GEOLOGIC ATLAS
OF THE
UNITED STATES

LONDON FOLIO
KENTUCKY

INDEX MAP

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WASHINGTON, D.C.

ENGRAVED AND PRINTED BY THE U.S. GEOLOGICAL SURVEY
RALPH WILCOX, SUPERINTENDENT OF PHOTOGRAPHIC WORKS

1938
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 a atlas, the parts of which are called folios. Each folio consists of a topographic base map and a geologic map 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) topographic, such as peaks, plains, plateaus, valleys, and mountains; (2) distribution of water, called drainage, as streams, swamps, etc.; and (3) the works of man, called culverts, as roads, railroads, boundaries, villages, and cities.

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

Contours and elevations are printed in black.

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

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2. Contours define the forms of slopes. Since contours are continuous horizontal lines conforming to the surface if upturned, they are printed on the map so as to be smooth and fairly smooth surfaces, recede into all perpendiculars of vertical columns and project in passing upward from a gentle slope on a gentle slope one must go farther than on a steep slope, and therefore contours are far apart in gentle slopes and close together in steep ones.

3. A fast or gently undulating country a small contour interval is used; for a steep or mountainous country a close contour is used. The smallest interval used on the atlas sheets of the Geological Survey is 2 feet. This is used for regions like the Mississippi Delta and the Pontine Swamp. In mapping large mountain masses, such as those in Colorado, the interval may be 250 feet. For intermediate relief contour intervals of 10, 20, 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. Arrows or arrows sines are used to indicate the direction the water takes. The drainage surface, the supposed underground course is shown by a broken blue line. Lakes, marshes, and other bodies of water are shown in blue, by appropriate conventional signs.

Culverts — The works of man, such as roads, railroads, and canals, together with boundaries of towns, counties, cities, and states, and artificial details, are printed in black.

3. The area of the United States (exclusive of Alaska) is about 9,000,000 square miles. The map shows the limits of each state, the boundaries of counties, townships, and cities, and all state and national parks, reservations, and zoological gardens are indicated.

Two scales are used on the atlas sheets of the Geological Survey: the smaller is the scale, and the larger is the scale. Each is drawn to correspond approximately to 4 miles, 2 miles and 1 mile on the ground to an inch on the map. On the scale, a square inch is necessary, and on the scale, about 10 square miles. At the bottom of each atlas sheet are the words "To the scale is equivalent to about 4 miles, 2 miles and 1 mile on the ground to an inch on the map."

3. The maps represent the topographic base map on which is superimposed a plan of the United States to an inch on the map. The map is a sheet, 10 inches square, and shows the distribution of water, vegetation, and other natural features. The map is an illustration of the topographic base map on which is superimposed a plan of the United States to an inch on the map. The map is a sheet, 10 inches square, and shows the distribution of water, vegetation, and other natural features. The map is an illustration of the topographic base map.

3. The igneous rocks are those which have cooled and consolidated from a liquid state. As shown, igneous rocks are deposited on the original igneous rocks. Through the igneous and sedimentary rocks of all ages, the mineral content of the original igneous rocks has been influenced by the processes of weathering, erosion, and deposition.

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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 sandbar. On each side of the valley is a terrace. The slopes of the terrace on the right rise gradually, while from that on the left the ground slopes steeply in a precipice. Contrasted with this precipice is the gentle descent of the left-hand slope. In the map each of these features is indicated, directly beneath its position in the sketch, by contours. The following explanation may make clear 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 30 feet; therefore the contours are drawn at 50, 150, 150, 200, and so on, above sea level. Along the contour at 250 feet lie all points of the surface 250 feet above sea level, and similarly with any other contour. In the space between any two contours are found elevations above the lower and below the higher contours. 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 level. The summit of the ridge is shown to be 300 feet, and accordingly the contour at 60 feet surrounds it. This illustration nearly all the contours are numbered. Where this is not necessary, the contours are drawn — say every fifth one — are contoured and numbered; the heights of others may then be ascertained by counting up or down from a numbered contour.

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3. The geologic map on the face of the country shows the geologic structure of the surface and the map shows the distribution of rock formations on the surface of the earth, and the structure section is shown by the map. In this geologic map, the topographic base map shows the location of rock formations on the surface of the earth, and the structure section is shown by the map.
DESCRIPTION OF THE LONDON QUADRANGLE.

GEOGRAPHY.

General relations.—The territory represented by the London atlas sheet embraces an area of 500.4 square miles, extending from latitude 37°15' N. on the north, and from longitude 84° 30' W. on the west, to latitude 38° 30' N. on the north, and from longitude 85° 45' W. on the west. It includes, wholly or in part, the counties of Rockcastle, Jackson, Lincoln, and Garrard, and it is named from London, the principal town within its bor-
ners. The chief towns, Jacksonport, Garrardville, and Le-
vey, are Richmond on the north, Beattyville on the northeastern, Manchester on the east, Cumberland Gap on the southeast, and Williamsburg on the south.

In its geographic and geologic relations this triangle 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.

Subdivisions of the Appalachian province.—Respecting the attitude of the rocks, the Appala-
chian province may be divided into two nearly equal portions by a line which follows the north-
western side of the Appalachian Valley along the Allegheny front and the eastern escarpment of the Cumberland table-land. East of this line the rocks are nearly level, and the surface is marked by moraines and faults, and in many places there are so metamorphosed that their original form can not now be determined. West of this line the division is broken by some almost vertical and the streams are nearly level, the surface is level, the surface is level, and the surface is level.

The western division of the province embraces the Cumberland Plateau and the Alle-
gheny Mountains and the lowlands of western Tennessee, Kentucky, and Ohio. Northeast-
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surface, and limestone deposition was taking place against the entire area. At an interval in which muddy sediments were laid down, but the extent of the interval and the origin of the deposits is unknown. In the uplift which followed, the material just deposited was largely eroded, deep channels were cut into the land, extending in some cases through the shale and into the limestone to a depth of 100 feet.

The erosion interval represents, without doubt, the earlier portion of Coal Measure time, when the Cincinnati arch was dry land separating the two coals in Kentucky. At the beginning of this portion of the interval the sea occupied a basin much further to the east than this region, and coal swamps and fossiliferous alluvial sediments were laid down, while the London quadrangle was dry land. Gradually the land subsided, and the sea encroached towards the west, finally engulfing the land of this region. The advancing shore line was marked by accumulations of sand and gravel which filled the inequalities of the land and which have since been consolidated into sandstones and conglomerates. Whether this sea transgressed sufficiently to cover all central Kentucky is uncertain, and their general character is shown in the colurnar sections, but a more detailed description of the individual beds and their probable equivalents in other fields are given in the following paragraphs.

**Cohoctonotus Shale.**

The rocks of this area are mainly marine origin, and distinctly underlie the lowest coal-bearing strata.

**Waverly Shale.**—This formation overlie the Cohoctonotus shale, and is easily separated from the latter on account of its color. At its base it is a light-blue clay shale, which passes upward into sandy shale, and argillaceous sandstone. The sandstone at the base abounds with light-blue and dull ironstone concretions, which on weathering change to bright reddish brown, and have been mistaken for volcanic rocks on account of their dark color and their extreme toughness. Over a wide area this formation is characterized by a great number of siliceous concretions, which ordinarily are only a few inches in diameter, but sometimes attain a diameter of two feet or more. So numerous and so large are they in the northern portion of this area that they have given the name to Boumoundee Creek, one of the principal tributaries of Blackwater River. In the vicinity of this creek they occur in beds several feet thick, and are visible at a distance of a quarter of a mile. They are more abundant at other horizons, having been replaced at the top of the formation by a thin sandstone which is to be seen at the cragging of Black Creek west of Dallas.

The name Waverly is derived from Ohio, where the formation was first described. It consists of light gray sandstone, an argillaceous limestone, and a sandstone, with a few gray siltstone. It is underlaid by a gray siltstone, and is underlain by a gray sandstone. The formation is 300 to 600 feet thick.

This formation is named from the station of Waverly, in Madison County, Kentucky, and is very prominent in the stratigraphic section in the middle, and a brown massive limestone at the top. The sandstone and shale are generally regarded as Silurian, and the limestone as Devonian age.

**Devonian Strata.**

Throughout the southern portion of the Appalachian province, and as far west as central Kentucky, the Devonian rocks are of varying lithologic character; it consists of black carbonaceous shales, and is thin and shales, and thinnest toward the south, and which in places has unconformably upon the rocks underlies.

Northward from central Kentucky the Devonian increases rapidly in thickness, and many beds of coarse material appear in the mass of shales.
for erosion, and consequently it forms the foundation for an extensive area of nearly level land in the northern portion the distance between it and the limestones is about 5 miles. There are various courses of old cut deep channels in the limestones and leaving the remnants of the conglomerate as mere caps or to the ridge.

The Lee formation is nearly equivalent to the Potteville series of Pennsylvania, but it does not contain either the Carboniferous or the upper limestone formations. This formation includes all of the Carboniferous rocks lying above the Carboniferous conglomerate. It is composed of shale and sandstone with occasional coal seams, but no individual bed is of sufficient importance to be shown as an independent formation. In the highest hills in the vicinity of London this formation shows about 300 feet in thickness. It is named from Breckinridge County, Kentucky, where the formation is present in great force.

**STRUCTURE**

To the eye of the observer the rocks of this quadrangle appear to lie horizontal, but when they are examined carefully it is evident that one outcrop is conspicuously higher than that of the neighboring area. In the sea bottom has generally less diversity of altitude than the present rocks; the center of the upturned position is due to movement in the crust of the earth.

**Definition of terms.**—The strata when compared with a horizontal plane are found to be inclined. The inclination is known as the dip of the rocks. In the process of deformation the rocks have been thrown into arches and troughs. In describing these folds the term synclinorium is applied to the downward-bending trough and the term anticlinorium to the upward-bending arch. A syndetic axis is a line running lengthwise in the synclinorium and at every point occupying its lowest part, toward which the rocks dip from either side. An anticlinorium is a line which occupies at every point the highest portion of the antclinal arch, and from which the rocks dip to either side. The axis may be horizontal or inclined. Its departure from the horizontal is called the pitch, and is usually only a few degrees in amount.

As a result of the strains and stresses which have affected the area, wide plains have been broken along certain lines, and the rocks on one side of the break have been lifted or depressed with respect to those on the other side. Where the rocks have been intensely folded, as in the Appalachian Valley, the breaks have developed from the compressed and overturned folds; but in the Ohio Basin the faults are due to tension, or the stretching of the strata. Faults of the former type are sometimes of great linear extent and of enormous displacement, and those of the latter are in this district generally short and of very slight displacement.

In addition to the crustal movements which have perceptibly deformed the rocks of this region, the province has been affected by vertical movements which have repeatedly elevated and depressed the surface of the land, but by amounts which are generally less than the magnitude of the folds. These slight movements were not continuous, but occurred new and then, the periods of greatest activity were separated by intervals of quiet in which the agents of erosion had time to record their action on the face of the land.
## COLUMNAR SECTIONS

### KENTUCKY

#### LONDON QUADRANGLE

### GENERALIZED SECTION FOR THE NORTHERN HALF OF THE LONDON QUADRANGLE.

**Scale:** 300 feet = 1 inch.

<table>
<thead>
<tr>
<th>Formation Name</th>
<th>Strata</th>
<th>Columnar Section</th>
<th>Character of Rocks</th>
<th>Character of Topography and Soil</th>
</tr>
</thead>
<tbody>
<tr>
<td>(Curtin conglomerate-limestone.)</td>
<td>(Ca)</td>
<td>3-110</td>
<td>Conglomerate or coarse pink sandstone.</td>
<td>Rounded ridges. Sandy soil.</td>
</tr>
<tr>
<td>Lee formation.</td>
<td>Ca</td>
<td>90-90</td>
<td>Sandy shale and sandstone with a few seams of coal.</td>
<td>Hills and slopes generally poor soil.</td>
</tr>
<tr>
<td>(Rockcastle conglomerate-limestone.)</td>
<td>(Ca)</td>
<td>90-130</td>
<td>Coarse conglomerate.</td>
<td>Cliffs. Sandy soil.</td>
</tr>
<tr>
<td>(Newman limestones.)</td>
<td>Cep</td>
<td>350-300</td>
<td>Blue limestones with a few nodules of chert.</td>
<td>Cliff and hill lands. Generally fertile soil where slopes are not too steep.</td>
</tr>
<tr>
<td>Panola formation.</td>
<td>Stg</td>
<td>90-120</td>
<td>Brown limestones, generally cherry, at the top; light-brown clay shale below.</td>
<td>Valleys. The shale forms poor soil and bad roads.</td>
</tr>
</tbody>
</table>

### GENERALIZED SECTION FOR THE SOUTHERN HALF OF THE LONDON QUADRANGLE.

**Scale:** 500 feet = 1 inch.

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<tr>
<td>Breathitt formation.</td>
<td>Cep</td>
<td>100</td>
<td>Sandy shale and coarse foraminiferous sandstone.</td>
<td>Sandy country, with gentle slopes and rounded remnants. Soil fair on shale; contempt; poor on sandstones.</td>
</tr>
<tr>
<td>(Curtin conglomerate-limestone.)</td>
<td>(Ca)</td>
<td>0-100</td>
<td>Conglomerate or coarse pink sandstone.</td>
<td>Cliff. Sandy soil.</td>
</tr>
<tr>
<td>Lee formation.</td>
<td>Cep</td>
<td>100-150</td>
<td>Sandy shale and sandstone with a few seams of coal.</td>
<td>Gentle rolling uplands; near the Buffalo River. Generally poor soil. (Cliffs. Sandy soil.)</td>
</tr>
<tr>
<td>(Rockcastle conglomerate-limestone.)</td>
<td>(Cep)</td>
<td>0-150</td>
<td>Coarse conglomerate.</td>
<td>Valley. Poor soil.</td>
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### NAMES OF FORMATIONS.

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</table>

**Marius R. Campbell,**
Geologist.
forming another gradation into sedimentary deposits. Some of this glacial wash was deposited in tunnels and channels left by the retreating glaciers; the prominent ridges and mounds of sand and gravel, known as cones, or cones, and kames. The material deposited in the water from these channels was carried by the glaciers, then washed from the ice onto the adjacent land and called modified drift. It was usual also to class as subglacial rock the gravel and sand of the streams of lakes and rivers that were made at the same time as the ice deposit.

AGES OF ROCKS

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

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

Several formations considered together are designated a system. The time taken for the deposition of a formation is called a geologic age, and the time taken for that of a system, or some larger fraction of the earth's history, is called an epoch. The ages of rocks are mapped by formations, and the formations are classified into systems. The systems composed a geologic period, and the time is called an era. Many of them are now given the same name, as, for instance, Cambrian system, Cambrian period.

As sedimentary rocks or strata accumulate, the youngest rock is 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 disturbances; sometimes in such regions the disturbances of the beds and the igneous rocks overlie or are overlain by the rocks of another period, and their relative position is reversed, and it is often difficult to determine the relative ages of the beds from their positions; then fossils or animals, are guides to show the relations between the beds in their beds, and animals, are guides to show the relation between 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 life that appeared in the oldest fossiliferous rocks were deposited. From time to time more complex kinds developed, and as the simpler ones lived on in modified form, their descendants, which have varied. But during each period there lived peculiar forms, which did not exist in earlier times and have not existed in later ages, and these forms, just as the plants, are classified by their size, and if the age of any bed of rock in which they are found. Other types appear on form and period, and thus linked the systems together, forming a chain of life from the time of the oldest fossiliferous rocks to the present.

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

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

Colors and patterns. To show the relative ages of strata, the history of the sedimentary rocks is divided into periods. The names of the periods in geologic time are proper names (from Latin) and they differ in color or pattern, and are classified by their size, and if the age of any bed of rock in which they are found. Other types appear on form and period, and thus linked the systems together, forming a chain of life from the time of the oldest fossiliferous rocks to the present.

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