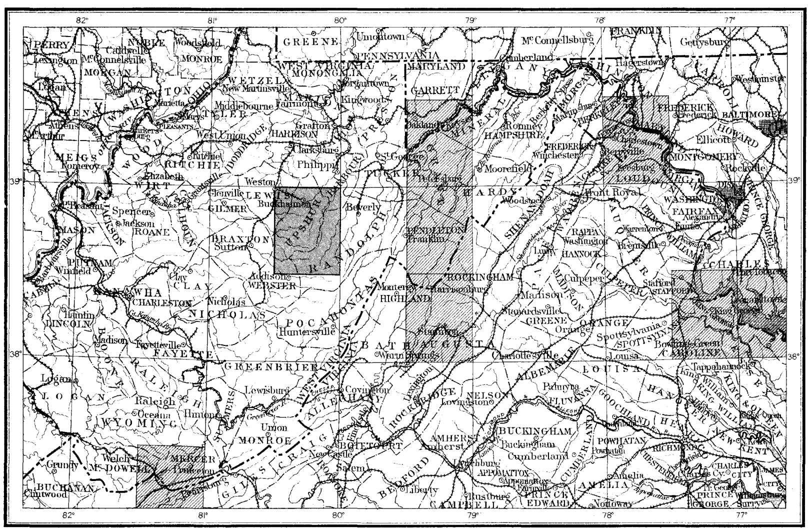
DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY
CHARLES D. WALCOTT, DIRECTOR

GEOLOGIC ATLAS
OF THE
UNITED STATES

BUCKHANNON FOLIO
WEST VIRGINIA

INDEX MAP



SCALE: 40 MILES - 1 INCH

AREA OF THE BUCKHANNON FOLIO

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FOLIO 34 | LIBRARY EDITION | BUCKHANNON

WASHINGTON, D. C.
ENGRAVED AND PRINTED BY THE U.S. GEOLOGICAL SURVEY
BAILEY WILLIS, EDITOR OF GEOLOGIC MAPS   S.J. KÜBEL, CHIEF ENGRAVER

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 stated on the map by numbers. It is desirable to show also the elevation of any part of a hill, ridge, or valley; 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 constant 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:

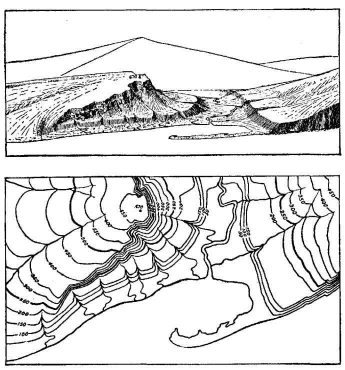

Fig. 1.—Ideal sketch and corresponding contour map.

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 to a precipice. Contrasted with this precipice is the gentle descent of the western slope. 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 occur 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 so with any other contour. In the space between any two contours occur 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.—Watercourses are indicated by blue lines. If the stream flows 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 240 feet long and 180 feet high this would cover, on a scale of 1 mile to the inch, 3,025,000 square inches. 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 special 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 "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 fractional 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 of natural length to an inch of map length. On the scale $\frac{1}{62,500}$ a square inch of map surface represents and corresponds nearly to 1 square mile; on the scale $\frac{1}{125,000}$, 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 three scales are stated, 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.—The map is being published in atlas sheets of convenient size, which are bounded by parallels and meridians. Each sheet on the scale of $\frac{1}{250,000}$ contains one square degree; each sheet on the scale of $\frac{1}{125,000}$ contains one-quarter of a square degree; each sheet on the scale of $\frac{1}{62,500}$ contains one-sixteenth of a square degree. These areas correspond nearly to 4,000, 1,000, 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. For convenience of reference and to suggest the district represented, each sheet 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 region 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 areal geologic map represents 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 maps show 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 either consolidates in cracks or fissures crossing the bedding planes, thus forming dikes, or else spreads out between the strata in large bodies, called sills or laccoliths. Such rocks are called *intrusive*. Within their rock enclosures they cool very 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 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 made are carried as solid particles by the 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 rocks 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 a guide 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 and formed 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 one was deposited first.

Fossil remains found in the rocks of different areas, of different provinces, and of different 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 color or colors and symbol assigned to each, are given below. The names of certain subdivisions 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 first (Pleistocene) and the last (Archean). The formations of any one period, with the exception of the Pleistocene and the Archean, are distinguished from one another by different patterns, made of parallel straight lines. Two tints of the

Period.	Symbol.	Color.
Pleistocene	P	Any colors.
Neocene { Pliocene / Miocene }	N	Buffs.
Eocene { including Oligocene }	E	Olive-browns.
Cretaceous	K	Olive-greens.
Juratrias { Jurassic / Triassic }	J	Blue-greens.
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.

period-color are used: a pale tint (the underprint) is printed evenly over the whole surface representing the period; a dark tint (the overprint) brings out the different patterns representing formations. Each formation is furthermore given a letter-symbol of the period. 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.

The number of surficial formations of the Pleistocene is so great that, to distinguish its formations from those of other periods and from the igneous rocks, the entire series of colors is used in patterns of dots and circles.

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 irregularly 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 rock is known to be of sedimentary origin the hachure patterns may be combined with the parallel-line patterns of sedimentary formations.

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 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. The formations are arranged according to origin into surficial, sedimentary, and igneous, and within each class are placed in the order of age, so far as known, the youngest at the top.

Economic 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 areal 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:

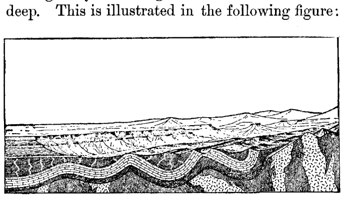

Fig. 2.—Sketch showing a vertical section in the front of the picture, with a landscape above.

The figure represents a landscape which is cut off sharply in the foreground by a vertical plane that cuts a section 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:

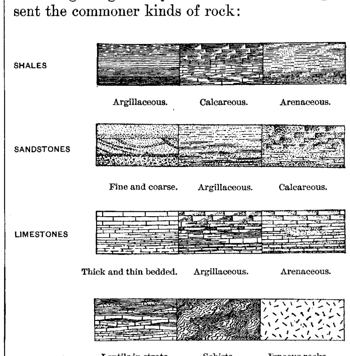

Fig. 3.—Symbols used to represent different kinds of rock.

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.

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. But these 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.

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 horizontal 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 position, 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 consist 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 of any mineral-producing or water-bearing stratum which appears in the section may be measured from the surface by using the scale of the map.

Columnar-section sheet.—This sheet contains a concise description of the rock formations which constitute the local record of geologic history. The diagrams and verbal statements form a summary of the facts relating to the character of the rocks, to the thicknesses of the formations, and to 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 under the heading "Thickness in feet," 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 1,000 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 other formations, 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 may be indicated graphically or by the word "unconformity," printed in the columnar section.

Each formation shown in the columnar section is accompanied by its name, a description of its character, and its letter-symbol as used in the maps and their legends.

CHARLES D. WALCOTT,
Director.

DESCRIPTION OF THE BUCKHANNON QUADRANGLE.

GEOGRAPHY.

An account of the physical features of the Appalachian province and the relations of those of the Buckhannon quadrangle.

General relations.—The Buckhannon quadrangle is bounded by the parallels of latitude 38° 30′ and 39° north and the meridians of longitude 80° and 80° 30′ west. **Extent of quadrangle.** It embraces, therefore, one-quarter of a square degree, which measures in this instance about 34½ miles from north to south and about 27 miles from east to west, and comprises 931½ square miles. The region adjoining on the north has not been surveyed. **Adjacent quadrangles.** The quadrangles contiguous to the Buckhannon are the Beverly on the east, the Huntersville on the south, and the Sutton on the west. The Buckhannon includes large portions of Upshur, Randolph, Webster, and Lewis counties and smaller parts of Barbour and Braxton counties, all in West Virginia. **Counties.**

In its geographic and geologic relations this district 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. **Definition of the province.** All parts of the region thus defined have a related history, recorded in the rocks, geologic structure, and 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 individual quadrangle in its relations to the entire province.

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

The central division is the Appalachian Valley. It is the best defined and most uniform of the three. **The Appalachian Valley, its extent and character.** In the southern portion of the province it coincides with the belt of folded rocks which forms the Coosa Valley of Georgia and Alabama and the Great Valley of East Tennessee. Throughout the central and northern portions the eastern side only is marked by great valleys, such as the Shenandoah Valley of Virginia and the Cumberland and Lebanon valleys of Maryland and Pennsylvania, while the western portion is but a succession of narrow ridges (the Allegheny ridges) with no continuous or broad intermediate 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 escarpment of the Cumberland Plateau, locally known as the Allegheny Front. Its rocks are almost wholly sedimentary and in large measure calcareous. **Relation of relief to rock character.** The strata, which must originally have been nearly horizontal, now stand at various angles and intersect the surface in narrow belts. The surface changes with the outcrop of different kinds of rock, so that sharp ridges and narrow valleys of great length follow the narrow belts of hard and soft rocks. Owing to the large amount of calcareous rock brought up on the steep folds of this district, its surface is more readily worn down by streams and is lower and less broken than that of the divisions on either side.

The eastern division of the province embraces the Appalachian Mountains, a system made of many individual ranges, which, under various local names, extends from southern New York to central Alabama. **The Appalachian Mountains; local ranges.** Some of its prominent parts are the South Mountain of Pennsylvania, the Blue Ridge and Catoctin Mountain of Maryland and Virginia, the Great Smoky Mountains of Tennessee and North Carolina, and the 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. **Nature of the rocks.**

The western division of the Appalachian province embraces the Cumberland Plateau and the lowlands of Tennessee, Kentucky, and Ohio. **The Cumberland Plateau.** Its northwestern boundary is indefinite, but may be regarded as coinciding with the Tennessee River from the northeastern corner of Mississippi to its mouth, and thence extending northeastward across the States of Indiana and Ohio to western New York. Its eastern boundary is defined by the plateau escarpment, or Allegheny Front. The rocks of this division are almost entirely of sedimentary origin, and the strata are generally 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 carved with ravines. In the southern half of the province the plateau is sometimes extensive and flat, **Its varied topography.** but it is oftener much divided by stream channels into large or small flat-topped hills. In West Virginia and portions of Pennsylvania the plateau is sharply cut by streams, which leave in relief irregularly rounded knobs and ridges bearing but little resemblance to the original surface. The region west of the plateau has suffered greatly from erosion, and the surface is now comparatively low and level.

Altitudes of the Appalachian province.—The Appalachian province as a whole is broadly arched, its surface rising from an altitude of about 500 feet along the eastern margin to the crest of the Appalachian Mountains and thence descending westward to about the same altitude on the Ohio and Mississippi rivers. **Extremes of altitude.**

Each division of the province shows one or more culminating points. Thus the Appalachian Mountains rise gradually from less than 1000 feet in Alabama to more than 6600 feet in western North Carolina. **Altitudes of the Appalachian Mountains.** From this culminating point they decrease to 3000 feet in southern Virginia, rise to 4000 feet in central Virginia, and descend to 2000 or 1500 feet on the Maryland-Pennsylvania line.

The Appalachian Valley shows a uniform increase 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 2500 or 2700 feet at its highest point, on the divide between the New and Tennessee rivers. **Altitudes of the Appalachian Valley.** 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. Throughout Pennsylvania it maintains about the same elevation as in the Potomac basin. 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 plateau, or western, division increases in altitude from 500 feet at the southern edge of the province to 1500 feet in northern Alabama, 2000 feet in central Tennessee, and 3500 feet in southern Kentucky. **Altitudes of the Plateau region.** It is between 3000 and 4000 feet high in West Virginia and descends to about 2000 feet in Pennsylvania. From the eastern edge 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. **Discharge of watersheds.** 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 to the Atlantic, while south of New River all except the eastern slope is drained westward by tributaries of the Tennessee or southward by tributaries of the Coosa.

The position of the streams in the Appalachian Valley is mainly dependent upon the geologic structure. In general they flow in courses which for long distances are parallel to the mountains on either side, following the lesser valleys along the outcrops of the softer rocks. **Trellis arrangement of streams.** 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 these transverse rivers are the Delaware, Susquehanna, Potomac, James, and Roanoke, each of which passes through the Appalachian Mountains in a narrow gap and flows eastward to the sea. In the central portion of the province 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 enters a gorge through the plateau on its westward course to the Ohio. South of Chattanooga the streams flow directly to the Gulf of Mexico.

TOPOGRAPHY.

Details of the plateaus, hills, valleys, and streams, with references to their past history.

Appalachian province.—The different divisions of the Appalachian province vary much in character of topography, as do also different portions of the same division. **Conditions determining character of topography.** This variation of topographic forms is due to several conditions, which either prevail at present or have prevailed in the past. In the Appalachian Valley, differences in rock character and in geologic structure are the conditions which chiefly govern erosion. In the Appalachian Mountains and the Cumberland Plateau, structure plays but a secondary part in the control of topographic forms. Throughout the entire province the forms produced are largely controlled by the altitude of the land, which during geologic ages has varied in relation to sea-level as the surface was worn down by erosion or was uplifted by movements of the earth's crust.

Buckhannon quadrangle.—The Buckhannon quadrangle lies almost wholly within the western division of the Appalachian province. **The valley tract.** A small area in the southeastern portion, east of Rich Mountain, may be included in the Appalachian Valley, or central, division of the province. This is the basin of Valley River, which has eroded a channel nearly 1500 feet below the surrounding mountain tops and down to 2100 feet above the sea. The topography of the area northwest of Rich and Point mountains is characterized by flat-topped hills and ridges, with a network of streams which are actively engaged in deepening their channels. **An early phase of topography defined.** The crests of these flat-topped hills and ridges mark a plain which dips gently toward the northwest. Near Pickens this plain has an elevation of about 3400 feet, while the crests which determine it in the northwestern portion of the quadrangle are but 1700 feet high. At some time in the past the surface of the country was this plain, which now is only in part preserved. The land then stood at a much lower altitude than now, so that this plain was nearly at sea-level. It has since been raised gradually to its present altitude. Here and there elevations above this plain were preserved, where the rocks were unusually hard or where they were protected from erosion by their position. Since the surface was not perfectly reduced it is called a "peneplain," and since it was formed near the lowest possible level of erosion it is called a "base-leveled" peneplain. The elevations which were not reduced to the level of the peneplain are termed "monadnocks." Bee Knob and Turkey Bone Mountain are examples of monadnocks.

In the northwestern portion of the quadrangle another and lower peneplain exists, at an elevation of about 1400 feet. The level area about Rock Cave is a portion of this peneplain, and it is also marked by the even-crested ridges and hills found between Ireland and Seymour. **A succeeding phase.** After the formation of this peneplain an elevation of the region began, which was probably accompanied by a northwestward tilting. The elevation amounted to 300 feet in the northwestern portion of this quadrangle, and was probably much more in the vicinity of Rich Mountain. The streams began active erosion, because of their steeper gradients, and the process of planing down to sea-level was again revived. At this time stability in the relative position of land and sea was maintained only long enough to permit of the leveling of the soft shales of the Braxton formation, while the harder rocks of the older beds were not reduced. The plain on the Braxton shales has an elevation of about 1400 feet. Above this lower peneplain rise monadnocks, such as Bald Knob, whose crests mark the position of the older peneplain. After erosion had cut this second peneplain in the upper soft beds, further elevation of the area took place. This lifting amounted to about 1100 feet in the northwestern portion of the region, and was accompanied by a marked northwestward tilting. This again renewed the activity of the streams and they began cutting their present channels.

Six rivers have their sources within the Buckhannon quadrangle, all belonging to the drainage of the Ohio River. **Local river systems.** Of these, the West Fork of the Monongahela, the Buckhannon, the Middle Fork, and the Valley rivers are parts of the Monongahela river system. The Little Kanawah flows directly into the Ohio, while Elk River belongs to the Great Kanawah system.

The streams flowing northwestward, in the direction of the general tilting, have the steepest gradients, and hence do the most rapid cutting. Not only have they eroded their beds to relatively greater depth, but they have cut back their headwater channels more rapidly and have moved the divides between the river basins farther toward the east. **Stream capture.** In some cases they have diverted the drainage of the adjoining river basins. Instances of this capture of drainage may be observed in the headwaters of Stone Coal Creek, west of Buckhannon. Glady Fork and Spruce Fork flow toward the Buckhannon River to a low, wide divide at the source of Brushy Fork, where they turn abruptly backward in a deep gorge and empty into the West Fork of Monongahela River. The drainage of Buckhannon River on the east side of the divide has nearly cut down to its base-level of erosion, while that of the West Fork, on the west, is cutting rapidly and deeply into the soft shale and sandstone, and if conditions of erosion remain as at present for a long period of time, Stone Coal Creek will doubtless cut back to Buckhannon River and divert its waters from their present course and lead them into West Fork. Other striking examples of diverted streams may be seen in the whole of the drainage of Little Kanawha River above Arlington. The headwater drainage of this river has persistently and rapidly cut northward, moving its watershed, and has captured the waters of Laurel, Cow, and Get Out runs, which originally belonged to French Creek and flowed northward into Buckhannon River.

Valley, Middle Fork, and Buckhannon rivers flow northward and have less descent. Middle Fork River is governed in its course principally by the structure of the rocks. Left Fork of Middle Fork flows in a narrow syncline from its source to Cassity, where it passes across the low anticline toward the west and joins the main Middle Fork in a shallow, tilted anticline, which it follows to the northern border of this region.

GEOLOGY.

STRATIGRAPHY.

An account of the origin and general significance of stratified rocks, with detailed descriptions of the strata in the Buckhannon quadrangle.

The general sedimentary record.—All of the rocks appearing at the surface within the limits of the Buckhannon quadrangle are of sedimentary origin—that is, they were deposited beneath bodies of water. **Origin of the rocks.** They have a maximum thickness of about 4800 feet, and consist of sandstone, shale, and limestone, presenting 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 beds of limestone were formed in part from the shells of various sea animals, and the beds of coal are the remains of a luxuriant vegetation which probably covered extensive swamps.

What the strata mean.

These rocks afford a record of almost uninterrupted sedimentation from middle Devonian to late Carboniferous time. Their composition and appearance indicate at what distance from shore and in what depth of water they were deposited. Sandstones marked by ripples and cross-bedded by currents, and shales cracked by the sun, indicate shallow water and mud flats; while limestones, especially by the fossils they contain, indicate greater depth of water and scarcity of sediment. The character of the adjacent land is also shown by the character of the sediments derived from its waste. Coarse sandstones and conglomerates, such as are found in the Coal Measures, were originally derived, doubtless, from high land, on which the stream grades were steep, and they may have resulted finally from wave action as the sea encroached upon a sinking coast. Limestones are formed either in moderate depths of the ocean or in shallow water when the adjacent land is near base-level and the streams are too sluggish to carry much sediment except that which is in solution. Such a period is favorable to rock decay and to the accumulation of deep residual soils in which oxidation is very complete. When the land is again elevated the red residuary products are swept into the sea, probably giving rise to the rocks of that color—red sandstones and shales near shore, and red argillaceous limestones farther out from the source of supply.

The seas in which these sediments were laid down covered most of the Appalachian province and the Mississippi basin, but their area probably varied from time to time within rather wide limits.

DEVONIAN ROCKS.

The oldest rocks in the Buckhannon quadrangle belong to the Devonian period. Judging from the stratigraphic column already determined in the Franklin quadrangle, 30 miles east of this, the lowest rocks here exposed are above the middle of the Devonian section. The thickness of the Devonian rocks exposed in the Buckhannon quadrangle is about 1600 feet.

Brown and greenish sandstone and sandy shale.

Jennings formation.—Only the upper 700 to 900 feet of this formation is here exposed, and its total thickness is not known. The rocks are composed of sandstone and shale of nearly equal prominence and are intimately interstratified. Many of the thicker sandstone beds are shaly and false-bedded, while numerous thin sheets are of purer sandstone, are hard, and cleave into nearly parallel flaggy layers. The sandstones are usually fine-grained. Much of the shale is sandy, and grades gradually into purer shale on the one hand and into shaly sandstone on the other. The shale is usually of greenish or olive color, with shades of yellow, while the sandstones are yellowish or brown, with tints of the colors common in the shale. Many of the flaggy sandstone layers are very fossiliferous, and such are often ferruginous to the point of low-grade iron ore, while fossiliferous lentils or bodies occur in some of the thicker shaly sandstone beds. The rocks of the formation crop out only in the basin of Valley River. In the lower portion of the river valley a large part of the rocks is concealed by river deposits of gravel, sand, and loam. The hills of this rock have oval forms, are often steep, and the surface is strewn with a talus of small sandstone fragments.

Reddish sandstone and sandy shale.

Hampshire formation.—This formation rests on the Jennings and extends upward to the base of the Carboniferous, and is estimated to be 700 to 900 feet thick. Excepting the color of the rock, there is little to distinguish the Hampshire formation from the Jennings. The shale of the Hampshire formation is prevailingly red, while the sandstones are reddish or brown. As in the Jennings, this formation is made up of shale and sandstone associated in thin beds. The shale predominates over the sandstone in abundance, and the sandstone is not so hard or prominent upon the surface as in the Jennings formation. The rocks of this formation are exposed in the slopes and tops of the spurs which project from the east side of Mill Mountain, and in the ridges on both sides of Valley River south of Stewart Run. The surface is less obstructed by sandstone talus than is that of the Jennings formation, and many small farms are located upon the more level high land.

CARBONIFEROUS ROCKS.

Obscure gray sandstone.

Pocono sandstone.—The Pocono sandstone is the earliest of Carboniferous deposits in this region. Its thickness is estimated to be less than 100 feet, and its boundaries are not clearly marked, neither base nor top being positively determined. The uppermost strata of the Hampshire formation are sandy beds similar to the Pocono sandstone, which grades into the succeeding Greenbrier limestone through a calcareous sandstone and siliceous limestone. The presence of the Pocono is usually determined by a talus of gray sandstone or conglomerate bowlders.

This rock is usually a gritty sandstone, but bodies of conglomerate are found in it, and from the character of the sandstone fragments on the surface it is believed that shale or soft sandy beds are interstratified with the sandstone, but this was not positively determined. The Pocono is exposed on the western limit of the Valley River syncline, and also on the eastern limit where it crosses the southeast corner of the area under consideration.

Limestone, with beds of shale.

Greenbrier limestone.—The Greenbrier limestone consists of blue limestone, yellowish siliceous limestone, red shale, and sandstone. The limestone, shale, and sandstone make a thickness of about 350 feet, the limestone predominating. The lower members of the limestone, near the Pocono sandstone, are siliceous, and in places approach a fine conglomerate of clear quartz pebbles bound in siliceous lime cement. The gradation upward from the base is into purer limestone. Near the middle of the formation sandy limestone beds occur with beds of red shale, and siliceous limestone and sandstone are in association at the top of the section. The uppermost limestone is a dark-blue fossiliferous bed, nearly 30 feet thick, below which there is about the same thickness of bluish and dark-red calcareous shale. The surface is generally smooth in the area where the limestone crops out. In the deep valleys, where conditions for rapid erosion are very favorable, ledges of limestone and sandstone project from the hillsides, but an abundant talus is nowhere produced. Where the soil remains it is good and is eagerly cultivated and secured for pasture lands. The limestone crops out in the Rich, Mill, and Elk mountains or in the hills near their bases.

Canaan formation.—This formation joins the Greenbrier limestone below without a very clearly marked parting line. A few feet are passed in transition from the blue limestone to the red shale and sandstone of the Canaan formation.

Red shale, with sandstone and conglomerate interbedded.

Deep-red shale with bands of green shale, friable and flaggy brown and gray sandstone, and limestone conglomerate comprise the rocks of this formation, in all 600 to 700 feet in thickness, the red shale predominating in thickness. Sandstone is more abundant in the lower than in the upper part of the formation, and in the southern than in the northern part of this region. Near the base of the formation there is a lentil or wedge-shaped body of hard, light-gray to white, pure sandstone. It becomes prominent in its exposures in the vicinity of Montville, and seems to increase in thickness southward to Elk Mountain, around whose base its position is marked by a talus of bowlders. Its presence was noted in the vicinity of Addison, on Back Fork of Elk River, and on Elk River. Beds of flaggy and false-bedded brown sandstone interstratified with shale constitute more than 100 feet in the lower part of the formation. Beds of conglomerate composed of subangular pebbles of calcareous sandstone and limestone bound in a gritty clay matrix occur near the center of the formation, and a conglomerate similar in character and composition is present, also, near its top on Elk River and Back Fork of Elk River. Many of the pebbles on long weathering are dissolved, leaving cavities in the face of the rock. A breccia or conglomerate of angular material was noticed near the top of the formation at Star post-office. In this case the matrix and included rock fragments were mostly of material of the same character, a sandy clay. Its nature indicates that the pebbles or fragments had been broken up by erosion and redeposited before the rock had become consolidated. The shales disintegrate rapidly upon appearing at the surface and fall readily into loose earth. Many of the sandstone beds, also, are friable and crumble into sand. The Canaan formation crops out in the steep slopes of Rich, Mill, Elk, and Point mountains. It is also exposed in narrow strips along the headwaters of Buckhannon and Back Fork of Elk rivers. This formation derives its name from Canaan Mountain, a locality in the southern part of the Piedmont quadrangle where it typically occurs.

Base of the Coal Measures.

Pickens sandstone. — The Pickens sandstone represents the base of the Coal Measures in this district, and is approximately of the age of the Pottsville conglomerate. The base of this sandstone rests upon the red shale and sandstone of the Canaan formation, and the top is a clearly marked parting between a massive white or gray sandstone bed and the overlying blue shales of the Pugh formation. The Pickens sandstone may be divided for convenience of discussion into three members—a massive sandstone and conglomerate at the base, white or gray in color, a light-gray or white sandstone at the top, and a series of brown sandstones, shales, and coals in the medial portion. The whole section makes 400 to 500 feet of strata. The Pickens sandstone appears to increase in thickness southward from near the middle of the quadrangle, where it comes to full exposure.

Lowest coal.

With the beginning of the Coal Measures deposits there was a marked change in sedimentation from that which prevailed at the closing epoch of the Canaan formation. It appears that through change of level the shore of the Carboniferous sea was pushed slowly landward, and the waves gained access to coarse gravels and sand, which they sorted from the fine material and deposited as beach sand and conglomerate. Such is the nature of the sandstone at the bottom and the top of the Pickens formation. Thin beds of shale and shaly sand occur in them, but the mass of the sandstone and conglomerate is a clean, wave-washed deposit. Not long after the formation of the lower sandstone member extensive flats and swampy lands bordering the sea spread over a large area. These swamps prevailed until the rank vegetation growing in them had deposited many feet of peat, which has now become a coal bed 3 to 5 feet thick, the lowest valuable coal in this region. From the lower sandstone upward for nearly 200 feet conditions for the formation of coal prevailed a number of times, but with shorter duration. Shale, thin coals, and sandstone alternate until the second thick coal in the Pickens sandstone is reached, a short distance below the upper sandstone member. The shales in the medial portion are dark-blue, black, or gray, and the sandstones are usually brown. This sandstone takes its name from Pickens, a town which is located near its top in the valley of Buckhannon River.

Dark shale, sandstone, and coal interbedded.

Pugh formation.—A series of blue and black clay-shale beds, thin brown sandstone, false-bedded gray sandstone, and in places white sandstone and conglomerate, 300 to 450 feet in thickness, follows above the Pickens sandstone. This series is named the Pugh formation, from a post-office which is located upon it in Webster County. The blue shale associated with beds of gray and black shale characterizes a large portion of the formation. False-bedded brown sandstone occurs near the middle of the formation. It is variable both in nature and in thickness. In some localities it is difficult to locate, while at other places its prominence may be noted in cliffs 50 feet high.

A bed of coal 3 feet 8 inches thick is found immediately above the false-bedded sandstone in the region of Pugh, but its grade is inferior. Shale and thin sandstone continue above this coal for 120 feet, where a double bench of sandstone about 40 feet thick occurs in the southern part of the region. In the vicinity of Pugh and Cleveland this bed is a hard, white sandstone and conglomerate, while in many other localities its presence can not be determined. Between this sandstone and the top of the formation shale and sandstone occur in thin beds and with locally variable characters. A number of thin coal seams interstratified with carbonaceous shale and fire-clay were observed near the top of the formation along the Buckhannon River. The coal was found to be of no considerale value.

Massive sandstone, with coal beds.

Upshur sandstone.—The Upshur sandstone is 350 feet thick in the northern part of the Buckhannon district, and it increases to about 500 feet at the southern border. With the thickening southward goes an increase in the proportion of sand to clay in the rock. Thick beds of clay-shale near the center of the Upshur sandstone in the northern part of this field give place to sandstone as they extend southward, and finally their position is occupied by thick sandstone beds separated by minor divisions of shale. North from the vicinity of Cleveland the Upshur sandstone is divided into two members by a bed of olive or yellow clay-shale 50 to 70 feet thick, which in places contains beds of brown, soft sandstone. Below this shale is sandstone or conglomerate about 100 feet thick. It is usually a hard, clean sand, light-gray or white in color, and projects from the hills in cliffs or is exposed in the form of large angular blocks or bowlders. It is well exposed in the hills bordering Buckhannon and Middle Fork rivers. Above the clay-shale there is nearly 200 feet of sandstone, with conglomerate beds near the middle. This sandstone member carries minor beds of shaly sandstone and shale, which in the upper part give red or yellow colors on weathering. This sandstone in its original condition is usually of bluish color, but on weathering becomes yellow or brown and falls to loose sand or rounded fragments. The surface of this rock, though hilly, is usually a smooth, sandy loam. In the southern part of the quadrangle the Upshur sandstone contains probably less conglomerate, but the sandstone is practically continuous, except for a few shaly beds, from the base to the top of the section.

The Upshur sandstone contains at least three valuable coal seams. They are not profitable to work at all points of their occurrence, neither are they known to be continuous bodies of coal through the entire field. Details of the coal deposits are given below under the heading Mineral Resources.

Red shale, locally calcareous or sandy, with coal.

Braxton formation.—This formation takes its name from Braxton County, over the greater portion of which it is the surface rock. It includes all of the rocks lying above the Upshur sandstone. The series is made up chiefly of red clay-shale, with some green and yellow shales interbedded with friable brown sandstone. More compact beds of sandstone also occur in the series, reaching, in some instances, a thickness of 30 to 40 feet. There are also lentils of sandstone, which have small areal distribution and are not thick. The shales locally become calcareous and grade into impure limestone. The limestone beds are not known to exceed 4 or 5 feet in thickness and have limited distribution. The original thickness of the Braxton formation is not known, since the upper part has been worn away by erosion. The maximum thickness exposed within the Buckhannon quadrangle is near its northern border, where it is 750 feet. It originally extended probably over the entire quadrangle, but it is now limited to the northwestern portion and to a few scattered areas found on the higher hilltops through the central portion of Upshur County and near the northern border of Webster County. It contains two valuable beds of coal, which will be discussed under the heading Mineral Resources.

STRUCTURE.

An account of the relative attitudes of the strata, which they now occupy as results of movements of masses of the earth's exterior.

Definition of folds and faults.

Definition of terms.—As the materials forming the rocks of this region were deposited upon the sea bottom, they must originally have extended in nearly horizontal layers. At present, however, the beds are usually not horizontal, but are inclined at various angles, their edges appearing at the surface. The angle at which they are inclined is called the *dip*. In the process of deformation the strata have been thrown into a series of arches and troughs. In describing these folds the term *syncline* is applied to the downward-bending trough, and the term *anticline* to the upward-bending arch. A synclinal *axis* is a line running lengthwise in the synclinal trough, at every point occupying its lowest part, toward which the rocks dip on either side. An anticlinal axis is a line which occupies at every point the highest portion of the anticlinal arch, and away from which the rocks dip on either side. The axis may be horizontal or inclined. Its departure from the horizontal is called the *pitch*, 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, allowing one portion to be thrust forward upon the other. Such a break is called a *thrust*, an *overthrust*, an *overthrust fault*, or simply a *fault*. Fault, however, is a term applied to many forms of dislocation in rocks. If the arch is eroded and the syncline is buried beneath the overthrust mass, the strata at the surface may all dip in one direction. They then appear to have been deposited in a continuous series. Folds and faults are often of great magnitude, their dimensions being measured by miles, but they also occur on a very small, even a microscopic, scale.

Structure of the Appalachian province.—Each subdivision of the province is characterized by a distinctive type of structure. In the plateau region and westward the rocks are generally horizontal and retain their original composition. In the Great Valley the rocks have been steeply tilted, bent into folds, broken by faults, and to some extent altered into slates. In the mountain district east of the Great Valley, faults and folds are prominent features of the structure, but the form of the rocks has been changed to a greater extent by the minute breaks of cleavage and by the growth of new minerals. In the valley region the folds and faults are nearly parallel to the old shore-line, extending in a northeast-southwest direction for very great distances. Some of these faults have been traced 300 miles, and some folds have even greater length. Many folds maintain a uniform size for great distances, bringing to the surface a single formation in a narrow line of outcrop on the axis of the anticline, and another formation in a similar narrow outcrop in the bottom of the syncline. The folds are also approximately equal to one another in height, so that many parallel folds bring to the surface the same formations. The rocks dip at all angles, and frequently the sides of the fold are compressed until they are parallel. Where the folds have been overturned it is always toward the northwest, producing southeastern dips on both limbs of the fold. In the southern portion of the Appalachian Valley, where this type of structure prevails, scarcely a bed can be found which dips toward the northwest.

General distribution and characteristics.

Out of the closed folds the faults were developed, and with very few exceptions the fault planes dip toward the southeast. Along these planes of fracture the rocks moved to varying distances, sometimes as great 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 localities. In south-central New York the strata are but slightly disturbed by a few inconspicuous folds. Passing through Pennsylvania toward Virginia, they rapidly become more numerous and dips grow steeper. In southern Virginia the folds are closely compressed and often closed, while occasional faults appear. Passing through Virginia into Tennessee the folds are more and more broken by faults, until, half way through Tennessee, nearly every fold is broken and the strata form a series of narrow, overlapping blocks, all dipping eastward. This condition holds nearly the same 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 same structure is found that marks the Great Valley, such as the eastward dips, the close folds, the thrust faults, etc. In addition to these changes of form, which took place mainly by motion on the bedding planes, there was developed a series of minute breaks across the strata, producing cleavage, or a tendency to split readily along these new planes. These planes dip southeast, usually about 60°. This slaty cleavage was somewhat developed in the Great Valley region, but not to such an extent as in the mountains on the east. As the breaks became more frequent and greater, they were accompanied by growth of new minerals out of the constituents of the old. The new minerals consist chiefly of mica and quartz, and were crystallized parallel to the cleavage planes. The final stage of the process resulted in the squeezing and stretching of hard minerals, like quartz, and complete recrystallization of the softer rock materials. All rocks, both sedimentary and original crystalline, were subjected to this process, and the final products from the metamorphism of very different rocks are often indistinguishable. Rocks containing the most feldspar were most thoroughly altered, and those with most quartz were least changed. Throughout the entire Appalachian province there is a regular increase of metamorphism toward the southeast, so that a bed quite unaltered at the border of the Great Valley can be traced through greater and greater changes until it has lost every original character.

Cleavage and metamorphism.

The structures above described are manifestly the result of 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 probably continued at intervals up to its culmination after the close of the Carboniferous.

The immediate cause of Appalachian structure.

In addition to the horizontal force of compression, the province has been subjected to other forces which have repeatedly elevated and depressed its surface. 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 vertical forces. In every case the movements have resulted in the warping of the surface, and the greatest uplift has generally coincided with the Great Valley.

Oscillations.

Structure sections.—The 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 on the line at the upper edge of the blank space. The vertical and horizontal scales are the same, so that the actual form and slope of the land and the actual dips of the strata are shown. 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, and they are therefore somewhat generalized from the dips observed in a belt a few miles in width along the line of the section.

Underground relations of strata.

Structure of the Buckhannon quadrangle.—The rock structure in the Buckhannon quadrangle is but little diversified, and the district, except the southeast corner, exhibits the gently inclined strata of the western division of the Appalachian Province. The rocks are all of sedimentary origin, and the deformation they have suffered has not caused any apparent change in their nature.

General character.

The region east of Rich Mountain may be classed with the Great Valley type of structure, which is that of flexures. The Valley River anticline is a prominent fold where it enters this quadrangle east of Mill Mountain. Its form is indicated in the structure sections. Dips on the west limb of the fold are steeper than those on the east side, which is characteristic of Appalachian folding. Since the surface rocks exposed here are soft shales and thin sandstones, they are crumpled into minor folds, and in some instances are faulted on a small scale. This minor structure is especially prominent upon the western, steeper side of the fold, so that it is difficult to determine even average dips of rock in the major fold. The extent and nature of this fold beyond the boundaries of this quadrangle toward the northeast have not been studied. Toward the south it rapidly declines until it becomes a low, wide arch. Upon this anticlinal arch are located Valley River and the source of Elk River. As the arch of the fold becomes lower toward the south the minor folding decreases, so that in the vicinity of Elk Mountain the crumpling of the Devonian shale is just perceptible.

The Valley River fold.

The western limb of this anticline dips into gentle flexures just west of Rich Mountain. There a narrow synclinal basin pitches rapidly downward toward the northeast. This basin is quite shallow in the vicinity of Whitman Knob, but becomes deeper northeastward. It enters the Beverly quadrangle east of Cassity, and is occupied by Roaring Creek basin west of the Valley River gorge in Rich Mountain. A low anticlinal fold lies immediately west of Roaring Creek basin. It is parallel to this basin, and its axis passes nearly through Blue Knob. These two small folds rise and spread into minor undulations between Rich and Point mountains.

Adjacent flexures on the west.

The region westward from Rich Mountain belongs to that part of the Appalachian coal field in which the rocks are not evidently disturbed; consequently the strata are supposed to dip regularly from the margin westward. Within the Buckhannon quadrangle the beds do in general dip toward the northwest, but a close examination shows that these dips are far from regular; in certain localities the rocks lie nearly horizontal, while frequently in adjoining areas they are perceptibly inclined. This irregularity of dip is liable to lead to confusion in tracing coal seams and to error in their correlation. As a rule the dips are so low that they can not be accurately measured in the outcrop, but must be determined by ascertaining the elevation of a great many points on some certainly recognized bed or horizon. Such a determination will show the variation of the bed from the horizontal. Since all the beds are approximately parallel, the form of any other bed may be inferred from that of the one whose conformation has been determined. In order that these slight irregularities may be shown, "deformation contours" have been introduced on the sheet showing the economic geology. These contours, like the surface contours, are lines of equal elevation above sea-level. They are drawn on the surface of the lower coal seam of the Upshur sandstone, an easily recognizable stratum that shows in outcrops over most of the quadrangle. These deformation contours represent the undulations of the stratum on which they are drawn, just as the surface contours represent the slopes of the present surface. They are indicated not only where the stratum is actually exposed but also where it has been removed by erosion or where it is buried beneath the surface. They are shown on the map by light-gray lines, and their elevations by light-gray figures. Like the surface contours, they are drawn at intervals of 100 feet. Points of outcrop of the bed on which the contours are drawn occur at the intersection of a deformation contour and a surface contour of the same elevation. As the distance of any stratum above or below this contoured bed can be determined from the columnar section, its approximate outcrop can be ascertained in a similar manner. In order to approximately determine the lines of outcrop of the bed on which deformation contours are drawn, locate points where successive white contour lines cross brown contour lines of the same elevation, and connect these points of intersection by lines drawn, as nearly as may be, parallel to the brown contour lines.

Dips in apparently flat strata.

To determine the depth of any formation.

MINERAL RESOURCES.

A statement of the relative positions of coal in the strata, and of the occurrence of limestone, building stone, clay, and soils.

Coal.—Three of the four formations of the Coal Measures in the Buckhannon quadrangle contain beds of coal that may be profitably worked. These are the Pickens sandstone, the Upshur sandstone, and the Braxton formation. All of the workable beds of coal have been prospected, but none have been worked except for local consumption. This is due to the fact that abundant coal of equal or higher grade occurs between this quadrangle and the seaboard and nearer to centers of large consumption.

Coal-bearing strata.

Many thin coal seams which occur in the central portion of the Pickens sandstone may be found thick enough to be economically worked, but only two beds have been shown to be valuable. The lower of these coals occurs close above the lower sandstone member and about 100 feet above the base of the formation. It has been worked in Rich Mountain, at the east end of Whitman Flats, near the border of the Beverly quadrangle. At this point the coal is 3 feet 6 inches thick and is of excellent quality. Coal beds in the same relative position in the formation have been worked at the north end of Point Mountain and just beyond the southern border of the quadrangle, northeast and northwest of Addison. A coal beneath the upper sandstone member of this formation has been opened at the north end of Point Mountain. The coal is 4 feet 7 inches thick and appears to be of fair quality. The areal extent, thickness, and quality of these coals in the wide region beyond the above-named exposures can only be inferred, since but little attention has been paid to the coals of this formation. The entire area of the Pickens sandstone within the Buckhannon quadrangle is nearly 740 square miles.

Threefoot-six bed.

Fourfoot-seven bed.

A coal bed about 3 feet 8 inches thick occurs in the Pugh formation in the vicinity of Pugh post-office. It is mined at Pugh and on Old Lick Creek, but the coal at these mines is not of high grade.

Threefoot-eight bed.

The Upshur sandstone contains three coal beds that have been found to be of workable value in parts of the field. The two lower of these coals have an area of approximately 400 square miles. The lower coal, locally known as the "Elevenfoot vein," occurs near the top of the lower sandstone member. In the northern part of the field its position is 60 to 80 feet above the base, while in the southern portion it is much higher above the base of the formation on account of the thickening of the lower portion of the lower sandstone member. This coal is not constant in either thickness or quality over any considerable extent of country. In the mines and prospects examined measurements have been made showing a thickness of 6 to 11 feet. The coal is found to be of the best quality where its thickness is least. Bands of shale and bone enter into the bed in places, increasing its general thickness and making the coal almost worthless. A mine at Mayton shows this coal to be 6 feet 2 inches thick and of good quality. One mile south of Sand Run it is 7 feet thick, and two miles southwest of Cleveland it has a section of 11 feet and is almost equally divided between coal and shale in nine separate bands. The second coal of this formation occurs near the base of the shale above the lower sandstone member. It is nearly 3 feet 6 inches thick, and it is softer and more bituminous than the lower coal of this formation. It has been prospected at numerous places, but it is mined on a very limited scale and only for individual use. The third workable coal bed of the Upshur sandstone occurs at the top of the formation, and has an area of about 170 square miles. It has a variable thickness of about 3 to 6 feet where it has been opened for examination. The coal is of fair grade. It has not been so well prospected as have the lower coals in this formation, but it is mined more extensively than any of these. Besides mines for private use, several are opened in the hills east of Buckhannon, from which the town is supplied.

The variable Elevenfoot bed.

Threefoot-six bed.

Three to six foot bed.

The Braxton formation covers an area of about 170 square miles and contains two workable coal seams. A few feet of carbonaceous shale, locally containing a little coal, are found 50 feet above the base of the formation. Fifty feet above this occurs the lower workable coal. This coal varies much in thickness and in quality. Near Ireland it is but 2 feet thick while near Spruce it reaches a thickness of 3 feet 4 inches. So far it has been exploited only for local use.

The highest coals.

Above this coal 130 feet, and 230 feet above the base, occurs the best coal of this formation. This is locally known as the "Zwick vein." It is of good quality, and has a thickness varying from 3 feet to 4 feet 8 inches. This seam also has been mined only for local use.

Limestone.—Of stones, limestone is the most valuable in the region. The Greenbrier limestone is the largest body, and its surface area is outlined upon the accompanying map. Many of the beds of this limestone are quite pure and will produce a good grade of lime. The uses of this rock are not appreciated as they may be in future, it being entirely undeveloped. Coals occur in the mountains above the outcrop of the limestone, and wood, as well, is abundant for the burning of lime. Thin beds of limestone occur near the base of the Braxton formation. They are associated with soft shales, which cover the outcrop. Fragments of this rock were seen in the talus along Stone Coal Creek southwest of Buckhannon.

Building stone.—Some layers of sandstone near the top of the Upshur sandstone and some of the harder sandstone beds in the Braxton formation are evenly bedded, may be easily worked, and will produce a fair grade of building stone. The color of the rock is usually buff or light-brown near the surface. The durability of this stone has not been tested. The white conglomerate, grit, and sandstone in the lower part of the Upshur and in the Pickens sandstones are almost pure quartz, usually very refractory, and could be worked only with much cost and difficulty.

Stone for road material is everywhere abundant. The limestone, when crushed and properly laid, cements firmly and makes durable roads.

Clay.—Fire-clay, as in other coal regions, occurs associated with, usually beneath, many of the coal beds. This clay, however, is rarely exposed, and will require testing to determine its quality for the production of fire-brick. Clay-shales occur in both the Upshur sandstone and the Braxton formation, but they are not developed.

Soils. — The soils of the Buckhannon quadrangle are for the most part the product of the decay and disintegration of the rocks which immediately underlie them, and are called residuary soils. The exceptions to this are the alluvial soils forming bottom lands along some of the rivers, and also soils found on the steepest slopes. As each different kind of rock yields a corresponding soil, the geological map showing the distribution of the various rocks can also be regarded as a soil map. The rocks exposed within the Buckhannon quadrangle are not much diversified, and consequently the soils of the different formations are often much alike. Disintegration of sandstone gives a sandy soil, while clay-shales yield a clay soil. Sandy clay soil results from the decay of rocks intermediate in character between the two. Siliceous cement is nearly insoluble, and rocks in which it is present, such as quartzite and some sandstones, are extremely durable and produce but scanty soil. Calcareous cement, on the other hand, is readily dissolved by water containing carbonic acid, and the particles which it held together in the rock crumble down and form a deep soil. In a limestone, as 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, being generally quite thin where the latter is pure, but often quite thick where it contains much insoluble matter. Usually clay largely predominates in soils derived from limestones, but some limestones contain considerable sand. Besides the residuary soils, whose distribution corresponds in a general way with the coloring of the areal map, there occur also the alluvial and overwash soils, which are not indicated on the map. The alluvial soils are confined to bottom lands. The overwashed soils are found on steep slopes, where they have migrated from rocks lying at a higher level.

Soils originate from the rocks.

Variations of character and depth.

Sandy soils.—The soils of nearly all the formations of the quadrangle contain more or less sand, but those derived chiefly from sandstones and sandy shale belong more properly to this class. The Devonian formation produces a rather light sandy soil which is not very productive. The Pickens, Pugh, and Upshur formations, being largely of sandstone, give as a rule a sandy soil. The soil derived from the coarser sandstones of these formations is ill adapted to cultivation and is not fertile. The finer sandstone beds, which are often interbedded with clay-shales, give a fairly good sandy clay soil.

Details of distribution.

Clay soils.—To this class belong the more productive soils of the district. Most of the clay soils contain more or less sand. The Greenbrier limestone yields a good clay soil, and, where surface conditions permit, affords good farming land. The Canaan formation produces a sandy clay soil, which is for the most part not available for agricultural purposes because it is exposed chiefly on steep hill-slopes. Portions of the Pugh and Pickens formations contain clay-shale beds of considerable thickness, which afford very good soils. Of the Coal Measures series the Braxton formation yields the best soil. It is a sandy clay soil, and is in part calcareous. It bears but little surface débris, and is productive. The region covered by the Braxton formation has been largely reclaimed, and even the small outlying patches are eagerly sought and cultivated.

JOSEPH A. TAFF,
ALFRED H. BROOKS,
Geologists.

June, 1896.

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

TOPOGRAPHY

WEST VIRGINIA
BUCKHANNON SHEET

LEGEND

RELIEF (printed in brown)

1408 — Figures (showing exact heights above mean sea-level.)

Contours (showing height above sea, horizontal form, and steepness of slope of the surface)

DRAINAGE (printed in blue)

Rivers

Creeks and runs

Sinks

CULTURE (printed in black)

Towns and cities

Houses

Railroads

Roads

Fords

Trails

County lines

Triangulation stations

Henry Gannett, Chief Topographer.
Gilbert Thompson, Chief Geographer in charge.
Triangulation by L.C.Fletcher.
Topography by L.C.Fletcher.
Surveyed in 1887-89-91.

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 mean Sea level

Edition of Aug. 1896.

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

AREAL GEOLOGY

WEST VIRGINIA
BUCKHANNON SHEET

LEGEND

SEDIMENTARY ROCKS

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

CARBONIFEROUS

XV, XIV	Cbx	Braxton formation *(red and yellow shale and brown sandstone; contains two workable coal beds)*
XIII	Cps	Upshur sandstone *(white and brown sandstone, conglomerate, and olive shale; contains coal, three beds workable)*
XIII	Cpg	Pugh formation *(blue, gray, and black shale and sandstone; contains low grade coal, two beds locally workable)*
XII	Cpi	Pickens sandstone *(gray, white, and brown sandstone, conglomerate, and black and gray shale; contains coal, two beds workable)*
XI	Ccn	Canaan formation *(red shale and gray and brown sandstone)*
XI	Cgr	Greenbrier limestone *(blue limestone, sandstone and red shale)*
X	Cpo	Pocono sandstone *(gray sandstone, in places a conglomerate)*

DEVONIAN

IX	Dh	Hampshire formation *(shale and sandstone, mainly red)*
VIII	Dj	Jennings formation *(olive and yellow shale and brown sandstone)*

Sections

Henry Gannett, Chief Topographer.
Gilbert Thompson, Chief Geographer in charge.
Triangulation by L.C. Fletcher.
Topography by L.C. Fletcher.
Surveyed in 1887-89-91.

Geology by Joseph A. Taff and Alfred H. Brooks.
Surveyed in 1895.

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 mean Sea level.

Edition of Aug. 1896.

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

ECONOMIC GEOLOGY

WEST VIRGINIA
BUCKHANNON SHEET

Henry Gannett, Chief Topographer.
Gilbert Thompson, Chief Geographer in charge.
Triangulation by L.C. Fletcher.
Topography by L.C. Fletcher.
Surveyed in 1887-89-91.

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 mean Sea level.

Edition of Aug. 1896.

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LEGEND

SEDIMENTARY ROCKS

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

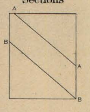
CARBONIFEROUS

- XV, XIV — Cbx — Braxton formation *(red and yellow shale and brown sandstone; contains two workable coal beds)*
- XIII — Cps — Upshur sandstone *(white and brown sandstone, conglomerate, and olive shale; contains coal, three beds workable)*
- XIII — Cpg — Pugh formation *(blue, gray, and black shale and sandstone; contains low grade coal, two beds locally workable)*
- XII — Cpi — Pickens sandstone *(gray, white, and brown sandstone, conglomerate, and black and gray shale; contains coal, two beds workable)*
- XI — Ccn — Canaan formation *(red shale and gray and brown sandstone)*
- XI — Cgr — Greenbrier limestone *(blue limestone, sandstone and red shale)*
- X — Cpo — Pocono sandstone *(gray sandstone, in places a conglomerate)*

DEVONIAN

- IX — Dh — Hampshire formation *(shale and sandstone, mainly red)*
- VIII — Dj — Jennings formation *(olive and yellow shale and brown sandstone)*

Sections



⚒ Coal mines
× Coal prospects

Known productive formations

- Cbx — *Braxton formation (contains two workable coal beds)*
- Cps — *Upshur sandstone (contains three workable coal beds)*
- Cpi — *Pickens sandstone (contains two workable coal beds)*
- *Limestone*

Light-gray contours and figures show the lay and the elevation above sea of the chief coal bed of the Upshur sandstone as it now exists and as it formerly existed where it has been eroded.

LEGEND

SEDIMENTARY ROCKS

CARBONIFEROUS

XV, XIV — Cbx — Braxton formation (red and yellow shale and brown sandstone; contains two workable coal beds)

XIII — Cps — Upshur sandstone (white and brown sandstone, conglomerate, and olive shale; contains coal, three beds workable)

Cpg — Pugh formation (blue, gray, and black shale and sandstone; contains low grade coal, two beds locally workable)

XII — Cpi — Pickens sandstone (gray, white, and brown sandstone, conglomerate, and black and gray shale; contains coal, two beds workable)

XI — Ccn — Canaan formation (red shale and gray and brown sandstone)

Cgr — Greenbrier limestone (blue limestone, sandstone, and red shale)

X — Cpo — Pocono sandstone (gray sandstone, in places a conglomerate)

DEVONIAN

IX — Dh — Hampshire formation (shale and sandstone mainly red)

VIII — Dj — Jennings formation (olive and yellow shale and brown sandstone)

Known productive formations

Cbx — *Braxton formation* (contains two workable coal beds)

Cps — *Upshur sandstone* (contains three workable coal beds)

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Limestone

Henry Gannett, Chief Topographer.
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Scale $\frac{1}{125000}$

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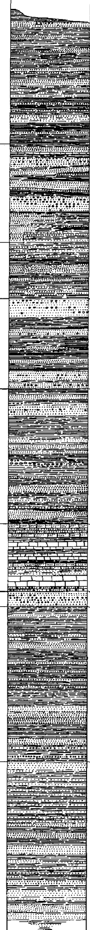
COLUMNAR SECTION

WEST VIRGINIA
BUCKHANNON SHEET

GENERALIZED SECTION FOR THE BUCKHANNON SHEET.

SCALE: 500 FEET = 1 INCH.

Period.	Formation Name.	Symbol.	Columnar Section.	Thickness in Feet.	Character of Rocks.	Character of Topography and Soils.
CARBONIFEROUS	Braxton formation.	Cbx		700+	Red and yellow shale, gray and brown sandstone, usually shaly, and coal seams.	Steep, generally smooth hill-slopes and narrow valleys. Red, yellow, and brown, sandy loam.
	Upshur sandstone.	Cps		350-500	White and brown sandstone, conglomerate, olive to yellow shale, and coal beds.	Rolling and hilly lands with restricted valleys. Yellow and gray, sandy soil. Steep, stony gorges and hill and mountain slopes.
	Pugh formation.	Cpg		300-450	Brown and white sandstone, and blue and black clay-shale with thin coal seams.	Generally steep and stony hillsides. Sandy soil, often concealed by loose sandstone blocks.
	Pickens sandstone.	Cpi		400-500	Brown, gray, and white sandstone and conglomerate, and gray to black shale with coal.	Precipitous, stony gorges and hill and mountain sides. Stony, sandy soil.
	Canaan formation.	Ccn		600-700	Shale, generally red and gray, and brown sandstone.	Steep mountain sides and rolling land. Red and yellow, sandy clay-soil, generally overplaced by sandstone and conglomerate talus.
	Greenbrier limestone.	Cgr		350	Blue limestone, calcareous sandstone, and red shale.	Steep escarpments of mountains. Red to yellow clay-soil.
	Pocono sandstone.	Cpo		50-100	Gray sandstone, locally a conglomerate.	
DEVONIAN	Hampshire formation.	Dh		700-900	Red, yellow, and greenish, sandy shale and clay-shale with thin-bedded brown sandstone.	Oval hilltops and steep escarpments. Thin, sandy and stony soil.
	Jennings formation.	Dj		800+	Olive, sandy shale and brown sandstone, usually thin-bedded.	Hill and valley lands. Thin, gray, sandy and stony soil.

NAMES OF FORMATIONS.

A TABULAR STATEMENT OF NAMES APPLIED BY VARIOUS AUTHORS TO THE STRATA OF THE BUCKHANNON DISTRICT. THE IMPLIED CORRELATIONS WITH OTHER STRATIGRAPHIC AREAS ARE NOT NECESSARILY ACCEPTED.

Period.	Names and Symbols used in this Folio.		N. H. Darton and J. A. Taff: Piedmont Folio, U. S. Geological Survey, 1896.	Names used by Various Authors.	H. D. Rogers: First Report of Pennsylvania, 1836; and W. B. Rogers: The Virginias, 1838, and later.	H. D. Rogers: Final Report of Pennsylvania, 1858.
Carboniferous	Braxton formation.	Cbx	Elkgarden formation.	Upper Coal Measures.	XV.	Seral.
	Upshur sandstone.	Cps	Fairfax formation.	Lower Barren Measures.	XIV.	
	Pugh formation.	Cpg	Bayard formation. Savage formation.	Lower Coal Measures.	XIII.	
	Pickens sandstone.	Cpi	Blackwater formation.	Pottsville conglomerate.	XII.	
	Canaan formation.	Ccn	Canaan formation.	Mauch Chunk shales.	XI.	Umbral.
	Greenbrier limestone.	Cgr	Greenbrier limestone.	Greenbrier limestone.		
	Pocono sandstone.	Cpo	Pocono sandstone.	Montgomery grits. Pocono sandstone.	X.	Vespertine.
Dev.	Hampshire formation.	Dh	Hampshire formation.	Catskill.	IX.	Ponent.
	Jennings formation.	Dj	Jennings formation.	Chemung.	VIII.	Vergent.

JOSEPH A. TAFF,
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Geologists.