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 on plains, valley bottoms, hills, and mountains; (2) distribution of water, called drainage, as streams, lakes, and swamps; (3) the works of man, called features.

2. Contours delineate the forms of slopes. Since contours are continuous horizontal lines conforming to the surface of the ground, they wind almost always smoothly about rough regions, being bounded by a line of abrupt transition to a lower part of the terrain, or by a line of change in the character of the surface. The relations of contour lines and angles to forms of the landscape can be traced in the map and sketch. The character of the land is shown in the following way:

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<tr>
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2. Contours show the approximate grade of the surface on a vertical section of the ground. These include all those which are most likely to be of practical interest, such as railroad, boundary, village, and city limits. They are called contours, and the constant vertical space between two of these contours is called the contour interval. Contours and elevations are printed in brown.

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

![Fig. 1. Ideal sketch and corresponding contour map.](image)

3. Contours determine the form of hills. In the foreground is the sea, with a bay and a terrace on the right a hill rises gradually, while from that on the left the ground ascends steeply from a numbered contour. The area of the United States (exclusive of Alaska) is about 2,925,000 square miles, and when plotted on a map 940 feet long and 180 feet wide this would cover, on a scale of 1 mile to the inch, 2,925,000 square inches. On this scale a square inch 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. The 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 in inches, and the denominator is 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 1 inch" is expressed by a fraction. 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 1 inch to the hundredth of a mile, the intermediate is 1 inch to 1 mile, and the largest is 1 inch to 20 miles. In each of these scales correspond approximately to 4 miles, 2 miles, and 1 mile of natural length to an inch or more on the map. The bottom of each atlas sheet is 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 scales.

4. Relief.—All elevations are measured from mean sea-level. The heights of many points are accurately determined, and those which are most likely to be of practical interest, such as railroad, boundary, village, and city limits, are called relief on plains, valley bottoms, hills, and mountains. All elevations are measured from mean sea-level, the heights of many points are accurately determined, and those which are most likely to be of practical interest, such as railroad, boundary, village, and city limits, are called relief. Relief is shown in the following way:

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Uses of the topographic sheet.—Within the limits of scale the topographic sheet is an accurate and characteristic delineation of the relief, limited by the elevation of the contours. When studying the landscape, the map in hand, every characteristic feature of sufficient magnitude should be studied; the topographic sheet must be used to guide the traveler. The relation of contour lines and angles to forms of the landscape can be traced in the map and sketch. The character of the land is shown in the following way:

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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 of the surface and of all but the highest rocks of the country. The map shows the underground relations, as far as they are known, and in such detail as the scale permits. 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 of the surface and of all but the highest rocks of the country. The map shows the underground relations, as far as they are known, and in such detail as the scale permits.

The geologic symbols are explained in the following way:

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**Uses of the topographic sheet.**

1. The topographic sheet is indispensable for the study of topography, and is one of the most important tools used in the field by the engineer preliminary surveys locating boulevards, railways, and irrigation ditches; provides educational material for schools and colleges, and of the many purposes of a map for local reference.

**THE GEOLOGIC MAP.**

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Afters.—The map is being published in series of convenient sizes, which are bounded by parallels and meridians. Each sheet on the scale of 1 inch to 1 mile contains one square degree; each sheet on the scale of 1 inch to 20 miles contains one-sixteenth of a square degree. These sheets, or the parts of sheets, are known as "blocks.

The age of an igneous rock is often difficult to determine. When it cuts across a sedimentary rock, the igneous rock is the older. The influence of dynamic and chemical forces on the rock are difficult to determine. The rock is often altered. The influence of dynamic and chemical forces on the rock are difficult to determine. The rock is often altered.

**Types of rocks.**

Types of rocks are divided into three major groups: igneous, sedimentary, and metamorphic.

- **Igneous rocks:** These are rocks that are formed from the cooling and solidification of magma. They can be classified into two main types: intrusive and extrusive. Intrusive igneous rocks are formed when magma cools and solidifies beneath the Earth's surface, while extrusive igneous rocks are formed when magma cools and solidifies on the surface.

- **Sedimentary rocks:** These are rocks that are formed from the accumulation of sediment, which is then compacted and cemented. Sedimentary rocks are often layered, with each layer representing a different time period. Examples of sedimentary rocks include sandstone, shale, and limestone.

- **Metamorphic rocks:** These are rocks that have been altered by heat, pressure, or chemical processes. Metamorphic rocks are formed when existing rocks are subjected to these processes, causing them to change in texture, structure, or composition. Examples of metamorphic rocks include marble, slate, and gneiss.

**The formation of sedimentary rocks.**

- **Sedimentary rocks:** These are formed from the accumulation of rocks, shells, and other materials in water bodies. Over time, these materials are compacted and cemented, forming sedimentary rocks.

**The formation of igneous rocks.**

- **Igneous rocks:** These are formed from the cooling and solidification of magma. Magma is molten rock that is produced by the melting of existing rocks. Depending on the temperature and pressure, the magma may cool and solidify beneath the Earth's surface (intrusive) or on the surface (extrusive). Examples of igneous rocks include granite and basalt.

**The formation of metamorphic rocks.**

- **Metamorphic rocks:** These are formed when existing rocks are subjected to heat, pressure, or chemical processes. This can occur when rocks are buried deep within the Earth, or when they are subjected to the effects of water or other fluids. Examples of metamorphic rocks include marble and slate.

**The classification of rocks.**

Rocks are classified based on their mineral composition, texture, and the processes that formed them. This classification system helps geologists understand the history of the rocks and the conditions under which they were formed.

**The uses of rocks.**

Rocks have a wide range of uses, from building materials to industrial applications. Some common uses of rocks include:

- **Building materials:** Rocks are used in construction, including as aggregate for concrete, as dimension stone for buildings, and as paving stones.

- **Industrial applications:** Rocks are used in a variety of industries, including as aggregates for asphalt, as abrasives for sandblasting, and as raw materials for the production of cement.

**The economic importance of rocks.**

Rocks are a valuable resource, and their economic importance is significant. The extraction and processing of rocks for use in construction, manufacturing, and other industries is a major contributor to the global economy. Understanding the properties and characteristics of rocks is crucial for their effective and sustainable use.
in channels and chasms in the ice, and forms large jutting ridges and mountains of sand and gravel, known as bars, or coves, and kames. The material deposited in these channels and chasms is called glacial drift; that washed from the ice into 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.

**AGED 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 subject of this discussion.

Several formations considered together are designated a system. The time taken for the deposition of a formation is called an age, 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. For instance, Cambrian system, Cambrian period, Cambrian era.

As sedimentary deposits or strata accumulate the younger rest on those that are older, and the relations of the formations beneath the surface. The arrangement of rocks in the earth's crust, and the relations between the two is called structure section.

The formations of any one period, with the color and its letter-symbol on the map the reader should look for that color, pattern, and symbol in the order of accumulation of successive deposits. Whether sedimentary rocks are also included is indicated graphically or by the word "unconformity." The section and landscape in fig. 2 are ideal, but they illustrate relations which actually occur.

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 ledges, like those of the first set, are conformable.

The horizontal strata of the plateau rest upon the younger strata thus rest upon an eroded surface of older strata the relation between the two is an unconformity.

The third set of formations consist of crystal, or igneous rocks and igneous rocks. At some period of their history the schists were piled by pressure and by the pressure and by intrusive movements. These pressures and intrusions of igneous rocks have not affected the overlying strata of the second set. Thus it is evident that an interval of considerable time has 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 metamorphic changes; they were the scene of eruptive activity; and they were deeply eroded. The contact between the second and third sets, marking a time of rest, is known as an unconformity.

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 the deposits of the sea, forming a plateau, and their change of elevation shows that a portion of the earth's mass has overwhelmed upward from a lower to a higher level surface. The strata of this set are parallel, a relation which is called conformable.

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