columbus, Ga.	1 b. Huronian.
9	Fort Mitchell.	18. Cretaceous.
20	Seale.	"
25	Hatchechubbee.	"
35	Hurtville.	"
39	Guerryton.	"
54	Union Springs.	"
63	Thomas Station.	"
72	Linwood.	"
77	Jonesville.	"
84	Troy.	19. Tertiary.

Mobile and Montgomery Railroad.

0	Montgomery.	18. Cretaceous.
10	McGehee's.	"
16	Morgansville.	"
21	Letohatchie.	"
28	Calhoun.	"
33	Fort Deposit.	"
44	Greenville.	19. Tertiary.
53	Bolling.	"
60	Georgiana.	"
67	Garland.	"
	Madge's Mills.	"
76	Gravella.	"
81	Evergreen.'	"
86	Sparta.	"
91	Castleberry.	"
106	Brewton.	"
114	Pollard.	"
119	Whiting or Pensacola Jun.	19. Tert'ry.
134	Williams.	"
155	Bay Minette.	"
163	Tensas River.	"
178	Mobile.	"

Selma and Gulf Railroad.

0	Selma.	18. Cretaceous.
	Pleasant Hill.	"
	Snow Hill.	"
35	Allenton.	"
40	Pine Apple.	19. Tertiary.
	Cokerville.	"

Mobile and Alabama Grand Trunk R. R.

0	Mobile.	19. Tertiary.
9	Cleveland.	"
20	Cold Creek.	"
29	Mount Vernon.	"
39	Leona.	"
50	Sunflower.	"
59	Jackson.	"

Mobile and Ohio Railroad.
(Part in Alabama.)

0	Mobile.	19. Tertiary.
5	Whistler.	"
18	Chunchula.	"
33	Citronelle.	"
44	Deer Park.	"
51	Escatawpa.	"
63	State Line.	"

Alabama Central Railroad.

Ms.		
0	Selma.	18. Cretaceous.
	Marion Junction	"
23	Brown's.	"
30	Uniontown.	"
35	Fawnsdale.	"
42	Macon.	"
	Van Buren.	"
50	Demopolis.	"
66	Coatopa.	"
81	York.	"
	Cuba.	"
	Toomsuba.	"
108	Meridian.	"

Montgomery and Eufaula Railroad.

0	Montgomery.	18. Cretaceous.
10	Oak Grove.	"
13	Perry's Mill.	"
16	Pike Road.	"
21	Matthews'.	"
25	Mitchell's.	"
28	Fitzpatricks.	"
33	Thompson's.	"
	Crossing of Mobile and Girard Railroad.	
40	Union Springs.	18. Cretaceous.
50	ThreePath Road	"
54	Midway.	"
62	Spring Hill.	"
66	Batesville.	"
74	Cochran.	"
81	Eufaula.	18. Cretaceous, marl bluff of the Chattahoochie River.

Selma, Marion and Memphis Railroad.

	Selma.	18. Cretaceous.
0	Marion Junction	"
14	Marion.	"
21	Grove Cottage.	"
29	Newbern.	"
37	Greensboro.	"
45	Sawyersville.	"

Savannah and Memphis Railroad.

0	Opelika.	1 b. Huronian.
10	Gold Hill.	"
15	Waverly.	"
22	Camp Hill.	"
	(Dudleyville	gold mines).
30	Dadeville.	1 b. Huronian.
35	Jackson's Gap.	"
40	Sturdevant.	"
42	Salisbury.	"
47	Alexander City.	"
53	Kellyton.	
60	Goodwater.	Stealite (soapstone) qur.

East Alabama and Cincinnati Railroad.

0	Opelika.	1 b. Huronian.
10	Oak Bowery.	"
23	Buffalo Wallow	"

Vicksburg and Brunswick Railroad.

0	Eufaula.	18. Cretaceous.
5	White Oak.	"
25	Clayton.	"

Mississippi.

Ms.	New Orleans, St. Louis and Chicago Railroad.	
88	Osyka.	19. Later Tertiary.
98	Magnolia.	"
108	Summit.	"
118	Bogue Chitto.	"
128	Brookhaven.	"
139	Beauregard.	"
149	Hazlehurst.	"
158	Crystal Springs.	"
167	Terry.	"
174	Byram.	"
183	Jackson.	19 a. Tertiary Eocene.
195	Madison.	"
206	Canton.	"
220	Vaughans.	"
234	Goodman.	"
242	Durant.	"
251	West.	"
262	Vaiden.	"
271	Winona.	"
283	Duck Hill.	"
295	Grenada.	"
310	Coffeeville.	"
323	Water Valley.	"
333	Taylor's.	"
340	Oxford.	"
357	Abbeville.	"
369	Holly Springs.	"
378	Hudsonville.	"
382	Lamar.	"
295	Grenada.	"
	Oakland.	"
	Sardis.	"
	Hernando.	"
	Memphis.	"

Ms.	Mobile and Ohio Railroad.	
63	State Line.	19. Later Tertiary.
71	Buckatunna.	"
82	Waynesboro.	19 a. Tertiary Eocene.
96	Shubuta.	"
109	Quitman.	"
120	Enterprise.	"

Ms.	Mobile & Ohio Railroad—*Continued.*	
135	Meridian.	19 a. Tertiary Eocene.
147	Lockhart.	"
164	Narkeeta.	"
176	Scooba.	18. Cretaceous.
188	Shuqulak.	"
198	Macon.	"
211	Crawford.	"
219	Artesia.	"
232	West Point.	"
241	Muldon.	"
254	Egypt.	"
262	Okolona.	"
275	Verona.	"
287	Saltillo.	"
297	Baldwyn.	"
309	Booneville.	"
318	Rienzi.	"
329	Corinth.	"

	New Orleans and Mobile Railroad.	
40	Grand Plain.	20. Quat'ry or Alluvium.
52	Bay St. Louis.	"
64	Scott.	"
71	Mississippi.	"
80	Biloxi.	"
90	Belle Fontaine.	"
100	East Pascagoula	"
108	Murray.	"

	Vicksburg and Meridian Railroad.	
0	Vicksburg.	20. Quaternary.
10	Bovina.	19 a. Tertiary Eocene.
18	Edwards.	"
27	Bolton.	"
35	Clinton.	"
45	Jackson.	"
59	Brandon.	"
70	Pelahatchie.	"
79	Morton.	"
90	Forest.	"
100	Lake.	"
109	Newton.	"
122	Chunky.	"
140	Meridian.	"

Louisiana.*

GEOLOGICAL FORMATIONS OF LOUISIANA:

General Table.	Louisiana Formations.
20. Quaternary.	20 c. Alluvium.
"	20 b. Bluff.
"	20 a. Drift.
19. Tertiary.	19 c. Grand Gulf.
"	19 b. Vicksburg.
"	19 a. Jackson.
18. Cretaceous.	18. Cretaceous.

Ms. | Vicksburg, Shreveport & Texas R. R.

0	Delta.	20 c. Alluvium.
10	California.	"
17	Tallulah.	"
24	Quebec.	"
35	Delhi.	20 b. Bluff.
47	Bee Bayou.	"
54	Girard.	"
64	Gordon.	20 c. Alluvium.
71	Monroe.	"

Texas and Pacific Railroad.
Marshall and Shreveport Division.

0	Shreveport.	19 a. Jackson, Tertiary.
8	Beckville.	"
10	Greenwood.	"
	(Continued in Texas.)	

New Orleans and Mobile Railroad.

0	New Orleans.	20 c. Alluvium.
9	Lee.	"
20	Chef Menteur.	"
31	Rigolet's.	"
	(Continued in Mississippi.)	

Ms. | Morgan's Louisiana and Texas R. R.

0	Algiers.	20 c. Alluvium.
3	Gretna.	"
12	Jefferson.	"
18	St. Charles.	"
24	Boutte.	"
32	Des Allemands.	"
40	Raceland.	"
46	Ewings.	"
52	Lafourche.	"
55	Terrebonne.	"
61	Chucahoula.	"
66	Tigerville.	"
73	Bayou City.	"
80	Morgan City.	"

New Orleans, St. Louis and Chicago R. R.

0	New Orleans.	20 c. Alluvium.
10	Kenner.	"
37	Manchac.	"
52	Hammond.	20 b. Bluff.
60	Amite.	"
74	Tangipahoa.	19 c. Grand Gulf, Ter'y.
75	Osyka.	"
	(Continued in Mississippi.)	

* From Prof. F. V. Hopkins' (late State Geologist) map of his Geological Reconnoissance of Louisiana, and revised by him.

Arkansas.*

GENERAL GEOLOGY OF THE STATE.—Dividing the State diagonally from northeast to southwest, beginning near the eastern boundary of Randolph county and running thence past Grand Glaise and Little Rock, through to Fulton in Hempstead county on Red River, (consequently nearly in the line of the St. Louis, Iron Mountain and Southern Railroad), almost all the State, *east* of said line, will be found of the 19. Tertiary formation, except along the river bottoms, where it is 20. Quaternary. The northern portion, *west* of said line, is mostly 2-8. Silurian, with some 9-12. Devonian and 14. Carboniferous, further south; the middle western part of the State being 14. Carboniferous, while the southwest part (namely, from Arkadelphia and Murfreesboro south and west) will be found 18. Cretaceous.

In consequence of the above general arrangement of the geological formations in the State, it will be readily perceived that the St. Louis, Iron Mountain and Southern Railroad runs mainly near the junction between the Silurian, Carboniferous and Cretaceous of the west side, and the 19. Tertiary, with some 30. Quaternary, of the east side. Further, that the Arkansas Central is chiefly in the 19. Tertiary and 20. Quaternary, while the Little Rock and Fort Smith Railroad passes through the 14. Carboniferous formation; also, that the Memphis and Little Rock Railroad runs through 19. Tertiary and 20. Quaternary.

The expression, "Quaternary over Silurian," is intended to indicate that the superficial deposits of the locality, opposite which the remark is placed, are Quaternary; but that when lower formations are exposed by denudation, &c., they would be found Silurian. A similar interpretation is designed to be given to "Tertiary over Cretaceous," and the like expressions. R. O.

Ms.	Arkansas Central Railroad.	
0	Helena.	20. Quat. over 19. Ter.
10	Bushville.	"
21	Marvell.	"
30	Palmer's.	"
40	Duncan.	"
48	Clarendon.	"

	St. Louis, Iron Mountain and Southern R.R.	
186	Moark.	20. Quat. over Silurian.
192	Corning.	"
203	Peach Orchard.	"
214	O'Kean.	"
225	Walnut Ridge.	"
232	Minturn.	"
244	Swifton.	"
262	Newport.	"
273	Grand Glaise.	14 a. Millstone Grit.
278	Bradford.	"
292	Judsonia.	"
305	Garner.	"
312	Beebe.	"
320	Austin.	"
332	Jacksonville.	"
345	Little Rock.	14. Carboniferous.
355	Mabelvale.	"
368	Benton.	"
388	Malvern.	"
410	Arkadelphia.	Junction of 14. Carb., 18. Creta. & 19. Ter.
437	Boughton.	19. Ter. over 18. Creta.
449	Emmet.	"
457	Hope.	"
471	Fulton.	"
490	Texarkana.	"

Ms.	Arkansas Central Railroad—*Continued.*	
388	Malvern.	14. Carboniferous.
406	Lawrence.	"
413	Hot Springs.	"

Ms.	Little Rock and Fort Smith Railroad.	
0	Argenta.	14. Carboniferous.
10	Warren.	"
30	Conway.	"
44	Plummerville.	"
63	Atkins.	"
75	Russellville.	"
83	Georgetown.	"
95	Cabin Creek.	"
101	Clarksville.	"
125	Ozark.	"
150	Alma.	"
159	Van Buren.	"
168	Cherokee.	"

	Memphis and Little Rock Railroad.	
0	Memphis.	20. Quat. over 19. Ter.
12	Riceville.	"
17	Edmondson's.	"
33	Black Fish Siding.	"
41	Madison.	19. Tertiary.
53	Palestine.	"
65	Wheatley.	"
70	Brinkley.	"
87	De Vall's Bluff.	19. Ter. over Mills. Grit.
94	Hazen's.	"
103	Carlisle.	"
112	Lonoke.	"
125	Galloway.	"
135	Little Rock.	14. Carboniferous.

* Prepared by Prof. Richard Owen, of Bloomington, Indiana.

Texas.

International and Great Northern Railroad.

Ms.		
	Galveston.	20. Quat. or Alluvium.
0	Houston.	"
23	Spring.	19. Tertiary.
47	Willis.	"
66	Phelps.	"
85	Trinity.	"
99	Lovelady.	"
114	Crockett.	"
127	Grapeland.	"
139	Elkhart.	"
152	Palestine.	"
164	Neches.	"
180	Jacksonville.	"
198	Troupe.	"
211	Overton.	"
223	Kilgore.	"
235	Longview.	"
259	Marshall.	"
275	Jefferson.	"
334	Texarkana.	18. Cretaceous.
	Austin.	"
0	Duval.	"
16	Hutto.	19. Tertiary.
50	Rockdale.	"
80	Hearne.	"
94	Englewood.	"
114	Marquez.	"
125	Jewett.	"
152	Oakwoods.	"
169	Palestine.	"
0	Troupe.	"
19	Tyler.	18. Cretaceous.
44	Mineola.	"

Columbia Division.

0	Columbia.	20. Quaternary.
18	China Grove.	"
30	Houston.	"

Texas and Pacific Railroad.

Trans-Continental Division.

0	Texarkana.	18. Cretaceous.
17	Whaleys.	"
34	De Kalb.	"
52	Walkers.	"
67	Begwell's.	"
90	Paris.	"
111	Honey Grove.	"
138	Savoy.	"
154	Sherman.	"

Jefferson and Southern Division.

0	Texarkana.	18. Cretaceous.
16	Sulphur.	19. Tertiary.
44	Kildare.	"
74	Marshall.	"
98	Longview.	"

Texas and Pacific Railroad—*Continued.*

Ms.		
116	Manthis.	19. Tertiary.
143	Minneola.	"
157	Grand Saline.	"
174	Wills Point.	"
190	Terrell.	"
209	Mesquite.	"
222	Dallas.	"
241	Arlington.	"
254	Fort Worth.	"

Houston and Texas Central Railroad.

0	Houston.	19. Tertiary.
18	Thompson.	"
35	Hockley.	"
50	Hempstead.	"
70	Navasota.	"
99	Bryan.	"
120	Hearne.	18. Cretaceous.
142	Bremond.	"
161	Thornton.	"
181	Mexia.	"
211	Corsicana.	"
239	Palmer.	"
265	Dallas.	"
296	McKinney.	"
329	Sherman.	"
338	Denison.	14. Carboniferous ?

Western Division.

0	Hempstead.	19. Tertiary.
21	Brenham.	"
46	Ledbetter.	"
78	MacDade.	"
115	Austin.	18. Cretaceous.

Waco Branch.

0	Bremond.	18. Cretaceous.
45	Waco.	"

Galveston, Harrisburg & San Antonio R. R.

0	Harrisburg.	20. Quaterary.
21	Stafford.	18. Tertiary.
33	Richmond.	"
52	East Bernard.	"
68	Eagle Lake.	"
84	Columbus.	"
109	Schulenburg.	"
146	Harwood.	"
166	Kingsbury.	"
176	Seguin.	"
181	Marion.	"

Gulf, Western Texas and Pacific Railroad.

0	Indianola.	
25	Placedo.	
55	Thomaston.	
70	Cuero.	

Indian Territory.

Ms.	Missouri, Kansas and Texas Railroad.	
355	Vinita.	14 b. Coal Measures.
379	Pryor Creek.	"
388	Choteau.	"
410	Gibson.	"
419	Muskogee.	"
449	Eufala.	"
470	Reams.	"
479	McAllister.	"
491	Savanna.	"
506	Limestone Gap.	"
525	Atoka.	"
536	Caney.	"
544	Caddo.	"

Ms.	Missouri, Kansas and Texas Railroad—*Continued.*	
556	Durant.	14 b. Coal Measures.
568	Colbert.	"
576	Denison.	"

	Atlantic and Pacific Railroad.	
337	Shawnee.	14 b. Coal Measures.
342	Prairie City.	"
348	Oseuma.	"
353	Afton.	"
358	Albia.	"
364	Vinita.	"

Florida.

Ms.	Jacksonville, Pensacola and Mobile Railroad.	
0	Chattahoochee.	20. Quat'y or Alluvium.
11	Mt. Pleasant.	"
20	Quincy.	"
32	Midway.	"
44	Tallahassee.	"
56	Chaires'.	"
62	Lloyd's.	"
71	Drifton.	"
78	Aucilla.	"
85	Greenville.	19. Later Tertiary.
99	Madison.	"
114	Ellaville.	20. Quat'y or Alluvium.
127	Live Oak.	"
138	Welborn.	"
150	Lake City.	"
162	Olustee.	"
172	Sanderson.	"
181	Darbyville.	"
190	Baldwin.	"
198	White House.	"
206	Jacksonville.	"
0	Tallahassee.	"
21	St. Marks.	"
0	Drifton.	"
4	Monticello.	"

Ms.	Atlantic and Gulf Railroad.	
	Jasper.	20. Quat'y or Alluvium.
	Live Oak.	"

	Atlantic, Gulf and West India Transit Company's Railroad.	
0	Fernandina.	20. Quat'y or Alluvium.
12	Hart's Road.	"
27	Callahan.	"
36	Dutton.	"
47	Baldwin.	"
62	Trail Ridge.	"
73	Starke.	"
84	Waldo.	"
98	Gainesville.	"
104	Arredondo.	"
113	Archer.	"
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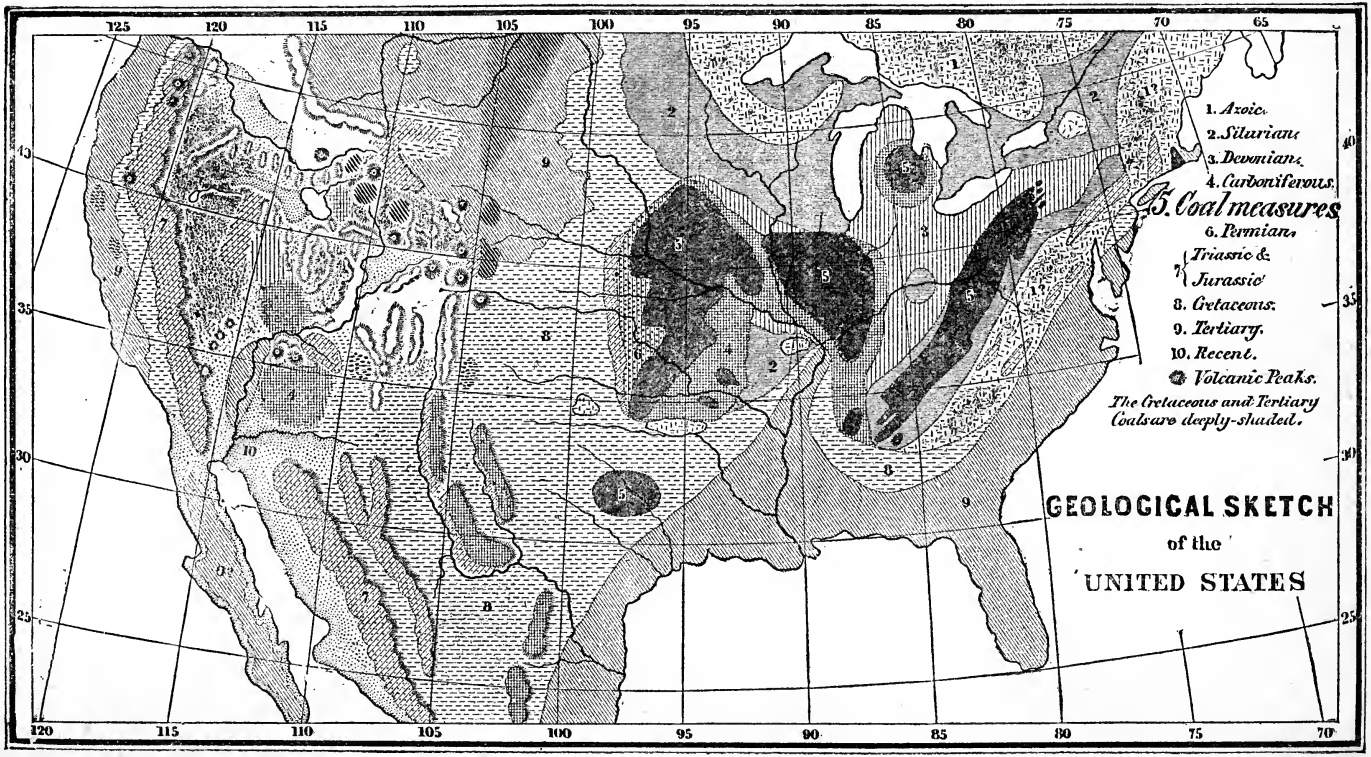
1. Azoic.
2. Silurian.
3. Devonian.
4. Carboniferous.
5. Coal measures
6. Permian.
7. Triassic & Jurassic
8. Cretaceous.
9. Tertiary.
10. Recent.
Volcanic Peaks.
The Cretaceous and Tertiary Coals are deeply-shaded.
GEOLOGICAL SKETCH
of the
UNITED STATES

CHRONOLOGY OF SOME OF THE OLDER IMPORTANT RAILROADS.

The several parts of what is now the NEW YORK CENTRAL AND HUDSON RIVER RAILROAD were completed at the following dates:

Albany to Schenectady	1831,	17 miles.
Schenectady to Utica	1836,	78 "
Buffalo to Niagara Falls	1837,	22 "
Rochester to Attica (Tonawanda Railroad)	1837,	42 "
Utica to Syracuse	1839,	53 "
Syracuse to Auburn (twenty-two miles in 1838)	1839,	26 "
Auburn to Rochester	August, 1841,	78 "
Buffalo to Attica	December, 1842,	32 "
Line completed, Albany to Buffalo (gap of one mile filled)	1845.	
Schenectady to Troy	1842,	21 "
Troy to Greenbush	1845,	6 "
Batavia to Niagara Falls (afterward taken up)	July 1, 1853,	36 "
Batavia to Buffalo (direct road)	1850,	69 "
Niagara Falls to Suspension Bridge	April 1, 1854,	3 "
Suspension Bridge to Lewiston	1854,	6 "
Rochester to Syracuse (direct road)	1853,	81 "
Rochester to Lockport and Suspension Bridge	July 1, 1852,	75 "
Buffalo to Lockport	1854,	26 "
Canandaigua to Batavia	January 1, 1853,	50 "
Schenectady to Athens (Athens branch)	1865,	41 "
New York Central Railroad, Albany to Buffalo (13 corporations) consolidated	May 1, 1853.	

Hudson River Railroad:

New York to Peekskill	September 29, 1849,	41 miles.
Peekskill to New Hamburg	December 6, 1849,	23 "
New Hamburg to Poughkeepsie	December 31, 1849,	9 "
East Albany to Hudson	June 16, 1851,	28 "
Hudson to Oakhill	July 7, 1851,	6 "
Oakhill to Tivoli	August 4, 1851,	10 "
Tivoli to Poughkeepsie	October 3, 1851,	25 "
Line, New York to East Albany (and to Buffalo), completed	October 3, 1851,	142 "
New York Central and Hudson River Railroads consolidated	November 1, 1869.	
New York and Harlem Railroad completed	January 19, 1852,	127 "

The several sections of the ERIE RAILWAY (now the New York, Lake Erie and Western) were opened at the following dates:

Piermont to Goshen	September, 1841,	46 miles.
Goshen to Middletown	June 7, 1843,	7 "
Middletown to Otisville	November 3, 1846,	8 "
Otisville to Port Jervis	January 6, 1848,	13 "
Port Jervis to Binghamton	December 28, 1848,	127 "
Binghamton to Owego	June 1, 1849,	22 "
Owego to Elmira	October, 1849,	37 "
Elmira to Corning	January 1, 1850,	17 "

Corning to Hornellsville	September 3, 1850,	41 miles.
Hornellsville to Dunkirk	April 22, 1851,	128 "
Whole line opened	April 22, 1851,	446 "
Hornellsville to Buffalo	1852,	92 "
Newburg branch	1850,	18 "
Corning to Avon (August 2, 1852, to Wayland)	1853,	76 "
Avon to Rochester	August, 1854,	19 "
Avon to Mt. Morris	June, 1859,	16 "
Avon to Le Roy	1853,	14 "
Le Roy to Batavia	1854,	10 "
Attica to Batavia	June 20, 1858,	11 "
Ithaca to Owego (now Delaware, Lackawanna and Western)	April 1, 1834,	33 "
Elmira to Watkins (now Northern Central Railroad)	December 16, 1849,	17 "
Watkins to Canandaigua (now Northern Central Railroad)	September 15, 1851,	47 "
Corning to Blossburg	1840,	41 "

BALTIMORE AND OHIO RAILROAD:

Baltimore to Ellicott's Mills (the first passenger railroad in the United States)	1830.
Baltimore to Washington	August 25, 1835.
Baltimore to Harper's Ferry	1834.
Baltimore to Cumberland	1842.
Baltimore to Wheeling	1853.
Baltimore to Parkersburg	May 1, 1857.

PENNSYLVANIA RAILROAD:

Philadelphia to Columbia (by the State of Pennsylvania)	1834.
Allegheny Mountain Portage Railroad	1834.
Philadelphia to Pittsburg by Pennsylvania Railroad and the State Portage Railroad	December 10, 1852.
Philadelphia to Pittsburg, by Pennsylvania Railroad, completed	February 15, 1854.

BOSTON AND ALBANY RAILROAD:

Boston to Worcester	July 4, 1835.
Worcester to Albany	December 21, 1841.

BOSTON, MASS., TO OGDENSBURG, NEW YORK ..... 1851.

CENTRAL RAILROAD OF NEW JERSEY (Easton to New York) ..... 1852.

LAKE SHORE AND MICHIGAN SOUTHERN RAILROAD:

Toledo to Chicago	March 22, 1852.
Buffalo to Pennsylvania Line	February 22, 1852.

CHICAGO, BURLINGTON AND QUINCY ..... 1854.

CHICAGO, ROCK ISLAND AND PACIFIC ..... 1854.

ILLINOIS CENTRAL (Main line) ..... December 28, 1855.

OHIO AND MISSISSIPPI (Cincinnati to St. Louis) ..... 1860.

CHICAGO AND NORTH-WESTERN to the Mississippi River at Fulton ..... July 3, 1862.

UNION PACIFIC RAILROAD AND CENTRAL PACIFIC RAILROAD:

Omaha to San Francisco	May 10, 1869.

THE COAL-REGIONS OF AMERICA:

Their Topography, Geology, and Development.

With a Colored Geological Map of Pennsylvania; a Railroad Map of all the Coal Regions; 24 other Maps, showing each County in all the States containing Coal; 15 full page and 25 smaller Illustrations.

By JAMES MACFARLANE, Ph. D.

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The facts are derived from the best sources, the reports of the several State Geological Surveys having been carefully studied, and later materials added from coal companies' reports and other sources, or derived from personal observations in the course of business, and in visiting the coal-regions.

The chapter on each State gives a full account of its coal-region, describing its geographical situation by counties, its topography, area, and geological structure, giving particularly the series of coal-strata, the number, size, and characteristics of its coal-beds, the quality and analysis of its coal, its advantages and disadvantages for mining, the state of its development, the statistics of its production, and any other facts of special interest.

The Appendix contains useful information, applicable to all the coal-regions, on the geology of coal, the combustion of coal, the conditions of success in the coal-trade, and the latest statistics of the coal mined in, and sketches of the coal-fields of all parts of the world.

It has become a standard authority on this subject, and it has been pronounced by the State Geologists and best critics to be a work of real merit, containing such a collection of accurate, interesting, and useful information of permanent importance and value, not to be found elsewhere, as has given it a wide circulation, and made it a valuable addition to every library.

Third Edition, 1877. One handsome octavo volume of 700 pages. Bound in Cloth, $5.00; Leather, $6.00. Sent by mail post-paid, on receipt of the price.

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A NEW SUMMER-RESORT.

GREEN LAKE, *Five Miles South of Syracuse, New York, and One Mile West of Jamesville on the Delaware, Lackawanna and Western Railroad.*

A Magnificent Exposure of the Upper Helderberg Limestone. Extraordinary Geological Phenomena. Grand and Beautiful Scenery.

THERE are very remarkable precipices of Onondaga and Corniferous limestone, or the Upper Helderberg group, surrounding Green Lake, quite near the old stage-road leading from Albany to Buffalo. It is a pleasant walk of one mile, by a dry turnpike from Jamesville station; or it can be reached by a short drive from Syracuse, either *via* Brighton, the shortest road, or by Onondaga Valley, or by the Jamesville turnpike—all of them excellent roads with fine scenery.

On approaching the lake from the turnpike on the south side, the tourist is startled at finding himself, without any notice, on the brink of a yawning gulf, precisely like that of the Niagara River below the Falls, and nearly as deep. The rocks form perpendicular precipices of greater height and extent here, and in this vicinity, than in any other locality of this formation in the United States; and they present many features of the highest interest to the geologist, and to all who enjoy a scene of beauty and grandeur.

The brink of the chasm has been fringed by Nature, as no art could have done it, with arbor vitæs (*Thuja occidentalis, L.*) and cedars (*Cupressus thyoides, L.*), growing in the crevices of the limestones, and between these may be obtained beautiful glimpses of the lake, the rocks, and the gorge; and at many points, on the projecting table rocks, are full views of one of the most surprising and picturesque landscapes in this part of the country. It can be best described by imagining that a circular mass of the limestones, a quarter of a mile in diameter, had suddenly sunk into the bowels of the earth, thus forming a chasm on the flat top of the Helderberg range, three hundred feet deep, with very high, perpendicular walls of hard limestone, extending nearly all around the depression. A circular lake of greenish-colored, pure water, of unknown depth, covering about ten acres, fills the whole of the interior. The scene at even a first view is very fine, and is so out of the usual way as greatly to surprise the beholder and leave a lasting impression on his memory. It is not a ravine or cañon; there is no stream of water whatever, and no place where one could ever have existed, and the lake, which glistens deep down in the gulf, has no visible outlet, the bottom of the gap being above the level of the water, which probably finds its outlet through crevices in the underlying limestones.

But the interest is increased when we have passed around the lake and seen the other depressions with which it is surrounded, and studied their meaning and history, or the method of their formation. First go eastward, toward the only gap in the rocky walls, or the place where the outlet of the lake should be, if it had one. The upper surface of the Onondaga limestone is extensively exposed, forming a flat pavement on the south and north sides of the lake, extending to the brink of the precipice. The natural joints of the rock are greatly enlarged, forming wide crevices and round holes extending down into the solid rock, every edge and corner being thoroughly rounded and water-worn, in an extraordinary manner, as it could only have been done by the dashing shore-

waves of an ancient sea of which this was the coast. Through the openings in the thicket of beautiful young cedars, you get new views of the amphitheatre, and of its perfectly circular form. The cliff maintains its height until, at the gap, you find yourself on a lofty pinnacle of rock, overlooking the narrow pass, like a sentinel-tower placed to guard the entrance from all intruders. But on glancing to your right, or to the eastward, you find you are on a narrow point of rock, scarcely ten feet in width, with a deep gulf in front and one on either hand. On tracing the eastern margin of this elevated wall of rock, for it is little more, and which we will call Sentinel Point, you find it is a long, very narrow rib of rock, separating Green Lake from another, similar circular depression east of it, in which at present there is no water, but which fills up and overflows in the spring of the year. Nothing can exceed the steepness of the slope or rather precipice, and the forest is too dense and dark to see its bottom or extent. The young and vigorous may explore it; but the most impressive views are from above, and these may all be seen without laborious walking.

Returning past your first point of observation, you now go to the western part of the circular gorge. All around three-fourths of this principal cavity is the same perpendicular precipice of the upper and harder limestone; and even that of the Water Lime group below, extending to the water, although covered with trees, has a very precipitous slope. The lake itself is absolutely inaccessible without a staircase of two hundred steps at the lowest point of the rocks, except at its natural gap on the east side, where a gateway would convert it into a prison or Botany Bay. It was the weight, strength and toughness of the Onondaga Limestone, that have preserved it, to become the huge cornice of this roofless temple. Here at the west, just as at the south and north sides, the horizontal strata forming the chasm are unbroken; but there is only a narrow neck of rock, of an irregular form, about sixty feet wide, west of which is a third depression similar to that of Green Lake, also forming a circle, but smaller in size and easy of access, with the Water Lime group exposed at the bottom. It has no water in it, but is covered with pasturage and young cedars. On the west side, the Corniferous limestone rises to a great height, forming the loftiest part of the tract. The rocks are less abrupt than around Green Lake, in fact forming slopes and terraces. The Coliseum of Rome could here be reconstructed, the sloping, rocky walls forming the seats for the audience, and much of it is quite as high as the walls of the original Coliseum, which were 162 feet. The interior, where the bottom fell out, represents the arena. The regular basin-like manner in which the rock has been broken off in a circular form, and sunk directly downward, is quite apparent; and, as the periphery is perfect, it seems impossible that the material could have been carried away by running water, as it has no gap or outlet, as the parent Green Lake has. It requires no practical or theoretical knowledge of geology to contrast the worn and rounded appearance of the extensive bare pavement, both on the south and north sides of the lake, which was evidently eaten away by the angry waves of an ancient ocean, with the sharp and quarry-like edges of all the rocks exposed in all of these great depressions. The high slender headland of Sentinel Point could not have stood a week exposed to such a sea. The proof is strong that the depressions were not worn out by water, either of a river or of an ocean, or by glacial action, but by the sinking of the material, the broken fragments of

which were engulfed beneath the waters of the lake, and in the dark depths of the other depressions.

If you now pass around to the north side of the principal chasm or Green Lake, you will find the walls of rock are considerably higher than on the south side, the elevation imparting grandeur to the scene. But, as you go eastward over the limestone pavement, honeycombed into large, open joints, and with its curious, round, water-worn holes, you will find yourself again, not, as you expected, on a wide, level plateau extending northward, but on another high, narrow wall similar to Sentinel Point; but this is a mole, not a promontory, and extends around this side of the lake nearly to the gap, separating the valley of Green Lake from two others of these remarkable deep depressions lying immediately north of it. They are very large, deep, dark, crater-like sink-holes, covered with heavy timber. Days might be spent in exploring the precipices and gorges in these cool forests. It is less than a quarter of a mile northward to the fine precipices which overlook the Delaware, Lackawanna and Western or Syracuse and Binghamton Railway, between Jamesville and Syracuse, affording magnificent views of Butternut Creek Valley. There is here also a very curious cave, of considerable extent, caused by the front of the cliff sinking, owing to its foundation giving way, and separating a great mass or pillar of the rock from the main body, producing a very deep fissure. It is an unfinished avalanche. Broken pieces of the upper part of the rock afterward fell into the opening, arching it over. There is a similar and larger cave farther west.

The most probable explanation of the general structure of this whole locality is, that all these depressions are sink-holes, and that their subsidence was caused by the former existence in the underlying Onondaga Salt group, beneath these limestones, of large beds of rock-salt—the most soluble of rocks—which were destroyed by underground solution, and that these singular depressions, Green Lake and those that surround it, and probably other important features in Central New York, have been caused by the consequent subsidence of the strata. The ancient sea, which has eaten out the surface of the overlying Onondaga limestone pavement, as above described, furnished the dissolving power, wearing great cavities in the salt-beds. With such an exposure, their destruction was inevitable. The solution was irregular, and the sinking corresponds to it—the narrow ribs of rock between the depressions being sustained either by similar ribs of salt saved from destruction, or, as is more probable, by the broken materials which fell into the cavities in such a way as to sustain the circumference of the pits. Their form indicates some unusual origin, and, accepting the explanation or theory of their formation, it appeals to the imaginative powers to fancy when the cataclysm occurred, and what were the sights and sounds that attended it, which there was no eye to see and no ear to hear. It is true that no rock-salt has ever been found in Onondaga County, salt being here extensively manufactured from brine, the source of which is only a matter of conjecture; but no search has ever been made for it under the limestone, where alone it could be protected. A bed of rock-salt, seventy feet thick, was found in June, 1878, at Wyoming, New York, thirty-seven miles southwest of Rochester, in a deep boring penetrating through the overlying formations into the Onondaga salt-group; and at Goderich, in Western Canada, beds of rock-salt from seventy to one hundred and twenty-six feet in thickness have been dis-

covered in this same formation. Green Lake is situated where the Salina or Onondaga salt-group is much thicker than it is farther west. This being the central and deepest part of the ancient inland sea, the evaporation of whose waters left the deposit of salt, it is but fair to infer that the salt-beds were here at their maximum thickness. In other parts of the world there are beds of salt measuring thousands of feet in thickness.

A practical conclusion is that the salt-beds should not be searched for where there is evidence of subsidence having taken place, but only in districts where the strata have never been disturbed.

Whatever explanation Science may ultimately give of the formation of Green Lake, it requires no scientific knowledge to see that it is a very remarkable, interesting, and beautiful place in a state of Nature; and that, with but slight improvement, it would deserve to rank with the best of American summer-resorts. The property has been lately purchased by James Macfarlane, Esq., of Towanda, Pennsylvania, the geologist, and he will soon cause it to be prepared for visitors in 1879, and such improvements to be made as the public patronage may warrant. To the neighboring city of Syracuse, five hundred feet below it, and all Central New York, it will supply what may be called a public want, as there is nothing in the vicinity to be compared with Green Lake.

September 2, 1878.