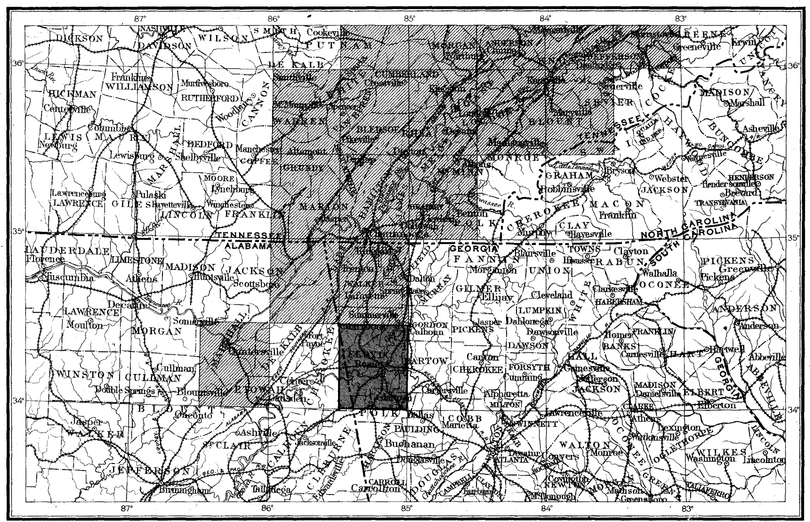
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

GEOLOGIC ATLAS
OF THE
UNITED STATES

ROME FOLIO
GEORGIA - ALABAMA

INDEX MAP



SCALE: 40 MILES-1 INCH

■ AREA OF THE ROME FOLIO

▨ AREA OF OTHER PUBLISHED FOLIOS

LIST OF SHEETS

DESCRIPTION
TOPOGRAPHY
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ECONOMIC GEOLOGY
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COLUMNAR SECTIONS

FOLIO 78
LIBRARY EDITION
ROME

WASHINGTON, D. C.
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GEORGE W. STOSE, EDITOR OF GEOLOGIC MAPS S. J. KÜBEL, CHIEF ENGRAVER
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EXPLANATION.

The Geological Survey is making a geologic map of the United States, which necessitates the preparation of a topographic base map. The two are being issued together in the form of an atlas, the parts of which are called folios. Each folio consists of a topographic base map and geologic maps of a small area of country, together with explanatory and descriptive texts.

THE TOPOGRAPHIC MAP.

The features represented on the topographic map are of three distinct kinds: (1) inequalities of surface, called *relief*, as plains, plateaus, valleys, hills, and mountains; (2) distribution of water, called *drainage*, as streams, lakes, and swamps; (3) the works of man, called *culture*, as roads, railroads, boundaries, villages, and cities.

Relief.—All elevations are measured from mean sea level. The heights of many points are accurately determined, and those which are most important are given on the map in figures. It is desirable, however, to give the elevation of all parts of the area mapped, to delineate the horizontal outline, or contour, of all slopes, and to indicate their grade or degree of steepness. This is done by lines connecting points of equal elevation above mean sea level, the lines being drawn at regular vertical intervals. These lines are called *contours*, and the uniform vertical space between each two contours is called the *contour interval*. Contours and elevations are printed in brown.

The manner in which contours express elevation, form, and grade is shown in the following sketch and corresponding contour map:

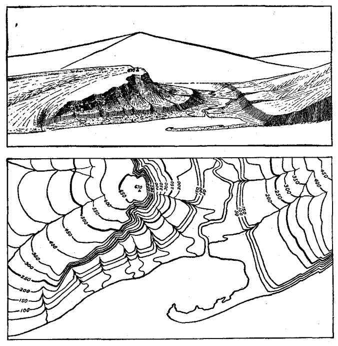


Fig. 1.—Ideal sketch and corresponding contour map.

The sketch represents a river valley between two hills. In the foreground is the sea, with a bay which is partly closed by a hooked sand bar. On each side of the valley is a terrace. From the terrace on the right a hill rises gradually, while from that on the left the ground ascends steeply in a precipice. Contrasted with this precipice is the gentle descent of the slope at the left. In the map each of these features is indicated, directly beneath its position in the sketch, by contours. The following explanation may make clearer the manner in which contours delineate elevation, form, and grade:

1. A contour indicates approximately a certain height above sea level. In this illustration the contour interval is 50 feet; therefore the contours are drawn at 50, 100, 150, 200 feet, and so on, above sea level. Along the contour at 250 feet lie all points of the surface 250 feet above sea; and similarly with any other contour. In the space between any two contours are found all elevations above the lower and below the higher contour. Thus the contour at 150 feet falls just below the edge of the terrace, while that at 200 feet lies above the terrace; therefore all points on the terrace are shown to be more than 150 but less than 200 feet above sea. The summit of the higher hill is stated to be 670 feet above sea; accordingly the contour at 650 feet surrounds it. In this illustration nearly all the contours are numbered. Where this is not possible, certain contours — say every fifth one — are accentuated and numbered; the heights of others may then be ascertained by counting up or down from a numbered contour.

2. Contours define the forms of slopes. Since contours are continuous horizontal lines conforming to the surface of the ground, they wind smoothly about smooth surfaces, recede into all reentrant angles of ravines, and project in passing about prominences. The relations of contour curves and angles to forms of the landscape can be traced in the map and sketch.

3. Contours show the approximate grade of any slope. The vertical space between two contours is the same, whether they lie along a cliff or on a gentle slope; but to rise a given height on a gentle slope one must go farther than on a steep slope, and therefore contours are far apart on gentle slopes and near together on steep ones.

For a flat or gently undulating country a small contour interval is used; for a steep or mountainous country a large interval is necessary. The smallest interval used on the atlas sheets of the Geological Survey is 5 feet. This is used for regions like the Mississippi delta and the Dismal Swamp. In mapping great mountain masses, like those in Colorado, the interval may be 250 feet. For intermediate relief contour intervals of 10, 20, 25, 50, and 100 feet are used.

Drainage.—Water courses are indicated by blue lines. If the streams flow the year round the line is drawn unbroken, but if the channel is dry a part of the year the line is broken or dotted. Where a stream sinks and reappears at the surface, the supposed underground course is shown by a broken blue line. Lakes, marshes, and other bodies of water are also shown in blue, by appropriate conventional signs.

Culture.—The works of man, such as roads, railroads, and towns, together with boundaries of townships, counties, and States, and artificial details, are printed in black.

Scales.—The area of the United States (excluding Alaska) is about 3,025,000 square miles. On a map with the scale of 1 mile to the inch this would cover 3,025,000 square inches, and to accommodate it the paper dimensions would need to be about 240 by 180 feet. Each square mile of ground surface would be represented by a square inch of map surface, and one linear mile on the ground would be represented by a linear inch on the map. This relation between distance in nature and corresponding distance on the map is called the scale of the map. In this case it is "1 mile to an inch." The scale may be expressed also by a fraction, of which the numerator is a length on the map and the denominator the corresponding length in nature expressed in the same unit. Thus, as there are 63,360 inches in a mile, the scale of "1 mile to an inch" is expressed by $\frac{1}{63,360}$. Both of these methods are used on the maps of the Geological Survey.

Three scales are used on the atlas sheets of the Geological Survey; the smallest is $\frac{1}{250,000}$, the intermediate $\frac{1}{125,000}$, and the largest $\frac{1}{62,500}$. These correspond approximately to 4 miles, 2 miles, and 1 mile on the ground to an inch on the map. On the scale $\frac{1}{62,500}$ a square inch of map surface represents and corresponds nearly to 1 square mile; on the scale $\frac{1}{125,500}$, to about 4 square miles; and on the scale $\frac{1}{250,000}$, to about 16 square miles. At the bottom of each atlas sheet the scale is expressed in three different ways, one being a graduated line representing miles and parts of miles in English inches, another indicating distance in the metric system, and a third giving the fractional scale.

Atlas sheets and quadrangles.—The map is being published in atlas sheets of convenient size, which are bounded by parallels and meridians. The corresponding four-cornered portions of territory are called *quadrangles*. Each sheet on the scale of $\frac{1}{250,000}$ contains one square degree, i. e., a degree of latitude by a degree of longitude; each sheet on the scale of $\frac{1}{125,000}$ contains one-quarter of a square degree; each sheet on a scale of $\frac{1}{62,500}$ contains one-sixteenth of a square degree. The areas of the corresponding quadrangles are about 4000, 1000, and 250 square miles, respectively.

The atlas sheets, being only parts of one map of the United States, are laid out without regard to the boundary lines of the States, counties, or townships. To each sheet, and to the quadrangle it represents, is given the name of some well-known town or natural feature within its limits, and at the sides and corners of each sheet the names of adjacent sheets, if published, are printed.

Uses of the topographic sheet.—Within the limits of scale the topographic sheet is an accurate and characteristic delineation of the relief, drainage, and culture of the district represented. Viewing the landscape, map in hand, every characteristic feature of sufficient magnitude should be recognizable. It should guide the traveler; serve the investor or owner who desires to ascertain the position and surroundings of property to be bought or sold; save the engineer preliminary surveys in locating roads, railways, and irrigation ditches; provide educational material for schools and homes; and serve many of the purposes of a map for local reference.

THE GEOLOGIC MAP.

The maps representing areal geology show by colors and conventional signs, on the topographic base map, the distribution of rock formations on the surface of the earth, and the structure-section map shows their underground relations, as far as known and in such detail as the scale permits.

KINDS OF ROCKS.

Rocks are of many kinds. The original crust of the earth was probably composed of *igneous rocks*, and all other rocks have been derived from them in one way or another.

Atmospheric agencies gradually break up igneous rocks, forming superficial, or *surficial*, deposits of clay, sand, and gravel. Deposits of this class have been formed on land surfaces since the earliest geologic time. Through the transporting agencies of streams the surficial materials of all ages and origins are carried to the sea, where, along with material derived from the land by the action of the waves on the coast, they form *sedimentary rocks*. These are usually hardened into conglomerate, sandstone, shale, and limestone, but they may remain unconsolidated and still be called "rocks" by the geologist, though popularly known as gravel, sand, and clay.

From time to time in geologic history igneous and sedimentary rocks have been deeply buried, consolidated, and raised again above the surface of the water. In these processes, through the agencies of pressure, movement, and chemical action, they are often greatly altered, and in this condition they are called *metamorphic rocks*.

Igneous rocks.—These are rocks which have cooled and consolidated from a liquid state. As has been explained, sedimentary rocks were deposited on the original igneous rocks. Through the igneous and sedimentary rocks of all ages molten material has from time to time been forced upward to or near the surface, and there consolidated. When the channels or vents into which this molten material is forced do not reach the surface, it may consolidate in cracks or fissures crossing the bedding planes, thus forming dikes, or spread out between the strata in large bodies, called sheets or laccoliths, or form large irregular cross-cutting masses, called stocks. Such rocks are called *intrusive*. Within their rock inclosures they cool slowly, and hence are generally of crystalline texture. When the channels reach the surface the lavas often flow out and build up volcanoes. These lavas cool rapidly in the air, acquiring a glassy or, more often, a partially crystalline condition. They are usually more or less porous. The igneous rocks thus formed upon the surface are called *extrusive*. Explosive action often accompanies volcanic eruptions, causing ejections of dust or ash and larger fragments. These materials when consolidated constitute breccias, agglomerates, and tuffs. The ash when carried into lakes or seas may become stratified, so as to have the structure of sedimentary rocks.

The age of an igneous rock is often difficult or impossible to determine. When it cuts across a sedimentary rock it is younger than that rock, and when a sedimentary rock is deposited over it the igneous rock is the older.

Under the influence of dynamic and chemical forces an igneous rock may be metamorphosed. The alteration may involve only a rearrangement of its minute particles or it may be accompanied by a change in chemical and mineralogic composition. Further, the structure of the rock may be changed by the development of planes of division, so that it splits in one direction more easily than in others. Thus a granite may pass into a gneiss, and from that into a mica-schist.

Sedimentary rocks.—These comprise all rocks which have been deposited under water, whether in sea, lake, or stream. They form a very large part of the dry land.

When the materials of which sedimentary rocks are composed are carried as solid particles by water and deposited as gravel, sand, or mud, the deposit is called a mechanical sediment. These may become hardened into conglomerate, sandstone, or shale. When the material is carried in solution by the water and is deposited without the aid of life, it is called a chemical sediment; if deposited with the aid of life, it is called an organic sediment. The more important rocks formed from chemical and organic deposits are limestone, chert, gypsum, salt, iron ore, peat, lignite, and coal. Any one of the above sedimentary deposits may be separately formed, or the different materials may be intermingled in many ways, producing a great variety of rocks.

Sedimentary rocks are usually made up of layers or beds which can be easily separated. These layers are called *strata*. Rocks deposited in successive layers are said to be stratified.

The surface of the earth is not fixed, as it seems to be; it very slowly rises or sinks over wide expanses, and as it rises or subsides the shore lines of the ocean are changed: areas of deposition may rise above the water and become land areas, and land areas may sink below the water and become areas of deposition. If North America were gradually to sink a thousand feet the sea would flow over the Atlantic coast and the Mississippi and Ohio valleys from the Gulf of Mexico to the Great Lakes; the Appalachian Mountains would become an archipelago, and the ocean's shore would traverse Wisconsin, Iowa, and Kansas, and extend thence to Texas. More extensive changes than this have repeatedly occurred in the past.

The character of the original sediments may be changed by chemical and dynamic action so as to produce metamorphic rocks. In the metamorphism of a sedimentary rock, just as in the metamorphism of an igneous rock, the substances of which it is composed may enter into new combinations, or new substances may be added. When these processes are complete the sedimentary rock becomes crystalline. Such changes transform sandstone to quartzite, limestone to marble, and modify other rocks according to their composition. A system of parallel division planes is often produced, which may cross the original beds or strata at any angle. Rocks divided by such planes are called slates or schists.

Rocks of any period of the earth's history may be more or less altered, but the younger formations have generally escaped marked metamorphism, and the oldest sediments known, though generally the most altered, in some localities remain essentially unchanged.

Surficial rocks.—These embrace the soils, clays, sands, gravels, and bowlders that cover the surface, whether derived from the breaking up or disintegration of the underlying rocks by atmospheric agencies or from glacial action. Surficial rocks that are due to disintegration are produced chiefly by the action of air, water, frost, animals, and plants. They consist mainly of the least soluble parts of the rocks, which remain after the more soluble parts have been leached out, and hence are known as residual products. Soils and subsoils are the most important. Residual accumulations are often washed or blown into valleys or other depressions, where they lodge and form deposits that grade into the sedimentary class. Surficial rocks that are due to glacial action are formed of the products of disintegration, together with bowlders and fragments of rock rubbed from the surface and ground together. These are spread irregularly over the territory occupied by the ice, and form a mixture of clay, pebbles, and bowlders which is known as till. It may occur as a sheet or be bunched into hills and ridges, forming moraines, drumlins, and other special forms. Much of this mixed material was washed away from the ice, assorted by water, and redeposited as beds or trains of sand and clay, thus forming another gradation into sedimentary deposits. Some of this glacial wash was deposited in tunnels and channels in the ice, and forms characteristic ridges and mounds of sand and gravel, known as osars, or eskers, and kames. The material deposited by the ice is called glacial drift; that washed from the ice onto the adjacent land is called modified drift. It is usual also to class as surficial rocks the deposits of the sea and of lakes and rivers that were made at the same time as the ice deposit.

AGES OF ROCKS.

Rocks are further distinguished according to their relative ages, for they were not formed all at one time, but from age to age in the earth's history. Classification by age is independent of origin; igneous, sedimentary, and surficial rocks may be of the same age.

When the predominant material of a rock mass is essentially the same, and it is bounded by rocks of different materials, it is convenient to call the mass throughout its extent a *formation*, and such a formation is the unit of geologic mapping.

Several formations considered together are designated a *system*. The time taken for the deposition of a formation is called an *epoch*, and the time taken for that of a system, or some larger fraction of a system, a *period*. The rocks are mapped by formations, and the formations are classified into systems. The rocks composing a system and the time taken for its deposition are given the same name, as, for instance, Cambrian system, Cambrian period.

As sedimentary deposits or strata accumulate the younger rest on those that are older, and the relative ages of the deposits may be discovered by observing their relative positions. This relationship holds except in regions of intense disturbance; sometimes in such regions the disturbance of the beds has been so great that their position is reversed, and it is often difficult to determine the relative ages of the beds from their positions; then *fossils*, or the remains of plants and animals, are guides to show which of two or more formations is the oldest.

Strata often contain the remains of plants and animals which lived in the sea or were washed from the land into lakes or seas or were buried in surficial deposits on the land. Rocks that contain the remains of life are called fossiliferous. By studying these remains, or fossils, it has been found that the species of each period of the earth's history have to a great extent differed from those of other periods. Only the simpler kinds of marine life existed when the oldest fossiliferous rocks were deposited. From time to time more complex kinds developed, and as the simpler ones lived on in modified forms life became more varied. But during each period there lived peculiar forms, which did not exist in earlier times and have not existed since; these are characteristic types, and they define the age of any bed of rock in which they are found. Other types passed on from period to period, and thus linked the systems together, forming a chain of life from the time of the oldest fossiliferous rocks to the present.

When two formations are remote one from the other and it is impossible to observe their relative positions, the characteristic fossil types found in them may determine which was deposited first.

Fossil remains found in the rocks of different areas, provinces, and continents afford the most important means for combining local histories into a general earth history.

Colors and patterns.—To show the relative ages of strata, the history of the sedimentary rocks is divided into periods. The names of the periods in proper order (from new to old), with the colors and symbol assigned to each, are given in the table in the next column. The names of certain subdivisions and groups of the periods, frequently used in geologic writings, are bracketed against the appropriate period names.

To distinguish the sedimentary formations of any one period from those of another the patterns for the formations of each period are printed in the appropriate period-color, with the exception of the one at the top of the column (Pleistocene) and the one at the bottom (Archean). The sedimentary formations of any one period, excepting the Pleistocene and the Archean, are distinguished from one another by different patterns, made of parallel straight lines. Two tints of the period-color are used: a pale tint is printed evenly over the whole surface representing the period; a dark tint brings out the different patterns representing formations. Each formation is furthermore given a letter-symbol composed of the period letter combined with small letters standing for the formation name. In the case of a sedimentary formation of uncertain age the pattern is printed on white ground in the color of the period to which the formation is supposed to belong, the letter-symbol of the period being omitted.

Period.		Symbol.	Color.
Cenozoic	Pleistocene	P	Any colors.
	Neocene { Pliocene Miocene }	N	Buffs.
	Eocene, including Oligocene	E	Olive-browns.
Mesozoic	Cretaceous	K	Olive-greens.
	Juratrias { Jurassic Triassic }	J	Blue-greens.
Paleozoic	Carboniferous, including Permian	C	Blues.
	Devonian	D	Blue-purples.
	Silurian, including Ordovician	S	Red-purples.
	Cambrian	Є	Pinks.
	Algonkian	A	Orange-browns.
	Archean	AR	Any colors.

The number and extent of surficial formations, chiefly Pleistocene, render them so important that, to distinguish them from those of other periods and from the igneous rocks, patterns of dots and circles, printed in any colors, are used.

The origin of the Archean rocks is not fully settled. Many of them are certainly igneous. Whether sedimentary rocks are also included is not determined The Archean rocks, and all metamorphic rocks of unknown origin, of whatever age, are represented on the maps by patterns consisting of short dashes irrregularly placed. These are printed in any color, and may be darker or lighter than the background. If the rock is a schist the dashes or hachures may be arranged in wavy parallel lines. If the metamorphic rock is known to be of sedimentary origin the hachure patterns may be combined with the parallel-line patterns of sedimentary formations. If the rock is recognized as having been originally igneous, the hachures may be combined with the igneous pattern.

Known igneous formations are represented by patterns of triangles or rhombs printed in any brilliant color. If the formation is of known age the letter-symbol of the formation is preceded by the capital letter-symbol of the proper period. If the age of the formation is unknown the letter-symbol consists of small letters which suggest the name of the rocks.

THE VARIOUS GEOLOGIC SHEETS.

Areal geology sheet.—This sheet shows the areas occupied by the various formations. On the margin is a *legend*, which is the key to the map. To ascertain the meaning of any particular colored pattern and its letter-symbol on the map the reader should look for that color, pattern, and symbol in the legend, where he will find the name and description of the formation. If it is desired to find any given formation, its name should be sought in the legend and its color and pattern noted, when the areas on the map corresponding in color and pattern may be traced out.

The legend is also a partial statement of the geologic history. In it the symbols and names are arranged, in columnar form, according to the origin of the formations—surficial, sedimentary, and igneous—and within each group they are placed in the order of age, so far as known, the youngest at the top.

Economic geology sheet.—This sheet represents the distribution of useful minerals, the occurrence of artesian water, or other facts of economic interest, showing their relations to the features of topography and to the geologic formations. All the formations which appear on the historical geology sheet are shown on this sheet by fainter color patterns. The areal geology, thus printed, affords a subdued background upon which the areas of productive formations may be emphasized by strong colors. A symbol for mines is introduced at each occurrence, accompanied by the name of the principal mineral mined or of the stone quarried.

Structure-section sheet.—This sheet exhibits the relations of the formations beneath the surface.

In cliffs, canyons, shafts, and other natural and artificial cuttings, the relations of different beds to one another may be seen. Any cutting which exhibits those relations is called a *section*, and the same name is applied to a diagram representing the relations. The arrangement of rocks in the earth is the earth's *structure*, and a section exhibiting this arrangement is called a *structure section*.

The geologist is not limited, however, to the natural and artificial cuttings for his information concerning the earth's structure. Knowing the manner of the formation of rocks, and having traced out the relations among beds on the surface, he can infer their relative positions after they pass beneath the surface, draw sections which represent the structure of the earth to a considerable depth, and construct a diagram exhibiting what would be seen in the side of a cutting many miles long and several thousand feet deep. This is illustrated in the following figure:

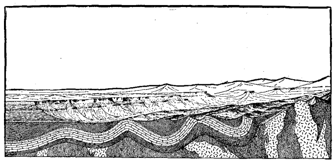
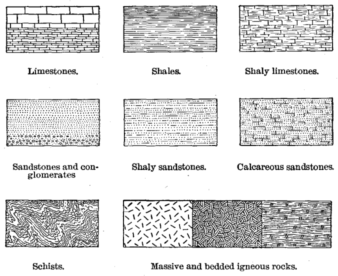


Fig. 2.—Sketch showing a vertical section in the front of the picture, with a landscape beyond.

The figure represents a landscape which is cut off sharply in the foreground by a vertical plane, so as to show the underground relations of the rocks.

The kinds of rock are indicated in the section by appropriate symbols of lines, dots, and dashes. These symbols admit of much variation, but the following are generally used in sections to represent the commoner kinds of rock:



Limestones.

Shales.

Shaly limestones.

Sandstones and conglomerates

Shaly sandstones.

Calcareous sandstones.

Schists.

Massive and bedded igneous rocks.

Fig. 3.—Symbols used to represent different kinds of rock.

The plateau in fig. 2 presents toward the lower land an escarpment, or front, which is made up of sandstones, forming the cliffs, and shales, constituting the slopes, as shown at the extreme left of the section.

The broad belt of lower land is traversed by several ridges, which are seen in the section to correspond to beds of sandstone that rise to the surface. The upturned edges of these beds form the ridges, and the intermediate valleys follow the outcrops of limestone and calcareous shales.

Where the edges of the strata appear at the surface their thickness can be measured and the angles at which they dip below the surface can be observed. Thus their positions underground can be inferred. The direction that the intersection of a bed with a horizontal plane will take is called the *strike*. The inclination of the bed to the horizontal plane, measured at right angles to the strike, is called the *dip*.

When strata which are thus inclined are traced underground in mining, or by inference, it is frequently observed that they form troughs or arches, such as the section shows. The arches are called *anticlines* and the troughs *synclines*. But the sandstones, shales, and limestones were deposited beneath the sea in nearly flat sheets. That they are now bent and folded is regarded as proof that forces exist which have from time to time caused the earth's surface to wrinkle along certain zones. In places the strata are broken across and the parts slipped past one another. Such breaks are termed *faults*.

On the right of the sketch the section is composed of schists which are traversed by masses of igneous rock. The schists are much contorted and their arrangement underground can not be inferred. Hence that portion of the section delineates what is probably true but is not known by observation or well-founded inference.

In fig. 2 there are three sets of formations, distinguished by their underground relations. The first of these, seen at the left of the section, is the set of sandstones and shales, which lie in a horizontal position. These sedimentary strata are now high above the sea, forming a plateau, and their change of elevation shows that a portion of the earth's mass has swelled upward from a lower to a higher level. The strata of this set are parallel, a relation which is called *conformable*.

The second set of formations consists of strata which form arches and troughs. These strata were once continuous, but the crests of the arches have been removed by degradation. The beds, like those of the first set, are conformable.

The horizonal strata of the plateau rest upon the upturned, eroded edges of the beds of the second set at the left of the section. The overlying deposits are, from their positions, evidently younger than the underlying formations, and the bending and degradation of the older strata must have occurred between the deposition of the older beds and the accumulation of the younger. When younger strata thus rest upon an eroded surface of older strata the relation between the two is an *unconformable* one, and their surface of contact is an *unconformity*.

The third set of formations consists of crystalline schists and igneous rocks. At some period of their history the schists were plicated by pressure and traversed by eruptions of molten rock. But this pressure and intrusion of igneous rocks have not affected the overlying strata of the second set. Thus it is evident that an interval of considerable duration elapsed between the formation of the schists and the beginning of deposition of the strata of the second set. During this interval the schists suffered metamorphism; they were the scene of eruptive activity; and they were deeply eroded. The contact between the second and third sets, marking a time interval between two periods of rock formation, is another unconformity.

The section and landscape in fig. 2 are ideal, but they illustrate relations which actually occur. The sections in the structure-section sheet are related to the maps as the section in the figure is related to the landscape. The profiles of the surface in the section correspond to the actual slopes of the ground along the section line, and the depth from the surface of any mineral-producing or water-bearing stratum which appears in the section may be measured by using the scale of the map.

Columnar section sheet.—This sheet contains a concise description of the rock formations which occur in the quadrangle. It presents a summary of the facts relating to the character of the rocks, the thicknesses of the formations, and the order of accumulation of successive deposits.

The rocks are described under the corresponding heading, and their characters are indicated in the columnar diagrams by appropriate symbols. The thicknesses of formations are given in figures which state the least and greatest measurements. The average thickness of each formation is shown in the column, which is drawn to a scale—usually 1000 feet to 1 inch. The order of accumulation of the sediments is shown in the columnar arrangement: the oldest formation is placed at the bottom of the column, the youngest at the top, and igneous rocks or surficial deposits, when present, are indicated in their proper relations.

The formations are combined into systems which correspond with the periods of geologic history. Thus the ages of the rocks are shown, and also the total thickness of each system.

The intervals of time which correspond to events of uplift and degradation and constitute interruptions of deposition of sediments are indicated graphically and by the word "unconformity."

CHARLES D. WALCOTT,
Director.

Revised January, 1902.

DESCRIPTION OF THE ROME QUADRANGLE.

By C. Willard Hayes.

GEOGRAPHY.

Location of the quadrangle.

General relations.—The Rome quadrangle is bounded by the parallels of latitude 34° and 34° 30′ and the meridians of longitude 85° and 85° 30′. It embraces, therefore, a quarter of a square degree of the earth's surface. Its dimensions are 34.5 miles from north to south and 28.6 miles from east to west, and it contains 986.3 square miles. The adjacent quadrangles are: on the north, Ringgold; on the east, Cartersville; on the south, Tallapoosa; and on the west, Fort Payne. The Rome quadrangle lies within the States of Georgia and Alabama, and embraces parts of Chattooga, Floyd, Gordon, Bartow, and Polk counties in Georgia, and Cherokee County in Alabama.

Definition of Appalachian province.

In its geographic and geologic relations this quadrangle forms a part of the Appalachian province, which extends from the Atlantic coastal plain on the east to the Mississippi lowlands on the west and from central Alabama to southern New York. All parts of the region thus defined have a common history, which is recorded in its rocks, its geologic structure, and its topographic features. Only a part of this history can be read from an area so small as a single quadrangle; hence it is necessary to consider the latter in its relations to the entire province.

Subdivisions of the Appalachian province.—The Appalachian province may be subdivided into three well-marked physiographic divisions, throughout each of which certain forces have produced similar results in sedimentation, in geologic structure, and in topography. These divisions extend the entire length of the province, from northeast to southwest.

The Appalachian Valley.

The central division is the Appalachian Valley. It is the best defined and most uniform of the three subdivisions. In its southern part it coincides with the belt of folded rocks which forms the Coosa Valley of Georgia and Alabama and the Great Valley of East Tennessee and Virginia. Throughout its central and northern portions its eastern side only is marked by great valleys—such as the Shenandoah Valley of Virginia, the Cumberland Valley of Maryland and Pennsylvania, and the Lebanon Valley of northeastern Pennsylvania—its western side being a succession of ridges alternating with narrow valleys. This division varies in width from 40 to 125 miles. It is sharply outlined on the southeast by the Appalachian Mountains and on the northwest by the Cumberland Plateau and the Allegheny Mountains. Its rocks are almost wholly sedimentary and in large measure calcareous. The strata, which must originally have been nearly horizontal, now appear at the surface at various angles and in narrow belts. The surface features differ with the outcrop of different kinds of strata, sharp ridges and narrow valleys following the belts of hard rock and soft rock, respectively. Owing to the large amount of limestone brought up by the steep folds in this division, the surface is more readily worn down by streams and is lower and less broken than that of the divisions on either side.

The Appalachian Mountains a system of minor ranges.

The eastern division of the province embraces the Appalachian Mountains, a system which is made up of many minor ranges having various local names, and which extends from southern New York to central Alabama. Some of its prominent parts are South Mountain of Pennsylvania, Blue Ridge and Catoctin Mountain of Maryland and Virginia, Great Smoky Mountains of Tennessee and North Carolina, and Cohutta Mountains of Georgia. Many of the rocks of this division are more or less crystalline, being either sediments which have been changed to slates and schists by varying degrees of metamorphism, or igneous rocks, such as granite and diabase, which have solidified from a molten condition.

The Cumberland Plateau and Allegheny Mountains.

The western division of the Appalachian province embraces the Cumberland Plateau and Allegheny Mountains, extending from New York to Alabama, and the lowlands of Tennessee, Kentucky, and Ohio. Its northwestern boundary is indefinite, but may be regarded as a somewhat arbitrary line coinciding with the Tennessee River from the northeast corner of Mississippi to its mouth, and thence crossing the States of Indiana and Ohio to western New York. Its eastern boundary is sharply defined along the Appalachian Valley by the Allegheny Front, the Cumberland Plateau escarpment, and Lookout Mountain. The rocks of this division are almost entirely of sedimentary origin and lie very nearly horizontal. The character of the surface, which is dependent on the character and attitude of the rocks, is that of a plateau more or less completely dissected in part or worn down to a lowland. In the southern half of the province the plateau is sometimes extensive and perfectly flat, but oftener it is divided by stream channels into large and small flat-topped hills. In West Virginia and portions of Pennsylvania the plateau is extensively cut by streams, leaving in relief irregularly rounded knobs and ridges which bear but little resemblance to the original surface. The western portion of the plateau has been completely removed by erosion, and the surface is now comparatively low and level, or rolling.

Altitudes in the Appalachian province.—The Appalachian province as a whole is broadly dome-shaped, the surface rising from an altitude of about 500 feet above sea level along its eastern margin to the crest of the Appalachian Mountains, and thence descending westward to about the same altitude on the Ohio and Mississippi rivers.

Greatest height of the Appalachian Mountains.

Each of the subdivisions of the province has one or more culminating points. Thus the Appalachian Mountains rise gradually from less than 1000 feet elevation in Alabama to more than 6600 feet in western North Carolina. From this culminating point their altitude decreases to 3000 feet in southern Virginia, rises to 4000 feet in central Virginia, and finally descends to 2000 or 1500 feet on the Maryland–Pennsylvania line.

The Appalachian Valley increases uniformly in altitude from 500 feet or less in Alabama to 900 feet in the vicinity of Chattanooga, 2000 feet at the Tennessee–Virginia line, and 2600 or 2700 feet at its culminating point, on the divide between the New and Tennessee rivers. From this point it descends to 2200 feet in the valley of New River, 1500 to 1000 feet in the James River Basin, and 1000 to 500 feet in the Potomac Basin, remaining at about that altitude through Pennsylvania. These figures represent the average elevation of the valley surface, below which the stream channels are sunk from 50 to 250 feet, and above which the valley ridges rise from 500 to 2000 feet.

The altitude of the plateau, or western, division increases from 500 feet at the southern border of the province to 1500 feet in northern Alabama, 2000 feet in central Tennessee, and 3500 feet in southeastern Kentucky. It is between 3000 and 4000 feet in West Virginia, and decreases to about 2000 feet in Pennsylvania. From its greatest altitude, along the eastern border, the plateau slopes gradually westward, although it is generally separated from the interior lowlands by an abrupt escarpment.

Drainage of the Appalachian province.—The drainage of the province is in part eastward into the Atlantic, in part southward into the Gulf, and in part westward into the Mississippi. All of the western, or plateau, division of the province, except a small portion in Pennsylvania and another in Alabama, is drained by streams flowing westward to the Ohio. The northern portion of the eastern, or Appalachian Mountain, division is drained eastward into the Atlantic, while south of New River all except the eastern slope of the mountains is drained westward by tributaries of the Tennessee or southward by tributaries of the Coosa.

Longitudinal streams and transverse trunk rivers.

The position of the streams in the Appalachian Valley is dependent upon the geologic structure. In general they flow in courses which for long distances are parallel to the sides of the Great Valley, following the lesser valleys along the outcrops of the softer rocks. These longitudinal streams empty into a number of larger, transverse rivers, which cross one or the other of the barriers limiting the valley. In the northern portion of the province they form the Delaware, Susquehanna, Potomac, James, and Roanoke rivers, which pass through the Appalachian Mountains in narrow gaps and flow eastward to the sea. In the central portion of the province, in Kentucky and Virginia, these longitudinal streams form the New (or Kanawha) River, which flows westward in a deep, narrow gorge through the Cumberland Plateau into the Ohio River. From New River southward to northern Georgia the Great Valley is drained by tributaries of the Tennessee River, which at Chattanooga leaves the broad valley and, entering a gorge through the plateau, runs westward to the Ohio. Southward from an irregular line crossing northern Georgia and Alabama the streams flow directly to the Gulf of Mexico.

TOPOGRAPHY OF THE ROME QUADRANGLE.

The Rome quadrangle lies entirely within the first physiographic province above outlined—the Appalachian Valley belt. Its northwest corner barely touches the foot of Lookout Mountain, which here forms the eastern portion of the Cumberland Plateau. Its southeast corner is about a mile from the escarpment which forms the northwestern border of the Piedmont Plateau. Although lying entirely within a single physiographic province, the surface of the quadrangle presents considerable variety in topographic forms. A broad belt of lowland, the Coosa–Oostanaula Valley, extends diagonally across the quadrangle from northeast to southwest, and the region southeast of this valley is distinctly different in topography from that lying to the northwest.

Topography southeast of Coosa-Oostanaula Valley.

A slightly elevated rolling plateau.

The region southeast of the valley is underlain largely by the Knox dolomite, a formation which contains a large amount of chert. When this formation weathers the chert remains upon the surface, mingled with red clay. This porous material quickly absorbs the water which falls upon it, so that small streams are rare, and the water, percolating through the loose material, finds its way by underground channels to the margin of the formation, where it emerges in a series of large springs. The result is that surface erosion is relatively slow, and the regions underlain by the Knox dolomite are always higher than those underlain by purer limestones. This portion of the quadrangle, therefore, may be characterized as a slightly elevated plateau with rolling or hilly surface, its general altitude being a little under 1000 feet, with a few points extending 200 or 300 feet higher. Areas of slate in the southeast corner of the quadrangle form somewhat more regular hills than those which characterize the dolomite areas.

Topography northwest of Coosa-Oostanaula Valley.

Monoclinal ridges.

Anticlinal ridges.

Synclinal ridges.

Small plateaus or mesas.

The region northwest of the Coosa–Oostanaula Valley is occupied by a series of ridges and small plateaus or mesas, with intervening level valleys. The summits of the ridges are very uniform and generally reach elevations of about 700 or 800 feet above the adjacent lowlands. The ridges differ somewhat in form, which depends directly upon internal structure. Gaylor Ridge, Taylor Ridge, Simms Mountain, and John Mountain are monoclinal ridges—that is, they are formed by the outcropping edges of resistant beds which dip in one direction, in these instances rather steeply southeastward. They are consequently unsymmetrical in form. One side of the ridge, the face toward the northwest, has a regular, smooth slope and is rather steep; the other side, the southeastern, or the back of the ridge, has a gentle slope, which is generally cut by innumerable ravines, the intervening spurs extending at right angles to the trend of the ridge. Lavender, Horn, Turkey, and Horseleg mountains and the northeastern end of Simms Mountain are anticlinal ridges—that is, they are produced by arches of resistant strata, dipping in opposite directions from the central axis. Both sides of these ridges therefore are similar, or would be if the strata had the same dip on both sides of the axis, and both sides correspond in character to the backs of the monoclinal ridges. Dirtseller Mountain, the northeastern point of Gaylor Ridge, and the southwestern point of Taylor Ridge are synclinal ridges—that is, they are formed by shallow troughs, in which the strata on opposite sides dip toward the center. Both sides of these ridges have the same character and resemble the faces of the monoclinal ridges; that is, their slopes are smooth and steep, without ravines and spurs normal to the axis. A fourth type of ridges, or rather mesas, embraces Rocky Mountain and Little Sand Mountain. In these the resistant strata to which they owe their elevation are practically horizontal. Their tops are flat and their sides are steep. The horizontal beds frequently form bounding cliffs.

Belts of chert-covered hills.

All these ridges have one characteristic in common: they owe their elevation to the presence of strata which resist erosion. The intermediate lowlands are occupied by less resistant formations, chiefly limestones and shales, although they are in part also occupied by the Knox dolomite, which gives a surface whose relief is intermediate between that of the high ridges and that of the lowest valleys. Thus Broomtown Valley is occupied by a rather broad belt of chert-covered hills, and a similar belt extends parallel to Gaylor and Taylor ridges on the west. These valleys, lying between the valley ridges, are slightly higher than the Coosa Valley, whose surface has an altitude of 600 to 650 feet. The latter valley extends almost to the escarpment which forms the western limit of the dolomite plateau to the southeast. Parallel with that escarpment is a low ridge, becoming somewhat broken and irregular southwest of Rome, whose summit reaches about the same altitude as the plateau to the eastward. This ridge is formed by the outcrop of Cambrian shales and sandstones, which are less resistant than the beds forming the valley ridges to the northwest, and it is therefore lower. The extreme southwest corner of the quadrangle is occupied by a valley ridge belonging to another type. It does not have the even crest which characterizes the valley ridges in the northern portion of the quadrangle, but tapers off toward the northeast and southwest, the direction of its axis, from a culminating point near the center. This ridge, Indian Mountain, is formed by the outcrop of massive Cambrian quartzites. Instead of a single simple ridge, it is made up of several roughly parallel, overlapping ridges, each one monoclinal in structure, the strata dipping rather steeply southeastward. Whereas the summits of the northern ridges are often cleared and cultivated, Indian Mountain is extremely rugged, deeply covered with angular fragments of quartzite, and supports but a scanty growth of pine and jack oak.

When the topography of this region is examined in connection with that of regions adjoining, the remnants of three well-defined plains of erosion, or peneplains, are found, separated by

Cumberland peneplain.

Coosa Valley peneplain.

vertical intervals of a few hundred feet. These have been named from the regions in which they are best developed. The highest, and therefore the oldest, is called the Cumberland peneplain. It is well displayed southeast of the quadrangle on the Piedmont Plateau, and also northwest of the quadrangle on the Cumberland Plateau. If it were restored over the valley region it would probably have an elevation in the northern portion of the quadrangle of about 1600 feet. The even crests of the valley ridges, whose altitude is slightly less, suggest its position, but it is not certain that their summits are preserved portions of that plain. The lowest peneplain, the one last developed, is found chiefly in the Coosa Valley, from which it is named. Its altitude in this region is about 630 feet, and it rises slightly in the valleys which intervene between the several valley ridges. The intermediate peneplain probably coincides very nearly with the undulating surface of the dolomite plateau, and its elevation is probably a little under 1,000 feet. The presence of these three peneplains in this region throws considerable light upon its recent geologic history.

Method of formation of a peneplain.

It is inferred that this region formerly stood at a much lower altitude than now, so that the peneplain which coincides with the summits of the valley ridges stood near sea level. The land was worn down by the same agencies of gradation that are now at work, chiefly running water, till its surface was reduced to a nearly featureless plain, above which rose a few isolated knobs and ridges, the only one of any importance in this region being that which now forms Indian Mountain and which is composed of exceptionally hard rocks. The region to the northwest was then elevated, so that a slight southeasterly slope was given to the smooth plain. By this uplift the streams, which had become sluggish, were stimulated to renewed activity, and the larger ones carved their channels down to the new base-level of erosion and then cut broad, level valleys. The plain was everywhere deeply dissected, and all except the hardest rocks were reduced to a new peneplain, the older one being preserved only upon the summits of the valley ridges and on the highlands on either side of this quadrangle. When the second peneplain was well advanced there was a second uplift, and a third base-level was established about 300 feet below the second. Only soft shales and limestones have been reduced to this new base-level; hence this lowest peneplain is confined to areas underlain by these soft rocks. The final event in the history of the region was the elevation to its present altitude, an event so recent that the streams are as yet only slightly stimulated by the uplift.

GEOLOGY.

STRATIGRAPHY.

The sedimentary record. — The rocks found within the limits of the Rome quadrangle belong wholly to the sedimentary class. They consist of sandstones, shales, and limestones, and present great variety in composition and appearance. The materials of which they are composed were originally gravel, sand, and mud, derived from the waste of older rocks and the remains of plants and animals which lived while the strata were being laid down. Thus, some of the great beds of limestone were formed largely from the shells of various sea animals, and the beds of coal found in adjoining quadrangles are the remains of a luxuriant vegetation which probably covered low, swampy shores.

Geologic history recorded in the rocks.

These rocks afford a record of more or less continuous sedimentation from early Cambrian to Carboniferous time. Their composition and appearance indicate something as to the conditions under which they were deposited, as distance from shore and depth of water. Thus, sandstones marked by ripples and cross-bedded by currents, and shales cracked by drying on mud flats, indicate shallow water; while limestones, especially by the fossils they contain, indicate greater depth of water and scarcity of sediment. Also the nature of the adjacent land is shown by the character of the sediments derived from its waste. Coarse sandstones and conglomerates, such as are found in the Ocoee formations to the east of this area and again in the Coal Measures to the west, may have been derived either from high land on which stream grades were steep or from wave action as the sea encroached upon a sinking coast. Red sandstones and shales, such as make up some of the Cambrian and Silurian formations, may result from the revival of erosion on a land surface which has been long exposed to rock decay and oxidation and is covered by a deep residual soil. Limestones, on the other hand, if deposited near the shore, indicate that the land was low and the streams were too sluggish to carry off coarse materials, the sea receiving only fine sediments and substances in solution.

The ancient inland sea.

The sea in which these sediments were laid down covered the central and western portions of the Appalachian province and the Mississippi Basin. The Rome quadrangle was near its eastern margin, and, therefore, the materials which formed its sedimentary rocks were derived largely from the land to the southeastward. The exact position of the eastern shore line of this ancient sea is not known, but it doubtless varied from time to time within rather wide limits. It seems probable that the earliest sea whose sediments are found in this region had the greatest eastward extension and that there was a general retreat toward the west in later ages. The retreat was not gradual and regular, but was accompanied by oscillations of the land, causing numerous retreats and readvances of the coast line.

Great cycles of deposition.

Buried granite islands of the earliest sea.

The rocks of this and immediately adjoining quadrangles record several great cycles of sedimentation as well as oscillations of the shore line. The Ocoee series, whose age is not definitely known, was deposited for the most part near the margin of the sea, where the supply of land waste was abundant but subject to great fluctuations. Fine sediments alternate with coarse material, and few of the formations retain the same characteristics for long distances, except in a very general way. During a part of the Ocoee epoch there were in this region several granite islands, whose waste was deposited about them as basal conglomerates. Later these islands were entirely covered by the sea and by the sediments derived from more distant lands and spread over the sea bottom. The extreme metamorphism which the rocks of this series have undergone toward the east renders it difficult to determine their original limit in that direction or their relations to the older rocks beyond.

Sedimentary record of the earth movements.

The oldest formations whose age can be approximately determined, and which thus afford the first definite time record, were coarse sandstones and sandy shales, which were deposited in early Cambrian time along the eastern margin of the interior sea as it encroached upon the land. As the land was worn down and perhaps still further depressed, the sediments became finer and less abundant and the Beaver limestone was deposited. This was followed by an elevation of the adjacent land surface, from which was washed a thoroughly oxidized residual soil, forming the red sandstones and shales of the Rome formation. The sediments again became finer and less abundant as the land remained stationary, and a great thickness of strata was deposited, at first shale and later limestone, extending to the top of the Chickamauga formation. Following this long period of quiet, there was a slight elevation, producing, as erosion was gradually stimulated on the old land surface, red shales and muddy limestones, which were followed by sandstones and conglomerates when the elevation gave the streams sufficient grade to carry the coarser materials to the sea. This elevation, which probably caused such an expansion of the land that it included the whole of this quadrangle and perhaps much of the southern Appalachian province during the greater part of Devonian time, was in turn followed by a period of depression, the land at the same time being worn down nearly to base-level and affording conditions favorable for the accumulation of the Devonian black shale and the Carboniferous limestone, which in general show little trace of shore waste. Another uplift brought these rocks into shoal water, and in some places above the sea, and upon them were deposited in shallow lagoons and swamps the sandstones, shales, and coal beds which form the Coal Measures. It is probable that the Rome quadrangle was dry land during the greater part of the Carboniferous period, the sea having permanently withdrawn from this region early in the Carboniferous, as it withdrew from the whole Appalachian province at the close of that period.

CAMBRIAN ROCKS.

Old quartzites forming Indian Mountain.

Weisner quartzite.—This formation includes the oldest rocks that come to the surface within the limits of the Rome quadrangle. It is confined to the extreme southwest corner; and since it contains the most resistant rocks, the areas of its outcrop are marked by the greatest elevation within the quadrangle—that is, Indian Mountain. The most prominent member of the formation is a hard, vitreous quartzite, but it contains also conglomerates, sandstones, and sandy shales. The coarser elements of the formation constitute a series of lenses, variable in extent and thickness, which are interbedded with the finer-grained rocks. The latter make up the bulk of the formation, although they are much less prominent than the more resistant coarser beds. The quartzite when exposed to atmospheric agencies breaks up into angular blocks, which nearly everywhere cover the surface, and exposures of the beds in place are rarely seen. For this reason, and also because of the enormous faults which intersect the formation, its thickness is difficult to determine. On a section from Bluffton to Rockrun its apparent thickness is over 10,000 feet, but it is by no means certain that this apparent thickness is not due in some measure to repetition by faulting and the minute folding of the less resistant beds. The section is limited by a fault on the west, and the foundation upon which the formation was originally deposited is nowhere exposed. Some of the conglomerate beds contain numerous feldspar pebbles, showing that the material composing the conglomerate was derived, in part at least, from granites. It probably came from a source to the southeast, and the beds which form Indian Mountain have the appearance of massive delta deposits. No fossils have as yet been found in these beds, but their relations to adjacent formations are such that there is little hesitation in correlating them with the lower Cambrian.

Beaver limestone.—The beds of the Weisner quartzite generally dip to the southeast and, where not limited by a fault, pass under a narrow belt of red clay soil containing many angular fragments of quartzite and a few masses of cellular chert. This red soil is derived from the decay of the Beaver limestone, which is itself rarely seen. It is a gray, semicrystalline, dolomitic limestone, generally massive, but sometimes slightly shaly. The exposures of this limestone are so infrequent that its thickness can not be determined, but, judging from the width of its outcrop and the prevailing dip of the adjoining beds, it is probably between 800 and 1200 feet thick. The principal areas of the Beaver limestone are in the vicinity of Indian Mountain, but a small area is found at a considerable distance from any outcrop of the quartzite, a few miles southwest of Rome. Associated with these two lower Cambrian formations are important deposits of iron ore, which will be more fully described later under the heading "Mineral resources."

Variegated, bright-colored shales and sandstones.

Rome formation.—This formation consists of thin-bedded, fine-grained sandstones and sandy shales. Its most striking peculiarity is the brilliant coloring of its beds. The prevailing colors are various shades of red, purple, green, yellow, and white. The changes in color are often very abrupt and the exposures of the formation present a distinctly banded appearance. The base of the formation, where it is found resting upon the underlying Beaver limestone, consists of thin-bedded red sandstones, and the top of the formation is characterized by a rather heavy bed of white sandstone. Northeast of Rome the upper portion of the formation consists chiefly of shale and is distinguished on the map as a lentil in the formation. In its type locality, south of Rome, the formation is between 700 and 1000 feet in thickness. Its beds are always more or less folded, so that it is impossible to make exact measurements of its thickness. The formation is confined to a narrow belt crossing the quadrangle diagonally from northeast to southwest at the eastern margin of the Coosa Valley. Its rocks are somewhat more resistant than the limestones which occur above and below, and it forms a line of low ridges between the lowlands on either side.

Great thickness of clay shales.

Conasauga formation.—This formation presents a number of widely differing phases within the limits of this quadrangle. At its type locality, in the Dalton quadrangle to the northeast, it consists of a great thickness of fine clay shales with occasional beds of limestone. The latter vary in thickness from a few inches to several hundred feet, and are always rather pure, blue limestone. In the vicinity of Rome and northeastward to the margin of the quadrangle the formation consists at the base of several hundred feet of fine olive clay shale, then beds of oolitic limestone, and finally 1000 or more feet of calcareous shales, interbedded toward the top with blue limestones. Southward from Rome the formation changes considerably by an increase in the amount of limestone. A typical section is exposed on Big Cedar Creek, where it crosses Vans Valley. The lower part of the formation consists of olive shales, above which are oolitic limestones, the same as at Rome. The upper portion of the formation, however, consists largely of heavy beds of limestone. Some of these limestone beds are gray and crystalline, closely resembling the Knox dolomite, but free from the compact nodular chert of the latter formation. Other beds contain considerable earthy matter, which often retains the form of the rock after the calcareous matter has been removed, and also masses of characteristic cellular chert. The two phases of the Conasauga formation above described are confined to the strip of lowland between the Rome sandstone ridges and the Knox dolomite plateau which occupies the southeastern half of the quadrangle.

Great variations in the shale series.

Northwest of the Rome sandstone ridges there is a much larger area of the Conasauga formation, occupying the greater part of the Coosa Valley. The formation here varies somewhat widely from the type to the east, and is capable of subdivision into three rather distinct phases. The upper portion of the formation, along the eastern margin of the Coosa Valley, consists of characteristic greenish siliceous shales. These have been separately mapped and are indicated on the sheet as a lentil in the formation. In some cases the shales are replaced by greenish micaceous sandstone, which is always highly contorted and crushed into a series of lenticular masses from a fraction of an inch to 4 or 5 inches in thickness. The sandstone is always filled with cracks or fissures, which have the appearance of having been produced by contraction of the bed. These cracks are partially filled with quartz, and where they are unweathered the remaining space is occupied by calcite. The sandstone is confined to the southeastern margin of the valley. Northwestward the siliceous beds become fewer, being replaced by fine olive-green shales, and throughout the central portion of the valley this division is represented by olive shales, in which occur numerous flat concretions composed of gray siliceous rock intermediate in character between fine-grained quartzite and chert. Along the northwestern border of the valley this division becomes very much more calcareous. The concretions are similar in appearance to those above described, but are composed of siliceous limestone. As the shale holding these siliceous concretions weathers they collect upon the surface and resemble deposits of waterworn gravel. The intermediate division of the Conasauga as it occurs in the Coosa Valley is composed of clay shales containing varying amounts of limestone. The limestone appears in some places as a few thin beds scattered through the shales, and in others as massive beds, frequently several hundred feet in thickness. In some places the limestone, instead of forming continuous beds, occurs as flat lenticular masses, an inch or less in thickness, rather closely crowded in the fine shales. The lower portion of the formation consists wholly of fine clay or slightly sandy shales, which appear yellow or brown at the surface and dark bluish gray or black below drainage.

These three subdivisions merge into one another without sharp boundaries. The formation contains no single stratum sufficiently characteristic to be identified at different outcrops and thereby used as a datum for the subdivision of the formation, so that the siliceous beds are represented only as a lentil in the formation. The rocks of the Coosa Valley are everywhere highly contorted and are probably also intersected by numerous faults. For these reasons, and also because large areas in the valley are deeply covered by recent gravels, it is impossible to estimate even approximately the thickness of the formation as a whole or of any of its subdivisions. The fact that the formation occupies such a broad area suggests, however, that its thickness must be very considerable, probably several thousand feet. In addition to the areas already described, the Conasauga forms a number of narrow belts in the northwestern portion of the quadrangle. These occupy the axes of narrow anticlinal rolls or are brought to the surface by faults. The formation here has much the same character as in the type locality; that is, it consists of fine clay shales with occasional beds of blue limestone. The Conasauga formation differs so widely in character in the closely adjoining regions that, except for the evidence derived from the fossils, the two phases would scarcely be correlated. Nothing resembling the upper siliceous division occurs in the region east of the Rome sandstone belt, and, on the other hand, the characteristic oolitic limestone of this eastern region is wholly wanting in the Coosa Valley.

Two explanations of these differences are suggested. The first is that there may have been a barrier of land between the two areas of deposition, so that the rocks of the Coosa Valley and those south of the Coosa fault were laid down in separate, though contiguous, basins. Deriving their sediments from different sources, they would differ in lithologic character, while the faunas might be essentially the same. No trace of such a land barrier, however, has yet been found, and the rocks in question contain none of the characteristic marks of littoral deposition. The second explanation is that the rocks now occupying adjacent areas at the surface were originally deposited in comparatively remote parts of the same sea, but have been brought side by side by folding and faulting, and that the observed lithologic differences are due to the gradual change which is always found upon tracing a bed for a considerable distance. The contrast in character is greatly heightened by the elimination of the intermediate varieties and by the most widely different types being brought into immediate contact, where comparison reveals differences which in the normal relation of the beds might escape notice. The two regions are separated by the Coosa fault, which will be more fully described later. It is quite possible that rocks now in contact on opposite sides of this fault were originally separated by an interval of 10 or 15 miles, and that the intervening rocks, now entirely concealed, would, if restored, present all the intermediate varieties between the two sharply contrasted phases of the formation.

Theoretical explanation of the abrupt change in sedimentation.

SILURIAN ROCKS.

Knox dolomite.—This formation consists of from 4000 to 5000 feet of massively bedded and somewhat crystalline, gray magnesian limestone. From the few fossils which have been found it appears probable that a transition from Cambrian to Silurian occurs in the lower third of the formation, but it is generally impossible to determine this line of division, so the whole formation is classed as Silurian on the Historical Geology sheet. This limestone, or, more properly, dolomite, contains a large amount of silica in the form of nodules and layers of chert, an impure variety of flint. Upon weathering, that part of the rock which consists of the carbonates of lime and magnesia is dissolved, leaving behind the chert, usually embedded in red clay. This residual material covers the surface to a great depth, and the dolomite is seldom seen except in the stream channels. Unlike the underlying Conasauga formation, the Knox dolomite affords some indication of having been deposited in proximity to land toward the east. In a few places the chert beds are replaced by coarse sand disseminated through the dolomite, in some cases making it a calcareous sandstone. This sand increases in abundance toward the east, in which direction, therefore, its source probably lay.

Thick deposit of dolomite with chert nodules.

The Knox dolomite occurs in a number of belts, from 1 to 3 miles in breadth, in the northwestern portion of the quadrangle, and also forms the surface in a much broader area which occupies nearly the whole of the southeastern third of the quadrangle. These areas are characterized by a hilly surface which is usually several hundred feet above the adjoining lowlands. Since exposures of the dolomite are rare, the extent of the formation is determined by means of the residual chert which covers its outcrops. In the vicinity of faults the chert is frequently altered by partial recrystallization of the silica and converted into a white granular rock which readily crumbles on exposure to the air. Hence, those portions of the formation which have undergone this alteration weather to a red siliceous clay soil. This can not be easily distinguished from the soil derived from the Beaver limestone and from portions of the Conasauga formation. Considerable uncertainty, therefore, pertains to the mapping of these three formations, particularly in a much faulted region, as in the vicinity of Indian Mountain.

Chickamauga limestone.—Exposures of this formation present wide differences in character in different portions of the quadrangle. In the narrow belt crossing the northwest corner of the quadrangle, parallel to the face of Lookout Mountain, it consists essentially of evenly bedded, blue limestone with occasional beds of earthy limestone. The latter are generally purple or drab, and the two colors are frequently combined in the same bed, forming a mottled rock. In this western belt the lowest beds of the formation are thick blue limestone, which rests directly upon the underlying cherty gray dolomite. In the next belt to the southeast, which extends diagonally across the quadrangle, the formation has nearly the same character as that above described. It contains, however, more of the mottled earthy limestones and some beds which have a shaly structure. The base of the formation in the southwestern portion of this belt is marked by a bed of conglomerate. The pebbles consist of more or less perfectly water-worn fragments of chert embedded in a muddy calcareous matrix. Still farther east, in the belt which forms the western bases of Gaylor, Simms, and Taylor ridges, the formation shows a still further increase in the proportion of earthy beds and a corresponding decrease in the pure, blue limestone. In the belt occupying the western base of Turnip Mountain and in a small area exposed near the southwestern end of Horseleg Mountain the formation consists largely of purple earthy limestones. The next outcrops of the formation toward the southeast are in the vicinity of Cedartown and in the valley of Euharlee Creek, north of Rockmart. The gradual change in character observed between the outcrops in the northwestern portion of the quadrangle and those in Horseleg Mountain continues toward the southeast, and in the Cedartown and Rockmart areas the formation is no longer a limestone, except in its lower part. The upper part differs so widely in character from any phase observed to the northwest that it is mapped as a distinct formation, the Rockmart slate. In the vicinity of Cedartown the Chickamauga consists of rather heavy beds of blue limestone. The same character prevails in the Rockmart area, although the limestone contains many beds which weather into yellow shale, and it is not sharply separated from the overlying slate. In these two areas the contact of the Chickamauga limestone with the underlying dolomite is everywhere concealed by a band of red clay soil. It is probable that this contact is an unconformity—that is, that the limestone was deposited upon an eroded surface of the dolomite, one which may have been deeply covered by red soil, the product of long-continued decomposition. It is quite certain that, at the end of the Knox dolomite epoch, the region to the south was elevated and a considerable area of the dolomite became dry land. Its surface was worn down by the ordinary agencies of subaerial degradation, and the waste derived therefrom was carried northward and deposited during the early part of the succeeding Chickamauga epoch. The chert formed the conglomerate beds which characterize the lower portion of the Chickamauga in the western belts, and the red clay gave its color to the matrix in which the pebbles are embedded.

Mottled earthy limestones.

Rockmart slate.—This formation is confined to the Cedartown and Rockmart areas, in the southern portion of the quadrangle. As was stated above, these rocks are contemporaneous with the upper portion of the Chickamauga limestone north of Coosa Valley. The formation consists chiefly of black slates, originally calcareous shales, but sufficiently altered for the development of slaty cleavage. In addition to the slate, which occupies the lower portion of the formation, it contains beds of highly ferruginous sandstone and some cherty limestone. It also contains coarse conglomerates, made up of limestone pebbles embedded in an earthy matrix. This upper portion of the formation was evidently deposited near the margin of the sea, where the supply of sediment was abundant and variable in character.

Slates in the southeast corner of the quadrangle.

Rockwood formation.—This formation exhibits a change in character from northwest to southeast similar to that observed in the Chickamauga. In the narrow band which crosses the extreme northwest corner of the quadrangle it consists chiefly of sandy shales with a few beds of hard, brown sandstone. In Dirtseller Mountain the proportion of sandstone to shale is much greater and the beds are heavier and coarser grained. In the next series of ridges, which form a broad, irregular belt northwest of Coosa Valley, the formation is still thicker and is composed more largely of sandstone. The sandstones are generally brown in color, although there are also some beds of clean-washed, white sand. The most southeasterly exposure of the formation is in Horseleg Mountain. Here it is made up largely of white sandstone, evidently a beach deposit. A short distance south of Cedartown, in the Tallapoosa quadrangle, the formation is probably represented by a stratum of white sandstone only a few feet in thickness. It thus appears that during the deposition of this formation the sea margin coincided nearly with the present Coosa Valley, probably fluctuating between narrow limits. The coarsest and most abundant sediment was deposited in the belt now occupied by the high valley ridges, while the finer sediment was carried farther toward the northwest. Still farther toward the northwest the sediment becomes decidedly calcareous. The formation contains several beds of red hematite, or "fossil iron ore." The conditions most favorable for the deposition of iron ore appear to have been in a belt lying between the coarse sandstones of the littoral margin and the calcareous rocks of the deeper sea.

Brown sandstone containing hematite iron ore.

DEVONIAN ROCKS.

Frog Mountain sandstone and Armuchee chert.—During the greater part of Devonian time the area of the Rome quadrangle was dry land. At the close of the Rockwood epoch the sea either became very shallow or retreated entirely from this region. There was probably a depression along the eastern margin of the present valley, within which some deposition took place in early Devonian time. Whatever may have been the original extent of the formations deposited at this stage, only small remnants have been preserved. The Frog Mountain sandstone is confined to the extreme southwest corner of the quadrangle, its largest outcrops being in the adjacent Fort Payne quadrangle. It consists chiefly of white quartzitic sandstone and yellow porous sandstone, the latter probably containing feldspar. It also contains some sandy shales. These rocks yield a few poorly preserved fossils of Oriskany age. On the northern side of the Coosa Valley is a limited area within which there occurs another formation, which is probably of the same age as the Frog Mountain sandstone. This is the Armuchee chert. It is developed in Horseleg Mountain, where it has a thickness of probably 50 feet, in the northeastern portions of Lavender and Sims mountains, and in a portion of Taylor Ridge. It also occurs in the ridges to the east—John, Turkey, and Horn mountains—extending northward about 10 miles into the adjoining Ringgold quadrangle. The formation consists of bedded chert, at places grading into a ferruginous sandstone. Its maximum thickness is found in Horseleg and Turkey mountains, and thence westward it decreases to a feather edge. It is fossiliferous in places, and the fossils are similar to those found in the Frog Mountain sandstone. It is probable, therefore, that it represents an offshore deposit contemporaneous with the coarse sandstones of Frog Mountain. The latter may originally have been continuous along the eastern margin of the Appalachian Valley belt, but if so they have been removed from that region in Georgia and Tennessee.

Dry land during part of the Devonian period.

Chattanooga shale.—Following the deposition of the sandstone and chert in early Devonian time, conditions were such over the entire region that no deposition took place until late Devonian. It is not known what the conditions preventing deposition may have been—whether the region was dry land or shallow seas swept by currents. In late Devonian time conditions were favorable for the deposition of a formation which extends for a long distance to the north and west with remarkable uniformity. This is the Chattanooga black shale, which consists generally of two divisions. The lower member is jet-black carbonaceous shale. It varies in thickness, reaching a maximum of 40 feet. It is in some places only 1 or 2 inches thick, but even then retains perfectly its characteristic features. Wherever present in the Rome quadrangle it has a thickness of 10 feet or less. The upper division consists of blue or greenish clay shale, usually containing phosphatic concretions. Generally these are perfectly round, from three-fourths of an inch to an inch in diameter, and are closely crowded together in certain layers of the formation. They sometimes increase in size to a foot or more in diameter, when they have oval or irregular forms. The green color of the formation is due to the presence of glauconite, a mineral containing potash, iron, and alumina. This upper member of the formation varies from 1 to 3 feet in thickness. The Chattanooga shale is absent over an irregular area near the center of the quadrangle, including the southwestern portions of Simms, Lavender, and Horseleg mountains and the eastern portion of Gaylor Ridge. Elsewhere it is found overlying either the Armuchee chert or, where that is absent, the Rockwood sandstone.

Jet-black carbonaceous shale.

Thin layer of phosphatic concretions.

CARBONIFEROUS ROCKS.

Fort Payne chert.—The uniform conditions which prevailed over a wide area during the deposition of the Chattanooga shale continued and became more widespread in succeeding (Carboniferous) time. The whole of this region was probably submerged and the sea margin advanced an unknown distance toward the east. The conditions were favorable for the deposition of cherty limestone, and the Fort Payne chert was deposited. This consists of from 50 to 150 feet of evenly bedded chert with a small amount of shale and limestone. The chert is usually, though not always, filled with fossil impressions, chiefly the impressions of crinoid stems. It is somewhat less resistant than the underlying Rockwood sandstone, and usually forms a narrow band upon the lower slopes of the Rockwood ridges. The formation is thinnest at its eastern outcrops, in Horseleg and Turkey mountains, and gradually thickens toward the northwest corner of the quadrangle.

Evenly bedded chert formation.

Floyd shale.—The uniform conditions favorable to the deposition of cherty limestone had prevailed but a relatively short time when the region to the southeast was elevated and the supply of sediment furnished to the neighboring sea became abundant. This checked the formation of chert along the eastern margin of the sea, and a great thickness of shale and sandstone was there deposited, while chert and, later, pure limestone were being deposited at a greater distance from the shore, toward the northwest. The Floyd shale forms an extensive area in the region northwest and north of Rome, underlying most of the low land between the various valley ridges from Horseleg Mountain to Taylor Ridge. It consists chiefly of fine, black shale, slightly sandy in places, and elsewhere grading into black or blue limestone. Some phases of the shale are indistinguishable from the Chattanooga. The limestones and some of the sandy beds are highly fossiliferous. The formation becomes gradually more calcareous toward the west, containing more limestone in the West Armuchee Valley than in the vicinity of Rome, and is probably represented by a band of shaly limestone along the base of Lookout Mountain which is included in the Bangor limestone.

Extensive areas of lowland occupied by black shale.

It is impossible to determine the thickness of the Floyd shale in the region of its greatest development. Between Turkey and John mountains it occupies a broad valley and its beds have usually a vertical dip. This is doubtless produced by a large number of close folds, and it is not probable that the formation has anything like the thickness which would be obtained by measuring across the outcrops of the beds. Between Simms and Lavender mountains the formation occurs in a gentle syncline and its thickness can be determined with a fair degree of accuracy. It is there about 1200 feet thick. To the westward the Floyd shale is represented by calcareous shales and impure limestones of variable thickness. These occupy the valley between the ridge of Fort Payne chert and Rockwood sandstone on one side and the plateau of Coal Measure sandstone on the other. They are almost never exposed, and merge with the overlying limetones so gradually that no attempt has been made to separate them.

Oxmoor sandstone.—After a great thickness of carbonaceous shale had been deposited the land to the eastward was still further lifted and coarse sediments were locally supplied to the adjacent sea. These form the Oxmoor sandstone, which occurs at or near the top of the Floyd shale. The only areas of the Oxmoor sandstone in this quadrangle occur on Judy Mountain, where it is a rather coarse conglomerate, and in a belt which entirely encircles Rocky Mountain, between Simms and Lavender mountains. In the latter locality the formation is much finer grained than in Judy Mountain, consisting chiefly of thin-bedded brown and white sandstones. The thickness as measured in this belt is 600 feet.

Conglomerate on Judy Mountain.

Bangor limestone.—In the northwestern portion of the quadrangle the next formation succeeding the Fort Payne chert is the Bangor limestone. As stated above, this consists at the base of calcareous shales and impure limestone not sharply separated from the underlying Fort Payne chert, and above of massive blue limestone. In some places the pure limestone extends entirely to the top of the formation, but generally the upper portion contains considerable argillaceous material and weathers to a fine clay shale. Along the base of Lookout Mountain the Bangor limestone has a thickness of about 800 feet. Toward the southeast the limestone is more and more largely replaced by shale and sandstone. In the vicinity of Little Sand Mountain and in Texas Valley it probably has a thickness of about 300 feet. The limestone is always highly fossiliferous and in many cases is made up almost entirely of fragments of crinoid stems.

Highly fossiliferous limestone.

Lookout sandstone.—During the early part of Carboniferous time the conditions were such that a large amount of sediment was furnished to the sea occupying this region, but it was confined to a narrow belt along the sea margin, and while shales and sandstones were being deposited there limestones were forming only a few miles northwestward. It should also be noted that the supply of sediment decreased, either by reason of the eastward expansion of the sea, which carried the zone of deposition beyond the limits of this region, or by reason of the wearing down of the land from which the sediment came. The latter appears the more probable explanation; but whatever may have been the cause, the conditions were favorable for the formation of limestones over the whole region in the latter part of lower Carboniferous time. In upper Carboniferous time the supply of sediment again became abundant, but conditions favored its transportation and deposition over a broad area. Conditions were also at times favorable for the formation of coal beds. The region was probably near sea level and doubtless suffered repeated oscillations by which it was alternately dry land and covered with a moderate depth of water.

The Lookout formation consists in this region of sandstones and sandy shales with a little conglomerate. The conglomerate is confined to the upper portion, which consists of from 100 to 130 feet of rather coarse, cross-bedded sandstone, with more or less abundant streaks of quartz pebbles. Below this are 100 or more feet of thin-bedded sandstones and sandy shales, and at the base of the formation from 50 to 80 feet of rather coarse sandstones. These subdivisions of the formation are variable in thickness and character, although they can be recognized in most sections. The formation as a whole varies between 320 and 400 feet in thickness. It occurs in the Rome quadrangle only in two isolated areas — Rocky Mountain and Little Sand Mountain. These areas occupy the bottoms of deep synclines in which the higher formations have been preserved from erosion. The formation was doubtless originally deposited over the whole of the quadrangle northwest of the Coosa Valley, and it may have extended considerably farther toward the southeast. The remnants which have been preserved do not differ greatly from the formation as it occurs in Lookout Mountain, and they do not afford any indication of having been formed near the margin of the deposition basin. The conglomerate pebbles are even less abundant in this region than they are many miles to the westward, and therefore it does not seem probable that the source of the material was chiefly to the southeast.

Sandstones forming Rocky Mountain.

The formation contains one bed of coal which may be of workable thickness, though its workable area will be so small that it is of little economic importance.

NEOCENE (?) SEDIMENTS.

Lafayette (?) formation.—At the close of the Carboniferous period the whole of the southern Appalachian region was permanently raised above sea level and the constructive process of sedimentation was replaced by the destructive process of subaerial degradation. During the later part of Carboniferous and the whole of Juratrias and Cretaceous time the region was subjected to repeated oscillations, and an enormous amount of material was carried off to adjoining seas by its streams. In Neocene time the gradients of the valleys were low and lodgment deposits were common phenomena. In the flatter portions of the valleys the streams for a short time built up alluvial deposits, chiefly sand and gravel, fragments of which still remain but have not been consolidated. These are confined chiefly to the Coosa Valley from Rome southwestward, but also occur in the Oostanaula Valley. They consist of coarse waterworn pebbles, sometimes 3 or 4 inches in diameter, and fine, red, sandy silt. In the vicinity of Rome the gravel is found at an elevation of from 200 to 250 feet above the river. It may once have formed extensive deposits at this altitude, but at present only the coarsest material has escaped erosion, and this has been worked over so that it does not show its original mode of deposition. In the Coosa Valley proper these alluvial deposits are found covering considerable areas. They are sometimes 30 or 40 feet in thickness and from 50 to 75 feet above the present river. Westward from Horseleg Mountain they are especially abundant, forming a series of low hills within the river valleys. There is usually a heavy bed of coarse gravel at the base of the formation, with a variable thickness of silt above. The two members are nearly always sharply separated, although lenses of gravel sometimes occur in the fine silt. Deposits of similar material occupy indistinct terraces nearer the present Coosa River. They apparently consist of the high-level gravels worked over and redeposited during the lowering of the stream channel. Although these deposits have not been traced continuously to the southwest, and therefore can not be definitely correlated, they probably constitute the inner margin of the Lafayette formation, which is extensively developed in central Alabama.

Remnants of unconsolidated gravel and silt terraces.

STRUCTURE.

Definition of terms.—As the materials forming the rocks of this region, excepting the igneous rocks above described, were deposited upon the sea bottom, they must originally have been in nearly horizontal layers. At present, however, the beds are not usually horizontal, but are inclined at various angles. The *strike* of a bed is the course which its intersection with a horizontal surface would take. The *dip* is the angle at which the bed is inclined to the horizontal, measured at right angles to the strike. When any particular bed is followed for a considerable distance it is generally found in the form of a series of arches and troughs. In describing these folded strata the term *syncline* is applied to the troughs and *anticline* to the arches.

A *synclinal axis* is a line running lengthwise along the bottom of the synclinal trough of any particular bed, toward which the rocks dip on either side. An *anticlinal axis* is a line which occupies the crest of the anticlinal arch of any particular bed, and from which the rocks dip on either side. These axes may be horizontal or inclined. Their departure from the horizontal is called the *pitch* of the axis, and is usually but a few degrees. In addition to the folding, and as a result of the continued action of the same forces which produced it, the strata along certain lines have been fractured and the rocks have been thrust in different directions on opposite sides of the fracture. Such a break is termed a *thrust fault.* The rocks are internally altered by the production of new minerals from the old, a change termed *metamorphism.*

Structure of the Appalachian province.—Three distinct types of structure occur in the Appalachian province, each one prevailing in a separate area corresponding to one of the three geographic divisions. In the Cumberland Plateau region and westward the rocks are but little tilted from their original horizontal position and are almost entirely unchanged in their mineralogical composition; in the Appalachian Valley the rocks have been steeply tilted, bent into folds, broken by faults, and to some extent the shales have been altered to slates; in the Appalachian Mountain district faults and folds are prominent, but the rocks have been changed to a greater extent by the development of cleavage and of new minerals.

In the Appalachian Valley the folds and the faults are approximately parallel to each other, and generally extend in a northeast-southwest direction for great distances. Some faults have been traced for 300 miles, and some folds have even greater length. Most of the rocks dip at angles greater than 10°, and frequently the sides of the folds are compressed until they are nearly parallel. The folds are most numerous in thin-bedded rocks, such as shale and shaly limestone, because the thin layers were most readily bent, and slipped along their bedding planes. Many of the folds are overturned toward the northwest, so as to produce a preponderance of southeastward dips. In some sections across the southern portion of the Appalachian Valley scarcely a bed can be found which dips toward the northwest.

Folds and faults of the Appalachian Valley.

In connection with the folding, faults were developed, and with very few exceptions the fault planes dip toward the southeast. Along these planes of fracture the rocks moved sometimes as much as 6 or 8 miles. There is a progressive increase in degree of deformation from northeast to southwest, resulting in different types of structure in different portions of the Appalachian Valley belt. In northern Pennsylvania folds are inconspicuous. Through Pennsylvania toward Virginia they become more numerous and dips grow steeper. In southern Virginia the folds are closely compressed and often closed, while occasional faults appear. From Virginia into Tennessee the folds are more and more broken by faults, until, halfway through Tennessee, nearly every fold is broken and the strata form a series of narrow, overlapping blocks, all dipping eastward. This condition prevails southward into Alabama, but the faults become fewer in number and their horizontal displacement much greater, while the folds are somewhat more open.

In the Appalachian Mountains the structure is similar to that which marks the Great Valley. There are eastward dips, close folds, and thrust faults. But in addition to these changes of form, which took place mainly by motion on the bedding planes, a series of minute breaks was developed across the strata, producing cleavage, or a tendency to split readily along new planes. These planes dip to the east at from 20° to 90°, usually about 60°. This slaty cleavage was somewhat developed in the valley, but not to such an extent as in the mountains. As the cleavage becomes more highly developed it is accompanied by the recrystallization of the rock constituents, forming new minerals. These consist chiefly of mica and quartz and are generally arranged in layers parallel to the cleavage cracks. The final stage of the process resulted in the squeezing and stretching of some minerals, like quartz, and complete recrystallization of the remaining constituents. All rocks, both those of sedimentary origin and those which were originally crystalline, were subjected to this process, and the final products of the metamorphism of very different rocks are often indistinguishable from one another. Rocks containing the most feldspar were most thoroughly altered, and those with most quartz were least changed. Throughout the greater part of the Appalachian Mountains there is a somewhat regular increase of metamorphism toward the southeast, so that rocks of the same age may be quite unaltered at the border of the Great Valley while farther east they have lost most of their original characteristics.

Cleavage and metamorphism in the Appalachian Mountains.

The structures above described are probably due chiefly to horizontal compression, which acted in a northwest-southeast direction, at right angles to the trend of the folds and cleavage planes. The compression apparently began in early Paleozoic time, and continued at intervals up to its culmination, shortly after the close of the Carboniferous, when the greater portion of the folding was effected.

In addition to the horizontal force of compression, the province has been subjected to other forces which have repeatedly elevated and depressed its surface. At least two periods of high land near the sea and two longer periods of low land are indicated by the character of the Paleozoic sediments; and in post-Paleozoic time there have been at least three, and probably more, periods of decided oscillation of the land due to the action of some vertical force. In every case the movements have resulted in the warping of the surface, and the greatest uplift has occurred nearly along the line of the Great Valley.

Structure sections. — The five sections on the structure sheet represent the strata as they would appear in the sides of a deep trench cut across the country. Their position with reference to the map is along the lines at the upper edges of the blank strips. The vertical and horizontal scales are the same, so that the elevations represented in the profile are not exaggerated, but show the actual slope of the land and the dip of the strata. These sections represent the structure as it is inferred from the position of the strata observed at the surface. On the scale of the map they can not represent the minute details of structure; they are therefore somewhat generalized from dips observed near the line of the section in a belt a few miles in width.

Faults are represented on the map by heavy solid or broken lines, and in the sections by lines whose inclination shows the probable dip of the fault plane, the arrows indicating the relative direction in which the strata have moved.

Structure of the Rome quadrangle.—As already stated, the Rome quadrangle is confined to a single physiographic province, namely the Appalachian Valley belt. Its structural features, therefore, are only such as characterize the Appalachian Valley. The close connection between the topography and the structure of the region has already been pointed out, and the different portions of the region which are characterized by different kinds of relief are also characterized by distinct types of structure.

Northwest of the Coosa Valley the structural features are similar to those found in the greater part of the great Appalachian Valley belt. The beds, originally horizontal, have been compressed by a force acting in a northwest-southeast direction, and a series of folds has been formed. These folds have a characteristic unsymmetrical form, the rocks dipping much more steeply on the northwestern side of the anticlinal axes than on the southeastern side. The rocks are also intersected by numerous faults, which extend in a direction generally parallel to the axes of the folds. Broomtown and Chattooga valleys are typical anticlines which are faulted along the western side of their axes. Lavender, Turkey, and Horn mountains are smaller anticlines in which the beds on the northwestern side of the axes are steeply inclined but are not faulted. This structure is comparatively simple and its details are shown on the sections, so that it does not require further detailed description.

Overturned and faulted anticlines.

The essential structural feature of the southeastern portion of the quadrangle is a broad, gently undulating syncline pitching southward. This region is occupied chiefly by the Knox dolomite, and this formation, here extremely massive, appears to have resisted the sharp folding which the rocks in the northwestern portion of the quadrangle suffered.

The belt occupied by the Coosa-Oostanaula Valley, extending diagonally across the quadrangle between these two regions of simple structure just described, has been much more profoundly affected by the compression which the region has suffered. From evidence afforded by the character of the sedimentary formations on either side it appears that this belt was at various periods during Paleozoic time an axis of uplift. There is evidence that in middle Cambrian time it was a narrow strip of shallow sea or dry land. At the close of the Knox dolomite epoch it was again elevated and the dolomite was wholly or in part removed. Again, throughout the whole of Devonian time, it was, in part at least, dry land; and during early Carboniferous time it was, near the sea margin, probably fluctuating above and below sea level. When the compression to which the region had been subjected at intervals during Paleozoic time culminated at the end of the Carboniferous period, this belt was therefore in a condition to be more intensely affected by this compression than the region on either side. In the region to the northwest the Knox dolomite and the Rockwood sandstone were both comparatively rigid and were only bent into a number of sharp folds. In the region to the southeast the Knox dolomite was exceptionally massive and resisted sharp folding. The belt between was occupied chiefly by fine shales of great thickness. These shales, being unsupported by rigid beds, were finely plicated and intersected by many faults. Two of these faults are of sufficient importance to merit somewhat detailed description. It will be observed on the Historical Geology map that the contact between the Cambrian shales of Coosa Valley and the Carboniferous and Silurian rocks to the northwest is extremely irregular. This line of contact, entering the quadrangle near the northeast corner, curves around the point of Horn Mountain and makes a loop in the valley of John Creek. Continuing southward, it passes the southern point of Turkey Mountain and makes another broad loop to the westward between Rome and Lavender Mountain. Continuing still farther southward, through Rome, and passing around the southern point of Horseleg Mountain, it makes a third loop west of the mountain. Thence westward to the margin of the quadrangle its course is marked by a number of curves and deep indentations. This contact is the line of intersection of one of the fault planes with the surface of the earth, and is called the Rome fault.

The Coosa-Oostanaula Valley an axis of uplift.

Outcrop of the Rome fault.

It is at once manifest that this fault differs widely from those which occur in the northwestern portion of the quadrangle and throughout the Appalachian Valley generally. The intersection of the latter type of fault with the surface is usually a nearly straight line, and wherever the actual fault plane can be observed it is found to have a steep dip, generally to the southeast. The plane of the Rome fault appears to have been at first nearly horizontal, dipping very gently to the eastward, and subsequently folded along with the underlying and overlying rocks. As the fault enters the northeast corner of the quadrangle it dips somewhat steeply eastward, and at first appears to have the character of the typical Appalachian faults. The manner in which it curves around the southern point of Horn Mountain indicates, however, that the fault plane has been affected by the folding to which that anticlinal ridge is due. The point extending northward some distance into Rocky Creek Valley occupies a syncline. The next point extending southward is in somewhat close conformity to the outline of the next ridge westward, which is also anticlinal, and the broad loop extending northward toward Everett Springs again occupies a syncline. The overthrust Cambrian shales are thus somewhat rudely conformable to the underlying Carboniferous and Silurian formations. The broad loop extending southwestward from Pope Ferry and the narrower loop extending northeastward from the southern point of Horseleg Mountain both occupy shallow synclines, and the overthrust Cambrian rocks appear to be conformable to the underlying Carboniferous. In this region, which contains these three distinct loops, the fault plane is between the Floyd shales below and the Conasauga shales above. The underlying Carboniferous rocks are generally not much disturbed, forming merely a series of shallow synclines and somewhat sharper anticlines. The overlying Cambrian rocks, on the other hand, are intensely contorted, both the shales and the interbedded limestone layers being bent into sharp folds and intersected by many cracks, which are generally filled with calcite. In general there is a sharp and unmistakable distinction between the underlying slightly disturbed carbonaceous shales and the overlying highly contorted calcareous shales. Fossils may usually be found in both, wherever there is any question of identification. In some cases the overlying calcareous shales near the fault have been converted into carbonaceous shales, apparently by the absorption of carbonaceous matter from the underlying rocks, probably at the time of faulting.

The Rome fault folded with the underlying rocks.

Condition of the strata along the Rome fault.

The conditions which favored the formation of this broad thrust fault have been in part indicated above. It probably began in late Carboniferous time. During the deposition of the Coal Measures to the westward, or shortly after the close of the Carboniferous, this belt, which had at various periods in Paleozoic time been uplifted and subjected to erosion, was again elevated, and all rocks which may have been deposited above the Floyd shale were removed. The region was then subjected to compression in a northwest-southeast direction, and along the old axis of elevation a fracture was developed, along which the Cambrian and overlying rocks to the southeast were thrust westward upon the surface of the Floyd shales, while the rigid beds on either side of this belt of weakness resisted folding and transmitted the thrust. The maximum distance to which the rocks were thrust along the fracture can not now be determined. The present extent of the faulting as observed from Rome northwestward is about five miles, but this is doubtless only a fraction of the original distance to which the older rocks were thrust over the younger. The distance has subsequently been shortened by folding and by the erosion of the overthrust rocks. The effect of the faulting was doubtless to strengthen the region, which had previously been structurally weak, and the continued compression thenceforth resulted in the development of folds and faults on either side of the belt. The overthrust and underthrust rocks were affected like conformable formations and the fault plane was folded as though it were a plane of deposition. As the anticlines rose, there summits were worn down; first the overthrust rocks were removed, and then to a greater or less extent the underthrust beds were eroded. The overthrust rocks, therefore, were preserved only in synclines, where they were protected by their position below the base-level of erosion. If the region were elevated a few hundred feet more it is probable that the remaining lobed areas of overthrust rocks would be nearly or entirely removed, and the fault plane would then have a rather regular intersection with the land surface.

Cause of Rome fault.

Displacement on Rome fault more than five miles.

A second fault, which is comparable in size with the Rome fault described above, although differing from it materially, crosses the quadrangle in a diagonal direction from northeast to southwest. This has been named the Coosa fault, as it occupies the eastern edge of the Coosa Valley. Northeast of Rome the fault has a very regular course and brings the Rome formation up onto the Conasauga shale. Southwest of Rome to the edge of the quadrangle its course is somewhat less regular. It there brings the Rome formation, and in places one phase of the Conasauga formation, upon another phase of the latter formation to the westward. This fault plane dips eastward at a low angle, rarely more than 15°. Wherever the plane can be actually observed it is marked by a bed of breccia, several feet in thickness, composed of the ground-up fragments of the beds on either side. In this case the rocks below the fault are usually much more highly altered than those above, especially when the latter are Rome sandstones. The Coosa fault appears to have been produced somewhat later than the Rome fault and was probably accompanied by or followed the folding of the region. Its fault plane, therefore, has not been so extensively folded as that of the Rome fault, and consequently its intersection with the present surface is much more regular, although the extent of the movement upon this plane may be quite comparable with that upon the plane of the older fault.

Course of the Coosa fault.

The region lying immediately southeast of the Coosa fault from Rome southwestward to the margin of the quadrangle is intersected by a large number of minor faults of a distinct type from those already described. The main structural axes in this region have a northeast-southwest trend, but these minor faults extend nearly north and south, making an acute angle with the major structures. They are probably later than both the Rome and Coosa faults, and may have been produced during the period of intense folding to the northwest. Where these faults are most numerous, as in the region south of Rome and that west of Cave Spring, the strata are broken into a number of long, narrow strips overlapping one another and all dipping to the eastward. The faults intersect the Knox dolomite and the underlying Conasauga shale, and wherever the latter is faulted to the surface a valley is formed. The faults probably extend some distance beyond the ends of the shale areas into the dolomite area, but they can not be traced on account of the great mass of residual chert which covers the Knox outcrops. The southwestern portion of the quadrangle, occupied chiefly by the Weisner quartzite, is intersected by a large number of these minor faults, only a few of which can be traced upon the ground, by reason of the absence of exposures and the abundance of débris.

A system of north-south faults.

MINERAL RESOURCES.

The more important mineral resources of the Rome quadrangle consist of iron ore, bauxite, roofing slate, lime, and building stone.

IRON.

The iron ores of the Southern Appalachian region fall naturally into five distinct groups, as follows: (1) magnetite, (2) specular hematite, (3) red hematite, or "fossil ore," (4) carbonate, or black-band ore, and (5) brown hematite, or limonite. Two of these groups are found in the Rome quadrangle; namely, red hematite and limonite.

The red hematite is confined chiefly to the region northwest of Coosa Valley. It occurs there in the form of regularly stratified beds associated with the Rockwood formation. It is not always present in this formation, and is generally absent where the formation is composed largely of sandstone. The iron ore, therefore, increases in abundance westward and is nearly or quite absent from the easternmost portion of the formation, which was deposited near the margin of the sea. At its outcrop the red hematite is usually soft and porous, is frequently made up of small oval and flattened grains, and generally contains many fossil impressions. When followed under the cover of overlying rocks, the soft ore passes into hard ore which contains a much larger proportion of lime carbonate, and in some cases the ore bed passes into a bed of more or less ferruginous limestone. The change from hard ore to soft ore is brought about by the solution and removal of the lime. This change is usually accompanied by a reduction in the thickness of the bed, although this does not always occur. Since the red hematite is in the form of a regularly stratified bed which retains its thickness and composition for considerable distances, the amount of ore in a given territory can be determined with a high degree of certainty. In this respect the ore differs widely from most iron ores, which occur in less regular deposits.

Bedded deposits of hematite iron ore.

The narrow belt of Rockwood shale and sandstone which crosses the northwest corner of the quadrangle contains two beds of ore, both of which are locally workable, although they are thinner in this quadrangle than they are a short distance to the northeast. The area of Rockwood sandstone forming Dirtseller Mountain contains the largest area of the red hematite in the quadrangle, having a workable thickness. The ore occurs in two distinct beds, separated by about 50 feet of sandy shale and thin-bedded sandstone. The upper bed varies from 12 to 16 inches in thickness and the lower from 18 to 24 inches. Both beds are extensively worked in the valley of Mills Creek, just beyond the edge of the quadrangle, and in the northern portion of Dirtseller Mountain. In the latter locality the mining is done chiefly by stripping, the ore occupying considerable areas near the surface in the sides and bottom of the shallow syncline. It is also mined by underground working.

The red hematite has been found in all of the valley ridges between Chattooga and Coosa valleys, but it probably does not occur in this region in beds of sufficient thickness to mine profitably. The outcrops of the bed, where mining can be done very cheaply, will doubtless afford considerable ore, but the beds are not sufficiently thick to pay for underground mining.

In the southeastern portion of the quadrangle the Rockmart slate contains some beds which very closely resemble the red hematite associated with the Rockwood formation. The ore occurs in thin plates, usually more or less disturbed and embedded in red clay. It results from the weathering of highly ferruginous bands in limestones and calcareous slates. While this ore somewhat closely resembles the red hematite of the Rockwood formation, it does not occur in beds having the remarkable uniformity and great lateral extent which characterize the latter. It appears to be confined to the few localities where the limestones were locally enriched by the deposition of iron and where conditions have been favorable for its preservation upon the weathering of the original beds. This ore has been somewhat extensively mined at one locality in the quadrangle.

The limonite, or brown hematite, is found chiefly in the southeastern portion of the quadrangle, and occurs under a variety of geologic conditions. During the process of Neocene base-leveling, previously described, the Chickamauga limestone was more quickly reduced to base-level than the Knox dolomite. It received the drainage from the surrounding dolomite areas, and extensive deposits of limonite or bog ore were formed. When the region was uplifted at the close of the epoch of Neocene base-leveling the surface of the limestone was again eroded more rapidly than that of the adjoining dolomite, and much of the iron ore which had been deposited upon the surface of the limestone was doubtless removed by erosion. Much remained, however, at or near the level of the old Neocene peneplain, embedded in the residual soil around the margins of the limestone areas. Thus the several areas of Chickamauga

Extensive deposits of limonite iron ore.

Limonite gravel ore.

limestone in the southeastern portion of the quadrangle are more or less completely surrounded by an ore-bearing belt of variable width. This ore is extensively mined in the vicinity of Hamlet, Long, Fish, and Cedartown. It consists largely of gravel ore — small irregular concretions from the size of shot up to masses a foot or more in diameter, disseminated through the red residual clay. The ore is mined in irregular open pits, and is usually screened and washed before smelting.

Ore deposits at limestone-quartzite contact.

The second mode of formation of limonite deposits is by the accumulation from the weathering of an overlying limestone formation upon an underlying impervious stratum. Conditions favorable for such deposition occur wherever the Weisner quartzite passes under the Beaver limestone. The latter contains a small percentage of iron, and as its soluble constituents were removed the iron was concentrated with other insoluble constituents into beds of limonite upon the surface of the underlying Weisner quartzite. Similar conditions are found to a limited extent where the Oxmoor sandstone passes under the Bangor limestone. Ore deposits of this class are found chiefly in the vicinity of Indian Mountain. They occur upon the steep slopes of the quartzite at various points on the southern side of the ridges. Their present position may be considerably above the present level of the limestone, but they mark the position of former contacts between limestone and quartzite. Some deposits of this class are also found in the narrow valley which surrounds Rocky Mountain. These latter have never been worked and their extent and value are questionable.

Iron ore along faults.

The third class of deposits is located along faults. It appears probable that the extensive faulting of the region was accompanied by the formation of springs, doubtless thermal, which brought minerals in solution from considerable depths. Among these, iron was most abundant, and when it reached the surface it was quickly oxidized and deposited in the form of limonite. The deposits of the last two classes are generally closely associated and can not always be discriminated. The most important of the deposits formed along fault lines occur on either side of Indian Mountain, where the faulting has been especially intense. This ore differs from the gravel ore by its occurrence in larger masses. These are often many feet in diameter and extend to a much greater depth than the gravel ore bed. These deposits of limonite are closely associated with the bauxites, both in their present occurrence and in their mode of formation.

BAUXITE.

Ore of aluminum.

This mineral bears the same relation to aluminum that limonite bears to iron; this is, it is the hydrated oxide, and is the chief ore employed in the production of the metal. Although aluminum is one of the most abundant elements entering into the composition of the earth's crust, it generally occurs in combination with silica, and on account of its strong affinity for silica such compounds can not be employed profitably in the production of the metal.

Workable deposits of bauxite are known to occur at only a few places in the United States, and by far the larger part of the mineral thus far mined in the United States has come from the Rome quadrangle.

Bauxite has usually a pisolitic or oolitic structure. It is composed of small, round concretions which vary in size from one-tenth of an inch up to an inch or more in diameter. These concretions consist of a nucleus, which in some cases is structureless and in others is composed of a rounded fragment of the ore, and, around this nucleus, concentric layers of the compact structureless mineral. The color varies from white or light gray to brick red, depending upon the amount of iron present. The ore contains, in addition to the oxide of aluminum and water, variable percentages of iron and silica. The metal aluminum is obtained by electrolysis of the pure anhydrous oxide, and this is obtained from bauxite by removing the iron and silica. Ore can be used for the production of alumina, and for the preparation of other aluminum compounds, as aluminum sulphate and alum, when the iron and silica combined amount to less than 10 or 12 per cent.

The ore occurs in the form of compact masses or pockets embedded in clay, tapering downward somewhat symmetrically. Their dimensions are from 50 to 300 feet in horizontal diameter and from 20 to 100 feet in depth. When a deposit has been worked out a cup-shaped depression is left, usually surrounded by fine mottled clay, which passes gradually into the reddish cherty clay derived from the weathering of the surface rocks. These pocket deposits occur both singly and in groups. In some cases several deposits merge more or less closely, in which case their symmetry is destroyed. Most of the deposits which have thus far been discovered in this region occur in five groups, four of which are within the limits of the Rome quadrangle. The location of the individual deposits is indicated on the Economic Geology sheet. The first group occurs a few miles northeast of Rome, within the limits of the Knox dolomite plateau. It includes about twenty separate deposits, most of which have been nearly or entirely exhausted. The second group of deposits occurs 8 or 10 miles south of Rome. These are also embedded in the residual material derived from the weathering of the dolomite, but are for the most part arranged along faults, and their origin is probably closely associated with these faults. The third group includes three deposits 2 miles southeast of Cave Spring. These are also probably located upon a fault. The fourth group is located at the northern base of Indian Mountain, just west of the Georgia–Alabama line. It contains the largest deposits which have yet been discovered in this region, though most of them are now exhausted. They are closely associated with a profound fault which passes along the northern base of Indian Mountain, and are partly within the Knox dolomite and partly in areas underlain by the Frog Mountain sandstone. In addition to these deposits occurring in groups, two isolated deposits have been found, one about 4 miles southeast of Rome and another in the vicinity of Summerville. These differ in no material respect from the individual deposits in the larger groups.

Origin of the bauxite.

The bauxite deposits above described are probably of Neocene age, since they occur at about the elevation of the peneplain which was developed during Neocene time. The theory of their origin may be briefly outlined as follows: The extensive system of faults by which the rocks of the region are intersected enabled surface water to penetrate to considerable depths below the surface. It there came in contact with the Conasauga shale, which consists largely of silicate of aluminum, but contains also considerable iron pyrite. The latter was oxidized and iron sulphate and some free sulphuric acid were formed. The acid attacked the aluminum silicate and effected its decomposition, with the formation of free silica and aluminum sulphate. The aluminum sulphate was brought to the surface in solution along fault fractures, and, upon coming in contact with the limestone near the surface, it was decomposed, forming lime sulphate and aluminum hydroxide. The latter, upon reaching the surface in the form of a gelatinous precipitate, was segregated into pisolitic concretions and deposited about the exits of springs, forming the bauxite deposits above described.

Other compounds, formed at the same time as the aluminum sulphate, were less readily decomposed and were either completely removed in solution or deposited at greater distances from the springs. The iron brought to the surface along with the aluminum compounds formed some of the extensive limonite deposits which occur in the same region.

SLATE.

The most extensive slate quarries in the United States south of Pennsylvania are located at Rockmart, just beyond the southeast corner of the Rome quadrangle. The formation in which the quarries are located, the Rockmart slate, extends across the border into the Rome quadrangle, but it is not certain that any workable slate will be found in this area. The formation is variable in composition, and to the north of Rockmart consists largely of unaltered clay shales with beds of ferruginous limestone and sandstone.

The portion of the formation which now produces roofing slate was originally a fine-grained homogeneous clay shale. Under the influence of metamorphism, connected probably with the extensive faulting which the region has undergone, a very perfect slaty cleavage was developed, which generally obscures, and in some cases entirely obliterates, the original bedding. East of the quadrangle, along the Cartersville fault, the slate is generally wrinkled near the fault, so that it does not cleave readily, and at a considerable distance from the fault the cleavage is only imperfectly developed. Hence the best slate will be found within a comparatively narrow belt, from 1 to 5 miles from the fault.

LIME.

Limestone suitable for making lime occurs at many places in the quadrangle. The best stone for this purpose is in the Chickamauga and Conasauga formations. The former is extensively burned at Davitte, in the southeastern portion of the quadrangle. It is also quarried in this district for flux in iron furnaces and for railroad ballast.

Numerous beds of pure blue limestone occur in the belt of Conasauga shale which extends diagonally across the quadrangle. This is quarried at many points and burned for local use.

SOILS.

Derivation and distribution.—Throughout the Rome quadrangle there is a very close relation between the character of the soils and that of the underlying geologic formations. Except in limited areas along the larger streams and on the steepest slopes, the soils are derived directly from the decay and disintegration of the rocks on which they lie. All rocks are changed by surface waters more or less rapidly, the rapidity depending on the character of the cement which holds the particles together. Siliceous cement is nearly insoluble, and rocks in which it is present, such as quartzite and some sandstones, are extremely durable and produce but a scanty soil. Calcareous cement, on the other hand, is readily dissolved by water containing carbonic acid, and the particles which it holds together in the rock crumble down and form an abundant soil. If the calcareous cement makes up but a small part of the rock, it is often leached out far below the surface, and the rock retains its form but becomes soft and porous; but if, as in limestone, the calcareous material forms the greater part of the rock, the insoluble portions collect on the surface as a mantle of soil varying in thickness with the character of the limestone, generally thin where the latter is pure, but often very thick where it contains much insoluble matter.

When derived in this way from the disintegration of the underlying rock, soils are called *sedentary*. If the rock is a sandstone or sandy shale the soil is sandy, and if it is a clay shale or limestone it forms a clay soil. As there are abrupt changes in the character of the rocks, sandstones and shales alternating with limestones, so there are abrupt transitions in the character of the soil, and soils differing widely in composition and agricultural qualities often occur side by side; and as the attitude of the strata determines the breadth of outcrop of each formation in different places, it also determines the area of the particular soil derived from each.

Igneous rocks, having formed by solidification from a molten condition, usually contain minerals which are not stable under ordinary atmospheric conditions. These minerals, therefore, undergo more or less rapid alteration, which generally results in the disintegration of a rock in which they are contained. Thus in granite the feldspar is converted into kaolin, and other constituents, chiefly quartz and mica, are thereby permitted to crumble down and the rock is converted into a sandy micaceous clay. Other crystalline rocks are converted into soil in a similar manner by the alteration of one or more of their mineral constituents.

The character of the soils derived from the various geologic formations being known, their distribution may be approximately determined from the Historical Geology sheet, which thus serves also as a soil map. The only considerable areas in which the boundaries between different varieties of soil do not coincide with the formation boundaries are upon the steep slopes, where soils derived from rocks higher up the slope have washed down and covered or mingled with the soil derived from those below. These are called *overplaced* soils, and a special map would be required to show their distribution.

Classification.—The soils of this region may be conveniently classified as: sandy soils, derived from the Lookout, Oxmoor, Rockwood, and Rome sandstones and the Weisner quartzite; clay soils, derived from the Bangor and Chickamauga limestones and some portions of the Conasauga shale; cherty soils, derived from the Knox dolomite and the Fort Payne and Armuchee cherts; shaly soils, derived from the Floyd and Conasauga formations; alluvial soils, deposited by the streams on their flood plains.

From the above enumeration it will be seen that the quadrangle presents considerable diversity in the character of its soils, and the several varieties are in general well differentiated, being for the most part confined strictly to the outcrops of the various formations from which they are derived.

Sandy soils.

The formations which yield sandy soils usually form ridges that are too steep for cultivation. The Lookout sandstone forms level-topped mesas, but the soil which it yields is generally thin. Calcareous beds in the Rockwood sandstone render the soil from that formation fertile, and it is cultivated wherever the surface is sufficiently level. The Rome sandstone and Weisner quartzite form steep ridges, with rocky, unproductive soil.

Clay soils.

The clay soil derived from the Chickamauga limestone varies considerably in character, with corresponding changes in the limestone itself. Where the latter is a blue, flaggy limestone the soil is generally blue clay, although in localities where conditions are favorable for its accumulation to considerable depths it becomes deep red. Where the limestone is argillaceous and purple in color the residual soil is generally heavy and deep red or purple. The narrow belts underlain by the Chickamauga limestone are, with the exception of the river bottoms, the most fertile areas in this district.

The Bangor limestone generally yields a deep-red clay soil, which is also fertile. The clay soils derived from the more calcareous portions of the Conasauga shale are not sharply differentiated from the shaly soil derived from the same formation. It is in some places, as Vans Valley, deep red and very fertile, but more often, as in Coosa Valley, it is gray and heavy.

Cherty soils.

The greater part of the cherty soil is derived from the Knox dolomite, which covers a broad area in the southeastern portion of the quadrangle. This soil varies considerably in character. In some cases it is deep red, with only occasional fragments of chert, and from this it varies to the other extreme in which the surface is composed almost entirely of white chert. The less cherty portions of the soil are extremely fertile, but the most cherty areas are practically barren. In some cases the silica is disseminated through the dolomite in fine grains, and the resulting soil is fine grained, gray, and extremely siliceous. This also is almost barren. The outcrops of the Fort Payne and Armuchee cherts form narrow bands, usually on the flanks of the Rockwood sandstone ridges, and their soils are unimportant.

Shaly soils.

Considerable areas in the northwestern half of the quadrangle are underlain by the Floyd and Conasauga shales. These formations yield soils which are much alike. They are generally thin, the shaly structure being found only a few inches below the surface, and they are not highly fertile. The surface is often flat and poorly drained, forming what is locally termed "flatwoods." These soils, however, are susceptible of great improvement by proper cultivation.

Alluvial soils.

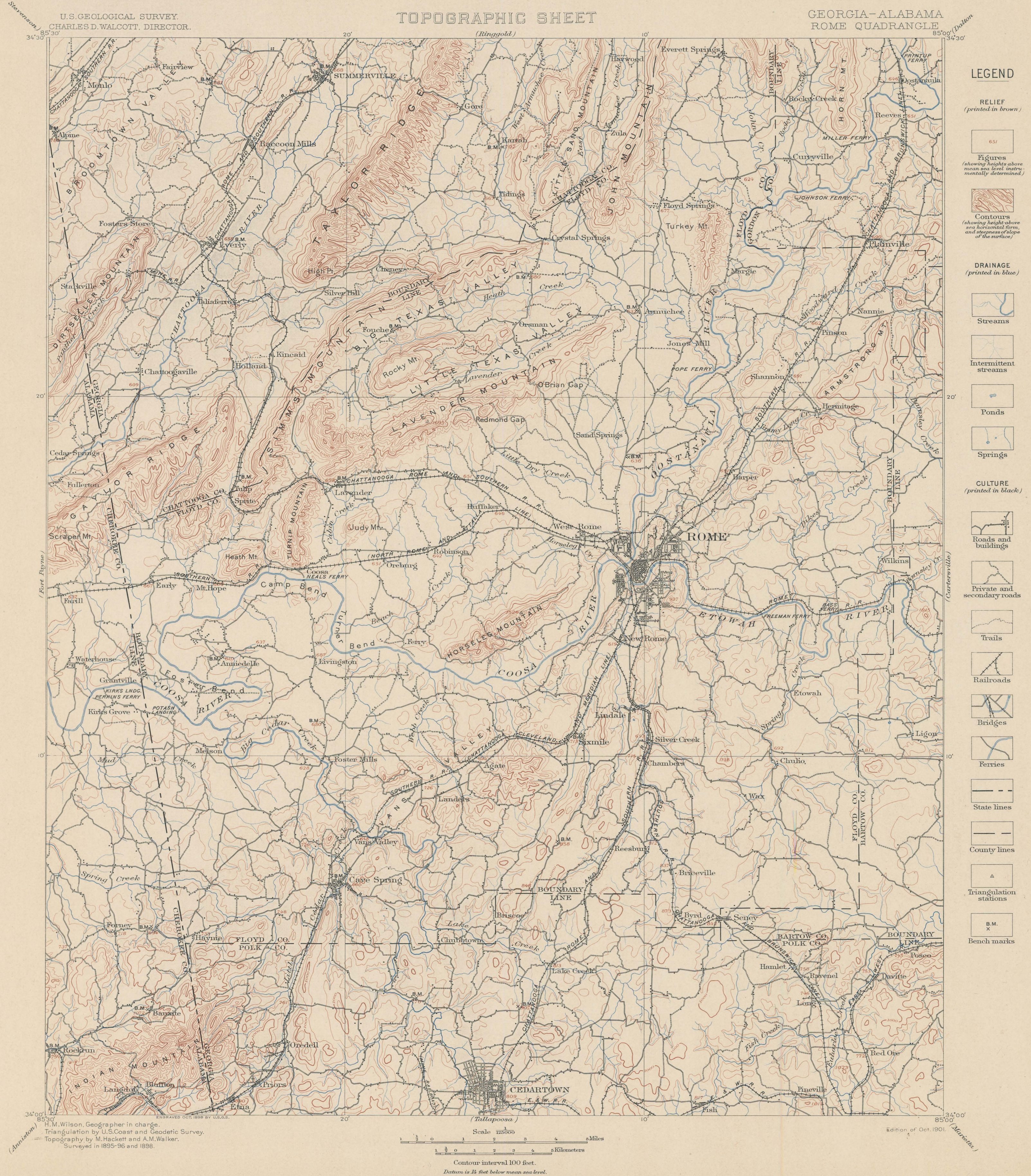
The alluvial soils embrace those deposited by the larger streams upon their present flood plains and also the deposits made by the former rivers which occupied this region. The present flood plains of the Chattooga, Oostanaula, Etowah, and Coosa are covered with a deposit of fine, sandy silt which is extremely fertile. The older alluvial deposits consist generally of coarse gravel with sandy silt above. The soils derived from these remnants of the Lafayette formation are much less fertile than those deposited by the present streams.

July, 1900.

U.S.GEOLOGICAL SURVEY.
CHARLES D. WALCOTT, DIRECTOR.

TOPOGRAPHIC SHEET

GEORGIA–ALABAMA
ROME QUADRANGLE



H.M.Wilson, Geographer in charge.
Triangulation by U.S.Coast and Geodetic Survey.
Topography by M.Hackett and A.M.Walker.
Surveyed in 1895-96 and 1898.

Scale $\frac{1}{125000}$

1 ½ 0 1 2 3 4 5 Miles

1 ½ 0 1 2 3 4 5 Kilometers

Contour interval 100 feet.

Datum is 14 feet below mean sea level.

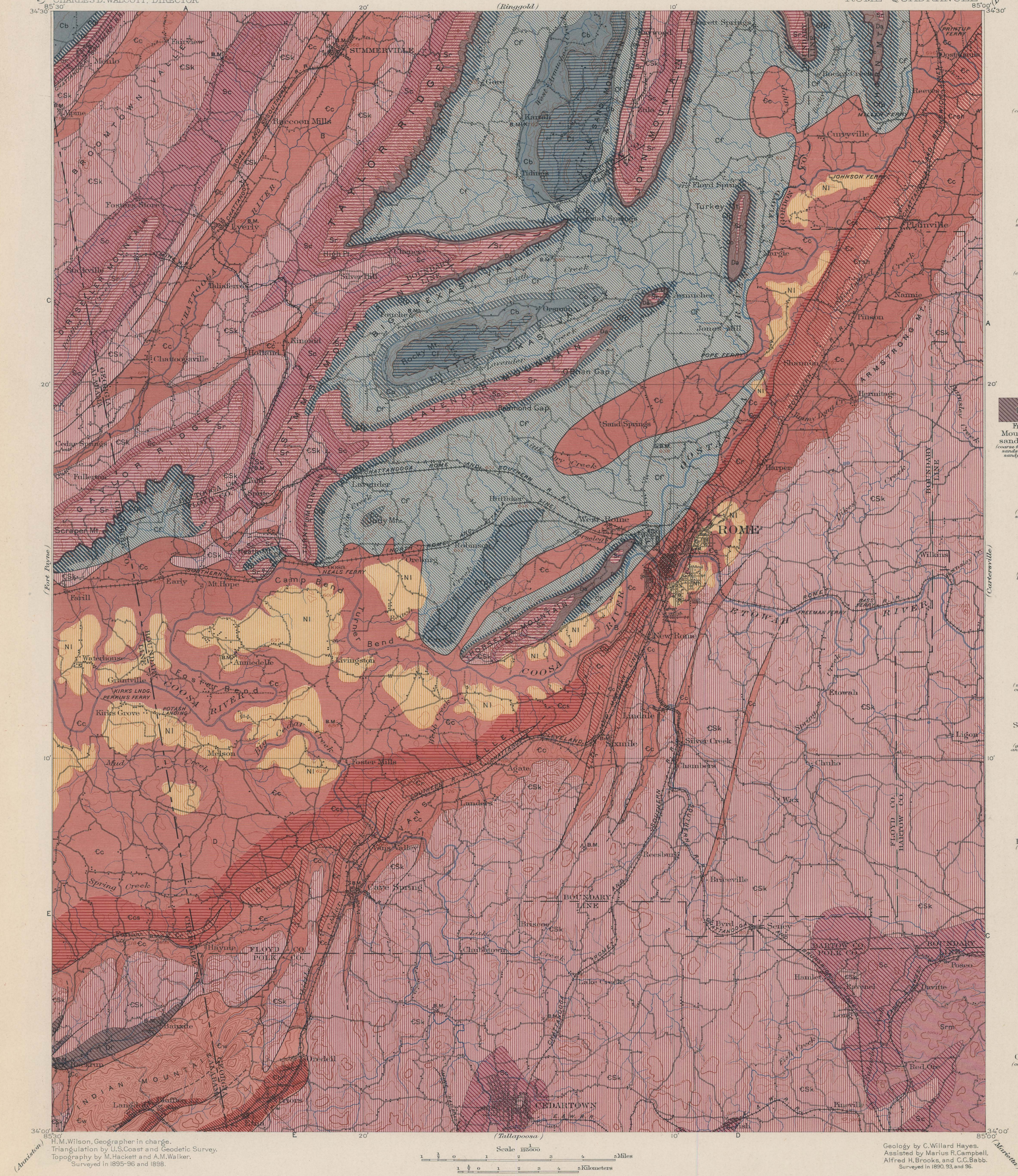
(The elevations on this map were derived from railroad levels at Rome. Subsequent accurate leveling by the U.S.G.S. shows these to have been 14 feet too high.)

Edition of Oct. 1901.

U.S.GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

HISTORICAL GEOLOGY SHEET

GEORGIA–ALABAMA
ROME QUADRANGLE



LEGEND

SEDIMENTARY ROCKS
(Areas of Sedimentary rocks are shown by patterns of parallel lines.)

NEOCENE?

Symbol	Formation
Nl	Lafayette? formation *(unconsolidated silt and gravel)*

CARBONIFEROUS

Symbol	Formation
Cl	Lookout sandstone *(conglomerate, sandstone, and sandy shale with thin coal beds)*
Cb	Bangor limestone *(blue limestone with chert nodules)*
Co	Oxmoor sandstone *(white and brown sandstone and conglomerate)*
Cf	Floyd shale *(carbonaceous shale and thin beds of limestone)*
Cfp	Fort Payne chert *(cherty limestone and bedded chert)*

DEVONIAN

Symbol	Formation
Dc	Chattanooga shale *(black carbonaceous shale)*
Df	Frog Mountain sandstone *(coarse ferruginous sandstone and sandy shale)*
Da	Armuchee chert *(rusty sandy chert)*

SILURIAN

Symbol	Formation
Sr	Rockwood formation *(white, brown, and purple sandstone and shale with beds of red hematite iron ore)*
Srm	Rockmart slate *(shale, slate, and coarse limestone conglomerate)*
Sc	Chickamauga limestone *(blue flaggy limestone with some chert conglomerate)*

CAMBRIAN

Symbol	Formation
€Sk	Knox dolomite *(massive gray limestone containing chert nodules)*
€cs	Siliceous layers in Conasauga formation *(greenish siliceous shale and micaceous sandstone)*
€c	Conasauga formation *(olive clay shale)*
€rsh	Shale in Rome formation *(variegated shale at the top of the formation)*
€r	Rome formation *(variegated sandstone and sandy shale)*
€br	Beaver limestone *(blue siliceous limestone)*
€w	Weisner quartzite *(quartzite, coarse conglomerate, and micaceous shale)*

Faults ▬▬ – –

Concealed faults
(continuation of known faults beneath Neocene gravels)
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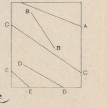
Sections



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Edition of Dec. 1901.

Geology by C.Willard Hayes.
Assisted by Marius R.Campbell,
Alfred H.Brooks, and C.C.Babb.
Surveyed in 1890, 93, and 96.

U.S. GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

ECONOMIC GEOLOGY SHEET

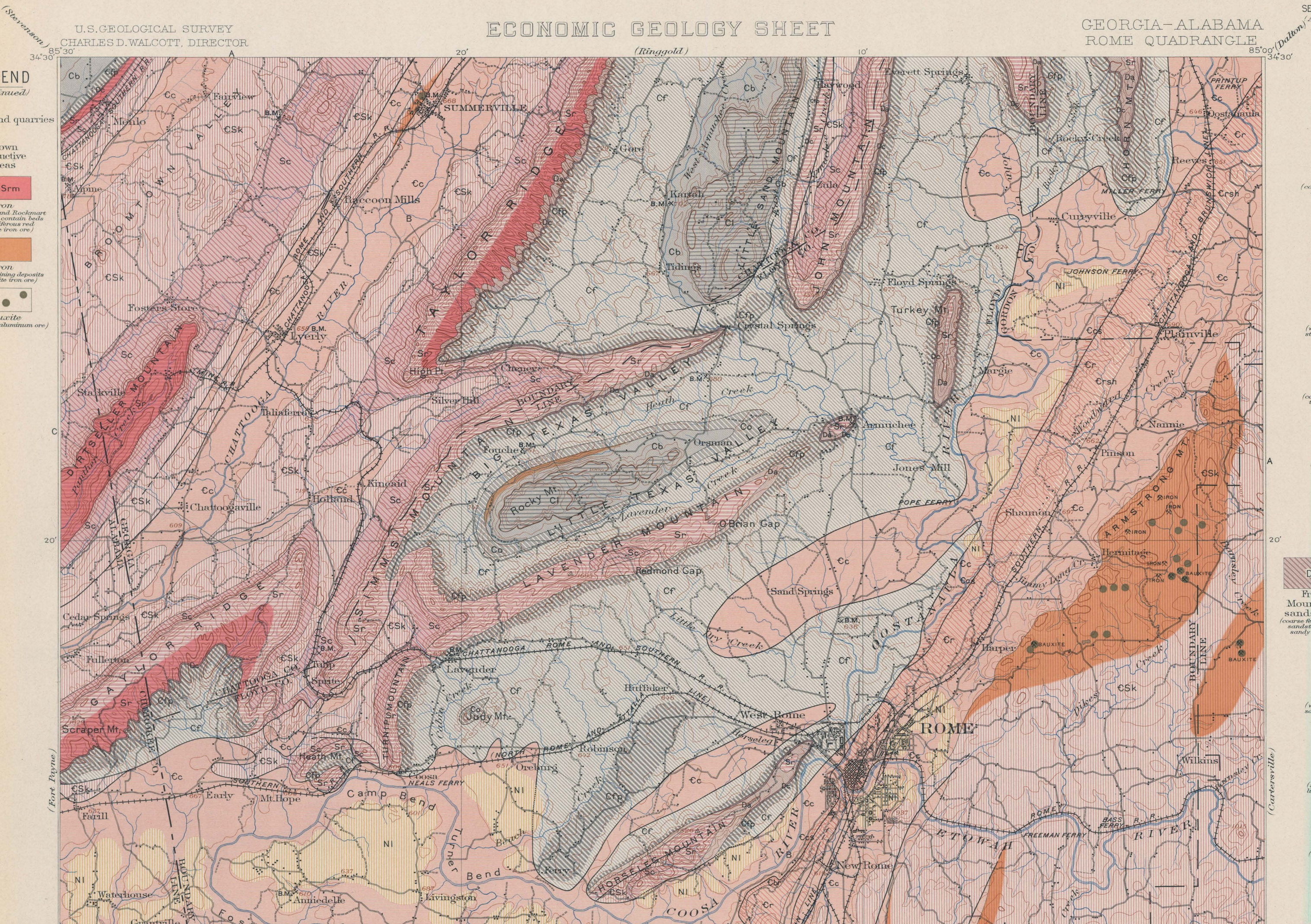
GEORGIA–ALABAMA
ROME QUADRANGLE

LEGEND
(continued)

⚒ Mines and quarries

Known productive areas

Sr-Srm	*Iron* (*Rockwood and Rockmart formations contain beds of fossiliferous red hematite iron ore*)
🟧	*Iron* (*area containing deposits of limonite iron ore*)
●	*Bauxite* (*deposits of aluminum ore*)



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LEGEND

SEDIMENTARY ROCKS
(Areas of Sedimentary rocks are shown by patterns of parallel lines.)

Nl	**Lafayette? formation** (*unconsolidated silt and gravel*)	NEOCENE?
Cl	**Lookout sandstone** (*conglomerate, sandstone, and sandy shale with thin coal beds*)	CARBONIFEROUS
Cb	**Bangor limestone** (*blue limestone with chert nodules*)	
Co	**Oxmoor sandstone** (*white and brown sandstone and conglomerate*)	
Cf	**Floyd shale** (*carbonaceous shale and thin beds of limestone*)	
Cfp	**Fort Payne chert** (*cherty limestone and bedded chert*)	
Dc	**Chattanooga shale** (*black carbonaceous shale*)	DEVONIAN
Df	**Frog Mountain sandstone** (*coarse ferruginous sandstone and sandy shale*)	
Da	**Armuchee chert** (*rusty sandy chert*)	
Sr	**Rockwood formation** (*white, brown, and purple sandstone and shale with beds of red hematite iron ore*)	SILURIAN
Srm	**Rockmart slate** (*shale, slate, and coarse limestone conglomerate*)	
Sc	**Chickamauga limestone** (*blue flaggy limestone with some chert conglomerate*)	
ƐSk	**Knox dolomite** (*massive gray limestone containing chert nodules*)	
Ɛcs	**Siliceous layers in Conasauga formation** (*greenish siliceous shale and micaceous sandstone*)	CAMBRIAN
Ɛc	**Conasauga formation** (*olive clay shale*)	
Ɛrsh	**Shale in Rome formation** (*variegated shale at the top of the formation*)	
Ɛr	**Rome formation** (*variegated sandstone and sandy shale*)	
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Ɛw	**Weisner quartzite** (*quartzite, coarse conglomerate, and micaceous shale*)	

Faults
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Concealed faults
(continuation of known faults beneath Neocene gravels)
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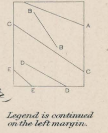
Sections

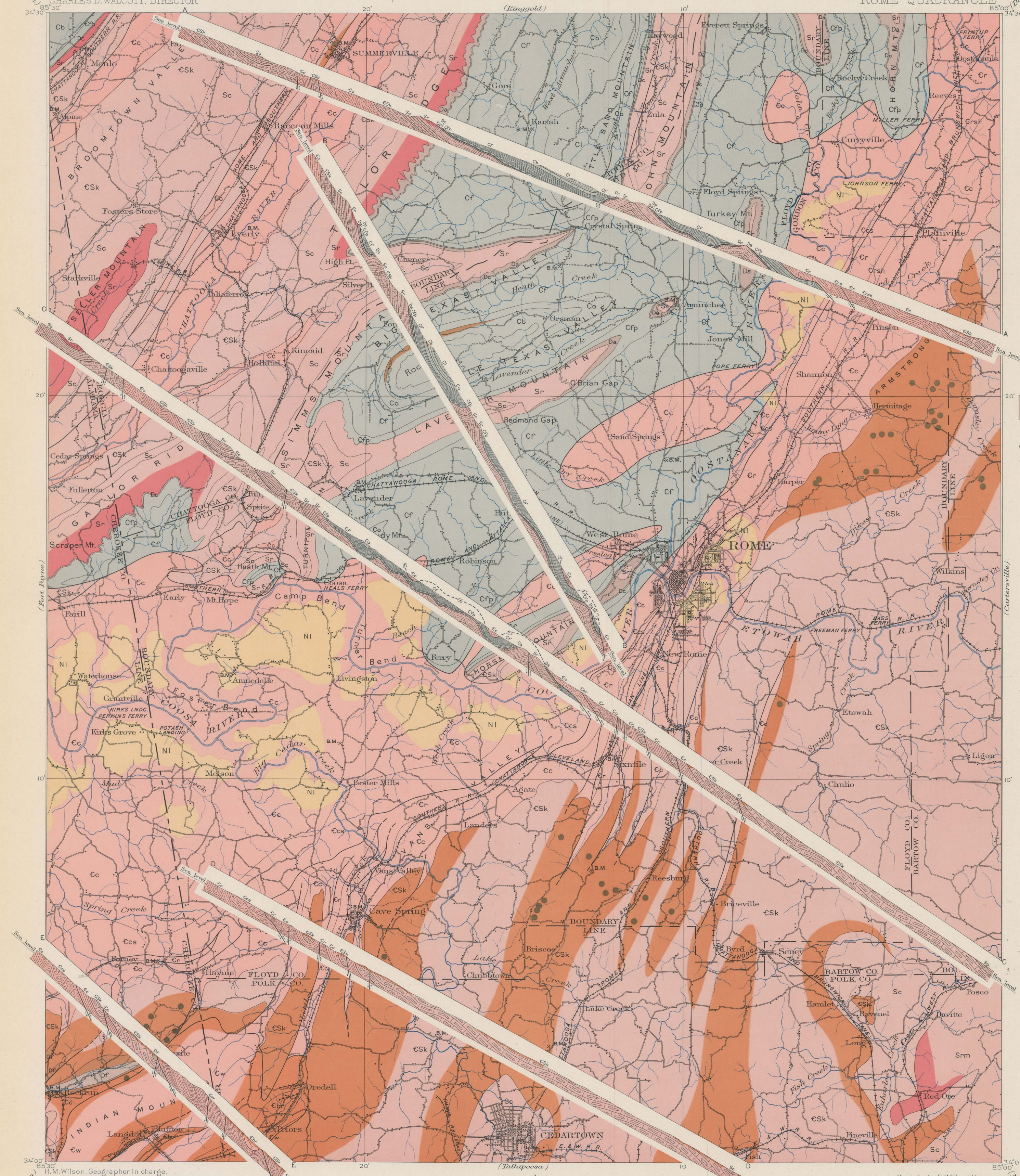


Legend is continued on the left margin.

U.S.GEOLOGICAL SURVEY
CHARLES D.WALCOTT, DIRECTOR

STRUCTURE-SECTION SHEET

GEORGIA-ALABAMA
ROME QUADRANGLE



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Edition of Mar. 1902.

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Assisted by Marius R.Campbell,
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LEGEND

SEDIMENTARY ROCKS

SHEET SYMBOL	SECTION SYMBOL		
Nl		Lafayette ? formation (unconsolidated silt and gravel)	NEOCENE ?
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Co	Co	Oxmoor sandstone (white and brown sandstone and conglomerate)	
Cf	Cf	Floyd shale (carbonaceous shale and thin beds of limestone)	
Cfp	Cfp	Fort Payne chert (cherty limestone and bedded chert)	
Dc	Dc	Chattanooga shale (black carbonaceous shale)	DEVONIAN
Df	Df	Frog Mountain sandstone (coarse ferruginous sandstone and sandy shale)	
Da	Da	Armuchee chert (rusty sandy chert)	
Sr	Sr	Rockwood formation (white, brown, and purple sandstone and shale with beds of red hematite iron ore)	SILURIAN
Srm		Rockmart slate (shale, slate, and coarse limestone conglomerate)	
Sc	Sc	Chickamauga limestone (blue flaggy limestone with some chert conglomerate)	
€Sk	€Sk	Knox dolomite (massive gray limestone containing chert nodules)	
€cs	€cs	Siliceous layers in Conasauga formation (greenish siliceous shale and micaceous sandstone)	CAMBRIAN
€c	€c	Conasauga formation (olive clay shale)	
€rsh	€rsh	Shale in Rome formation (variegated shale at the top of the formation)	
€r	€r	Rome formation (variegated sandstone and sandy shale)	
€br	€br	Beaver limestone (blue siliceous limestone)	
€w	€w	Weisner quartzite (quartzite, coarse conglomerate, and micaceous shale)	

Faults
——— — —

Concealed faults
(continuation of known faults beneath Neocene gravels)
⋯⋯⋯⋯

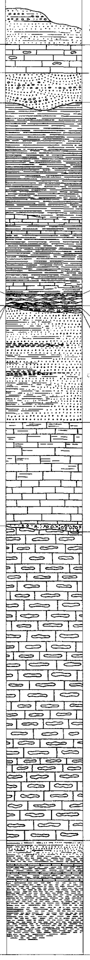
Known productive areas

Sr-Srm	*Iron* (Rockwood and Rockmart formations contain beds of fossiliferous red hematite iron ore)
🟧	*Iron* (area containing deposits of limonite iron ore)
● ● ●●	*Bauxite* (deposits of aluminum ore)

COLUMNAR SECTION SHEET 1

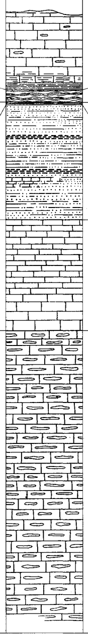
GENERALIZED SECTION FOR ROME QUADRANGLE NORTHWEST OF COOSA FAULT.

SCALE: 1 INCH = 1000 FEET.

Period.	Formation Name.	Symbol.	Columnar Section.	Thickness in Feet.	Character of Rocks.	Character of Topography and Soil.
CARBONIFEROUS	Lookout sandstone.	Cl		320–400	Conglomerate, sandstone, and sandy shale, with thin irregular beds of coal.	Level-topped mesas. Sandy soil.
	Bangor limestone.	Cb		300	Blue crinoidal limestone with nodules of chert.	Mesa slopes and valleys. Red clay soil.
	Oxmoor sandstone.	Co		50–550	White and brown sandstone and conglomerate.	Narrow ridges. Rocky, sandy soil.
	Floyd shale.	Cf		2000+	Black carbonaceous shale with occasional beds of crinoidal limestone.	"Flatwoods." Thin gray shale soil.
	Fort Payne chert.	Cfp		20–200	Bedded chert and limestone.	
DEV.	Chattanooga shale.	Dc		0–22	Black carbonaceous shale.	Low ridges. Rocky, cherty soil.
	Armuchee chert.	Da		0–40	Rusty, sandy chert.	
SILURIAN	Rockwood formation.	Sr		1000–1500	White, brown, and purple sandstone and sandy shale with beds of red fossiliferous hematite iron ore.	High even-crested ridges. Rocky, sandy soil.
	Chickamauga limestone.	Sc		700–1500	Blue flaggy limestone, sometimes purple and mottled, earthy toward the top. In places, heavy chert conglomerate at the base.	Narrow valleys. Very fertile red and blue clay soil.
?	Knox dolomite.	€Sk		1500–4000	Magnesian limestone or dolomite, white, gray, or light blue, generally granular and massively bedded, and containing nodules and layers of chert.	Low ridges and irregular rounded hills of residual material. Red clay soil, generally containing much chert.
CAMBRIAN	(Siliceous layers in Conasauga formation.)	(€cs)			Greenish siliceous shale and micaceous sandstone.	
	Conasauga formation.	€c		1000+	Olive clay shale.	Level valleys and "flatwoods." Stiff clay soil.

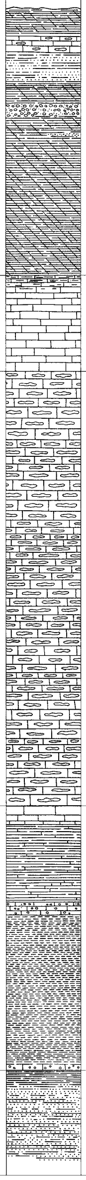
GENERALIZED SECTION NORTHWEST CORNER OF ROME QUADRANGLE.

SCALE: 1 INCH = 1000 FEET.

Period.	Formation Name.	Symbol.	Columnar Section.	Thickness in Feet.	Character of Rocks.	Character of Topography and Soil.
CARB.	Bangor limestone.	Cb		800	Blue crinoidal limestone with chert nodules, and shaly beds toward the base.	Slope of Lookout Mountain Red clay soil.
	Fort Payne chert.	Cfp		125	Bedded chert and limestone.	Low ridges. Rocky, sandy soil.
DEV.	Chattanooga shale.	Dc		28	Black carbonaceous shale with phosphatic concretions.	
SILURIAN	Rockwood formation.	Sr		1200	White, brown, and purple sandy shale with some sandstone and beds of red fossiliferous hematite iron ore.	Even-crested ridges. Rocky, sandy soil.
	Chickamauga limestone.	Sc		1150	Blue flaggy limestone, thicker beds at the base.	Narrow valleys. Very fertile red and blue clay soil.
? CAMBRIAN	Knox dolomite.	€Sk		3000+	Magnesian limestone, white, gray, or light blue, massively bedded, and containing nodules and layers of chert.	Low ridges and irregular rounded hills of residual material. Red clay soil, generally containing much chert.

GENERALIZED SECTION FOR ROME QUADRANGLE SOUTHEAST OF COOSA FAULT.

SCALE: 1 INCH = 1000 FEET.

Period.	Formation Name.	Symbol.	Columnar Section.	Thickness in Feet.	Character of Rocks.	Character of Topography and Soil.
SILURIAN	Rockmart slate.	Srm		2500–3000	Shale, beds of cherty limestone, and some sandy beds. Coarse limestone conglomerate. Calcareous shale altered to roofing slate.	Short ridges and narrow valleys. Thin shaly soil.
	Chickamauga limestone.	Sc		800–1200	Blue flaggy limestone, shaly in upper portion.	Level valleys. Blue or red clay soil.
?	Knox dolomite.	€Sk		4000–5000	Magnesian limestone or dolomite, white, gray, or light blue, generally granular and massively bedded, and containing nodules and beds of chert.	Undulating plateau with low ridges and irregular rounded hills of residual material. Red clay soil, generally containing much chert.
CAMBRIAN	Conasauga formation.	€c		1500–4000	Blue seamy limestone with heavy beds near top. Olive clay shale with beds of oolitic limestone.	Valleys. Red clay soil.
	(Shale in Rome formation.)	(€rsh)			Sandy shale in northeastern portion.	
	Rome formation.	€r		700–1200	Purple, white, green, and brown sandstone and interbedded sandy shale.	Comby ridges. Rocky, sandy soil.

COLUMNAR SECTION SHEET 2

GENERALIZED SECTION FOR SOUTHWEST CORNER OF ROME QUADRANGLE.

SCALE: 1 INCH = 1000 FEET.

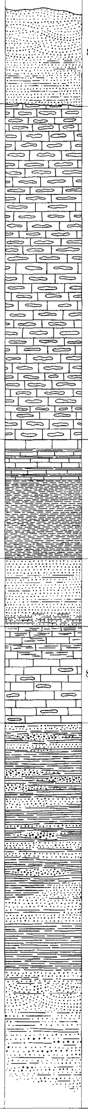
Period.	Formation Name.	Symbol.	Columnar Section.	Thickness in Feet.	Character of Rocks.	Character of Topography and Soil.
DEVONIAN	Frog Mountain sandstone.	Df		800-1200	Coarse, ferruginous, feldspathic sandstone and sandy shale.	Low ridges. Deep sandy soil.
SILURIAN ? CAMBRIAN	Knox dolomite.	€Sk		3000-4000	Magnesian limestone or dolomite, white, gray, or pale blue, generally granular and massively bedded, and containing nodules and beds of chert.	Undulating plateau with low ridges and irregular rounded hills of residual material. Red clay soil, generally containing much chert.
	Conasauga formation.	€c		1000-1500	Thin-bedded and massive blue limestone. Olive clay shale.	Valleys. Gray clay soil.
	Rome formation.	€r		700	Purple, white, green, and brown sandstone with some shale beds.	Comby ridges. Rocky, sandy soil.
	Beaver limestone.	€br		800-1200	Blue or gray siliceous limestone, shaly toward the top.	Narrow valleys. Deep, red, sandy clay soil.
	Weisner quartzite.	€w		5500+	Quartzite, shale, and lenses of coarse feldspathic conglomerate. Micaceous shale. Quartzitic conglomerate.	High crescentic ridges. Rocky, sandy soil.

TABLE OF FORMATION NAMES.

Period.	Names and Symbols used in this Folio.		Hayes: U. S. Geological Survey, Ringgold Folio, 1894.	Smith: Geology of the Valley Region adjacent to the Cahaba Coal Field, Alabama, 1890.	Safford: Geology of Tennessee, 1869.
Carboniferous	Lookout sandstone.	Cl	Lookout sandstone.	Coal Measures.	Coal Measures.
	Bangor limestone.	Cb	Bangor limestone.	Bangor limestone.	Mountain limestone.
	Oxmoor sandstone.	Co		Oxmoor sandstone and shale.	Siliceous group.
	Floyd shale.	Cf	Floyd shale.		
	Fort Payne chert.	Cfp	Fort Payne chert.	Fort Payne chert.	
Devonian	Chattanooga shale.	Dc	Chattanooga black shale.	Black shale.	Black shale.
	Armuchee chert.	Da			
	Frog Mountain sandstone.	Df			
Silurian	Rockwood formation.	Sr	Rockwood formation.	Clinton or Red Mountain formation.	Dyestone group. White Oak Mountain sandstone.
	Rockmart slate.	Srm	Chickamauga limestone.	Trenton or Pelham limestone.	Trenton, Lebanon, or Maclurea limestone.
	Chickamauga limestone.	Sc			
?	Knox dolomite.	€Sk	Knox dolomite.	Knox dolomite.	Knox dolomite.
Cambrian	Siliceous layers in Conasauga formation.	€cs	Connasauga shale.	Montevallo or Choccolocco shales.	Knox shale.
	Conasauga formation.	€c			
	Shale in Rome formation.	€rsh	Rome formation.		Knox sandstone.
	Rome formation.	€r	Rome sandstone.		
	Beaver limestone.	€br			
	Weisner quartzite.	€w		Weisner quartzite.	Chilhowee sandstone.

C. WILLARD HAYES,

Geologist.

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