The Geological Survey is making a large topographic map and a large geologic map of the United States, which are being issued together in the form of a Geologic Atlas. The parts of the atlas are called folios. Each folio contains a topographic map and a geologic map of a small section of country, and is accompanied by explanatory and descriptive texts. The complete atlas will comprise several thousand folios.

**EXPLANATION.**

1. **Topographic Map.**
   - The features represented on the topographic map are of three distinct kinds: (1) inequalities of surface, called relief; (2) distributions of water, called drainage; and (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 printed in brown. It is desirable to show also the elevation of a hill, ridge or valley to delineate the horizontal outline or contour of all slope; and to indicate their degree of steepness. This is done by lines of constant elevation above mean sea level, which are drawn at regular vertical intervals. The lines are called contours and the constant vertical space between each two contours is called the contour interval. Contours are printed in brown.
   - The manner in which contours express the three conditions of relief (elevation, horizontal form and degree of slope) is shown in the following sketch and corresponding contour map.

   **The Sketch.**
   - The sketch represents a valley between two hills. In the foreground, in the sea, is a bay which is partly closed by a hooked sand bar. On either side of the valley is a terrace, and it is seen that on the right the hill rises gradually with rounded forms, whereas from that on the left the ground ascends steeply to a precipice which presents sharp corners. The western slope of the higher hill contrasts with the eastern by its gentle descent. In the map each of these features is indicated, directly beneath its position in the sketch, by contours.

   **The Contour Map.**
   - A contour indicates approximately a height above sea level. In this illustration the contour lines are drawn at intervals of 50, 100, 150, 200, 250, 300 feet, and so on, above sea level. Along the contour at 200 feet all points of the surface 200 feet above sea; and so on 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 surface above the contour 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, according to the contour at 600 feet. In this illustration nearly all the contours are numbered. Where this is not possible, certain contours are made heavy and are numbered; the heights of others may then be ascertained by counting up or down from a numbered contour.

   - 2. Contours define the horizontal forms of slopes. Since contours are continuations of horizontal lines conforming to the surface of the ground, they wind smoothly about smooth surfaces, recede into all concavity and rise into all convexity, representing all actualities of form and features. The relations of contours to contours of the landscape can be traced in the map by means of the lines of constant slope that can be drawn on it.

   - 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. Therefore contours are far apart on the gentler slopes and near together on steep ones.

   For a flat or gently undulating country a small contour interval is chosen; for a steep or mountainous country a large contour interval is necessary. On the map the smallest contour interval is 25 feet. For the Contour Map of the United States the largest contour interval is 1,000 feet.

   - The atlas sheets, being only parts of one map of the United States, are laid out without regard to the geographical limits 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. At the sides and corners of each sheet the names of adjacent sheets are printed.

2. **Geologic Map.**
   - A geologic map represents the distribution of rocks, based on a topographic map—that is, to the topographic representation the geologic representation is added. Rocks are of many kinds in origin, but they may be classed in four great groups: (1) Superficial Rocks; (2) Sedimentary Rocks; (3) Igneous Rocks and Metamorphic Rocks. The different kinds found within the area represented by a map are shown by devices printed in colors.

   - Rocks are further distinguished according to their relative ages, for rocks were not formed all at one time, but from age to age the earth's history has been marked by geologic periods like locality, for the conditions of their deposition at different times and places have not been alike. Moreover, the rocks show many variations. Where beds of sand were buried beneath beds of mud, sandstone may now occur under shale; whereas where the flow of lava cooled and was overlaid by another bed of lava, the two may be distinguished.

   - Each of these masses is limited in extent to the area in which it was formed, and is bounded, and is composed above and below by different rocks. It is convenient to geology to call such a mass a forma­tion. (1) Superficial Rocks—These are composed chiefly of clay, sand, and gravel, disposed in heaps and irregular beds, usually unorganized.

   - Within a recent period of the earth's history, thick and extensive ice sheet covered the northern rocks of the United States and part of British America, as one now covers Greenland. The ice gathered slowly, moved forward and retreated as climatic changes of climate, and after a long and varied existence melted away. The ice left peculiar heaps and ridges of gravel; it spread across layers of sand and clay, and the water flowing from it distributed sediments of various kinds far and wide. These deposits from ice and flood, together with those made by water and winds, upon the land and shore after the glacier had melted, and those made by similar agencies where the ice sheet did not rest, are the superficial formations. These are of two kinds, (1) those of the period of the earth's history, from the beginning to the present day, and (2) those of the post glacial epoch to the present, is called the pliocene epoch.

   - The distribution of the superficial rocks is represented on the map by colors printed in patterns of dots and circles.

   - The water courses are indicated by blue lines drawn uniformly, wherever the stream flows the round year, and dotted where the channel is dry part of the year. Where the terminal areas and reappears at the surface, the sup­

   - The distribution between distance in nature and corresponding length on the map is called the scale of the map. This special case is it “one mile to an inch,” on the United States half as long and high would have a scale half as great; its real would be “two miles to an inch,” or four square miles to a square inch. Scale is expressed as a fraction, of which the numerator is the length on the map and the denominator the corre­

   - These, such as roads, railroads and towns, together with names of natural and artificial details and boundaries of towns, counties and states, are printed in black.

   - 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. Therefore contours are far apart on the gentler slopes and near together on steep ones.

   - A folio is called the area of the United States (without Alaska) is about 9,250,000 square miles. On a map 500 feet long and 199 feet high the United States would cover 9,250,000 square miles. Each square mile of ground surface would be repre­

   - Westerner forms of the landscape can be traced in the map by means of the lines of constant slope that can be drawn on it.

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pour out of cracks and volcanoes and flow over the surface as lava. Sometimes they are thrown from volcanoes as ash and spray and spread over the surface by winds and storms. Lava flows are interbedded with sediments.

The first rocks of the earth, which formed during the Archean period, were igneous. Igneous rocks have intruded among masses beneath the surface and have been thrown out from volcanoes at all periods of the earth’s development. These rocks occur because of sedimentary formations of all periods, and their ages can sometimes be determined by the ages of the sediments with which they are associated.

Igneous rocks are represented on the geologic maps by patterns of triangles or rhomboids printed in any brilliant color. When the age of a formation is not known, the letter-symbol consists of small letters which suggest the name of the rocks; when the age is known the letter-symbol has the initial letter of the appropriate period prefixed to it.

Altered rocks of crystalline texture. These are rocks which have been so changed by pressure, movement, and chemical action that the mineral particles have recrystallized. Both sedimentary and igneous rocks may change their character by the growth of crystals and the gradual development of new minerals from the original mass. Marble, which has been crystallized, is one of the common minerals which may thus grow. By this chemical alteration sedimentary rocks become crystalline, and igneous rocks change their composition to a greater or less extent. The process is called metamorphism and the resulting rocks are said to be metamorphic.

Metamorphism is promoted by pressure, high temperature, and water. When a mass of rock, under these conditions, is subjected to movements during the earth’s crust, it may divide into many thin parallel layers. When these layers are formed in thin layers by deposition they are called slates; but when rocks of any class are found in thin layers that are due to pressure they are called slates. When the cause of the thin layers of metamorphic rocks is not known, or is not simple, the rocks are called schists, a term which applies to both slate and slate structures.

Rocks of any period of the earth’s history, from the Neocene back to the Algonkian, may be more or less altered, but the younger formations have generally escaped marked metamorphism, and the oldest sediments known remain in some localities essentially unchanged.

Metamorphic crystalline formations are represented on the map in various types which have sharply irregular places. These are printed in any color and may be darker or lighter than the background. If the rock is not shown, the map may be arranged in 20 parallel lines.

If the formation is known the letter-symbol of the formation is preceded by the capital letter-symbol of the proper period. If the age of the formation is known the letter-symbol consists of small letters such as are used in the geologic periods.

USES OF THE MAPS.

Topographic.—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 the region is brought out. It may guide the traveler, who can determine the position and surroundings of points of interest, and mountain peaks in the extreme right.

Archaic geography. This sheet shows the areas occupied by the various rocks of the district. On the margin is a legend, which is the key to the map. To ascertain the mineralogical character of any portion of the map the reader should look for that section of it next to the section line, there he will find the name and description of the formation. If it is desired to find any given formation, its name is indicated on the section line, and its color and pattern will be traced out. The layers of rock or strata are the partial sequence of the geologic history of the district. The formations are arranged in groups according to origin—igneous, sedimentary, or metamorphic—according to their composition and the changes they have undergone.

The older rocks have the initial letter of the appropriate period prefixed to it.

Economic geology. This sheet represents the distribution of useful minerals, the occurrence of petroleum, or other facts of economic interest showing their relations to the features of topography and to the geologic formations. All the rock formations which appear on the map are shown in different colors, and the areal geology of the various formations is shown on the map in the proper relation to the geologic structures and to the features of topography. The strata of this group are parallel, a relation which is shown on the map by horizontal parallel lines. The strata are divided into groups, which correspond with the great periods of geologic history. The strata are grouped according to their deposition.

Igneous formations are represented on the section line by symbols of small letters only. The occurrence of useful minerals, and qualifications of doubtful conclusions, are represented on the maps by patterns consisting of short horizontal lines of different colors.

The sheet presents the facts of geological history in strong colors with marked distinctions, and is adapted to use as a wall map as well as to closer observation. Knowing the manner of the formation of rocks, their composition, and the changes they have undergone, the learner can infer their relative positions after they pass beneath the surface. The areal geology, thus printed, is the map in hand, every characteristic feature of the surface is brought out. It may guide the traveler, who can determine the position and surroundings of points of interest, and mountain peaks in the extreme right.