EXPLANATION.

A Geological Survey is making a large topo-
graphic map and large-scale 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 coun-
try, and is accompanied by explanatory and de-
scriptive texts. This atlas will comprise several thousand folios.

The Topographic Map.

The features represented on the topographic map are of three distinct kinds: (1) inequalities of sur-
faces, called reliefs as plains, prairies, valleys, hills, and mountains; (2) distribution of water, called rivers, as streams, ponds, lakes, swamps and canals; (3) the works of man, called colonies, as roads, railroads, boundaries, villages and cities.

Reliefs. All elevations are measured from sea
mean level. The heights of many points are accu-
rate and determined and those which are most im-
portant are stated on the map by numbers printed in brown. It is desirable to show also the elva-

cation of any part of a hill, ridge, slope, or valley; to delineate the horizontal outline and inclined of all

to indicate their degree of slope. This is done by lines of constant elevation above mean sea level, which are drawn at regular intervals. The lines are called contour lines and show the constant vertical space between each two con-
tours in the horizontal plane. Contours are printed in brown.

Rivers. The manner in which the course of the

easternmost part of the United States is shown in the following sketch and corresponding contour map:

...
LIVINGSTON ATLAS SHEET

DESCRIPTION.

GEOGRAPHY AND TOPOGRAPHY.

The area of country covered by the Livingston sheet lies between the parallel of 45° and 46°, and the meridians of 110° and 111°, embracing 8,340 square miles. It lies wholly in Montana, the line of parallel between the bounding lines of this sheet and Wyoming. It includes portions of Gallatin and Park counties, and derives its name from Livingston, Montana, the county seat, which is near the center of the area within its limits. It is an elevated region, wholly above an altitude of 4,000 feet and mainly above 6,000 feet, the highest peaks being over 11,000 feet above sea level.

Immediately south of this area is situated the Yellowstone National Park, which, with the exception of a narrow belt of country in Montana and a still narrower one in Idaho, lies in the State of Wyoming. The center of the park is essentially a broad volcanic plateau, with an average elevation of 8,000 feet, surrounded on all sides by mountainous subdivisions and ridges rising from 2,000 to 4,000 feet above the enclosedtablaund. Mountains and plateau, taken together, present an almost unbroken rim 75 miles in length. Two of the ranges against which the volcanic rocks of the Park plateaus rest, the Gallatin and Sweetwater, are of notable size.

The principal topographical and geological features of the Livingston sheet are the Snowy Range, Gallatin range, Bridger range, Crazy mountains, and Yellowstone valley.

The Yellowstone river is the main drainage channel for this region, receiving all the waters except a few small streams on the west side of the Gallatin and Bridger ranges. It has its source in Yellowstone lake on the Park plateau, flowing northerly through the Grand canyon of the Yellowstone, and thence westward along the southern slope of the Snowy range, it leaves the Park near the boundary of Montana. Thence north to Livingston it flows through a broad valley incised by mountains of bold aspect. This valley widens to three miles and is over 80 miles long. Just before reaching Livingston the river traverses a narrow gorge cut through uplifted sedimentary rocks, exposing an excellent section across the Paleozoic strata. Thence, making a sharp curve, it flows eastward across the great plains of the upper Missouri river.

The Yellowstone valley sharply divides the Gallatin range on the west from the Snowy range on the east. Beyond the great curve is the river near Livingston the broad valley separates the Snowy range from the long slope of the Gallatin range.

The Snowy range occupies a third of the area represented on the map and is enclosed by the Yellowstone river. The central part of the range is characterized by high plateaus and table topped ridges, which differ greatly in origin as they do in materials. The surface of the plateaus of granite which is drained by the Boulder river and its tributaries appears to have been placed to the level of an ancient sea. The stream then flowing could not have been higher than the plateau but has since been elevated by the forces of erosion.

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peaks outward have left imposing natural embankments at the mouths of tributary valleys and in the Bridger range. In some cases, the local glacial lines into whose moraines of angular debris are prominent among the lesser features of the foot-hill plains.

Since the melting of the glaciers the rivers have deposited fine gravel, sand and alluvium in beds that now form the valley terraces and fertile flood plains.

**DESCRIPTIONS OF THE SEDIMENTARY ROCKS.**

Sedimentary rocks cover nearly one-half of the 3,340 square miles of the Livingston sheet, and they embrace a total thickness of 20,000 feet, of which all the great divisions of geologic time are represented. The most striking range of character within this region is the great development of Cretaceous, or, to be more exact, of the Upper Cretaceous strata, of which there is a thickness of 12,000 feet above the Laramie coal measures, while the formations of the Paleocene age attain a total thickness of but 5,500 feet.

The Paleocene strata, which are in general the mountain formations, are thick, and are in many areas at such a height that the surface of the earth remains below the strata, as indicated by a series of minima of elevation, which are well defined, and are in general covered with a thin mantle of alluvium.

The Triassic series is well developed in small areas near the mountains, and is represented by a series of beds of sandstone, shale, and limestone, which are well exposed in the valleys and on the flanks of the mountains.

The Jurassic series is well developed in the region, and is represented by a series of beds of sandstone, shale, and limestone, which are well exposed in the valleys and on the flanks of the mountains.

The Cretaceous series is well developed in the region, and is represented by a series of beds of sandstone, shale, and limestone, which are well exposed in the valleys and on the flanks of the mountains.

The Quaternary series is well developed in the region, and is represented by a series of beds of sandstone, shale, and limestone, which are well exposed in the valleys and on the flanks of the mountains.

The allemagic rocks are well developed in the region, and are represented by a series of beds of sandstone, shale, and limestone, which are well exposed in the valleys and on the flanks of the mountains.

The Devonian rocks are well developed in the region, and are represented by a series of beds of sandstone, shale, and limestone, which are well exposed in the valleys and on the flanks of the mountains.

The Eocene rocks are well developed in the region, and are represented by a series of beds of sandstone, shale, and limestone, which are well exposed in the valleys and on the flanks of the mountains.

The Oligocene rocks are well developed in the region, and are represented by a series of beds of sandstone, shale, and limestone, which are well exposed in the valleys and on the flanks of the mountains.

The Miocene rocks are well developed in the region, and are represented by a series of beds of sandstone, shale, and limestone, which are well exposed in the valleys and on the flanks of the mountains.

The Pliocene rocks are well developed in the region, and are represented by a series of beds of sandstone, shale, and limestone, which are well exposed in the valleys and on the flanks of the mountains.

The Pleistocene rocks are well developed in the region, and are represented by a series of beds of sandstone, shale, and limestone, which are well exposed in the valleys and on the flanks of the mountains.

The Quaternary rocks are well developed in the region, and are represented by a series of beds of sandstone, shale, and limestone, which are well exposed in the valleys and on the flanks of the mountains.

The Tertiary rocks are well developed in the region, and are represented by a series of beds of sandstone, shale, and limestone, which are well exposed in the valleys and on the flanks of the mountains.

The Cenozoic rocks are well developed in the region, and are represented by a series of beds of sandstone, shale, and limestone, which are well exposed in the valleys and on the flanks of the mountains.

The Mesozoic rocks are well developed in the region, and are represented by a series of beds of sandstone, shale, and limestone, which are well exposed in the valleys and on the flanks of the mountains.

The Paleozoic rocks are well developed in the region, and are represented by a series of beds of sandstone, shale, and limestone, which are well exposed in the valleys and on the flanks of the mountains.

The Precambrian rocks are well developed in the region, and are represented by a series of beds of sandstone, shale, and limestone, which are well exposed in the valleys and on the flanks of the mountains.

**STRAINS OF THE CAMBRIAN PERIOD.**

The Cambrian rocks constitute readily recognizable formations in the region of the map. They include a considerable variety of quartzites, sandstones, and shales, and are well exposed in the range of the Bridger Basin, where they have been subjected to a considerable amount of metamorphism. The lower Cambrian rocks in the Bridger range are characterized by the presence of a great thickness of arkose, which is well exposed in the Bridger range, and is well represented in the Bridger range of the Wyoming and the Bridger range of the Montana.

The Red rocks of the Bridger range are characterized by the presence of a great thickness of arkose, which is well exposed in the Bridger range, and is well represented in the Bridger range of the Wyoming and the Bridger range of the Montana.

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but it is greatly exceeded in other parts of the Gallatin valley. The beds are slightly tilted, dip- ping at angles of 15° to W. The beds are conformable upon Archean schists and all sedi- mentary strata, including the Livingston. Fine exposures occur in many of the lower north branch of the East Gallatin river, near Fort Ellis. A smaller area of lake-beds assigned to this age occurs near Friarley, in the upper Yellowstone valley. The rocks consist of light cream-colored marls, becoming conglomeratic near Friderick. Upon these, streams gravel was deposited and these were subsequently covered by a basaltic lava flow. These beds were formed in an independent lake occupying this part of the Yellowstone valley.

SUPPLEMENTAL DEPOSITS OF THE PLIOCENE PERIOD.

Glacial drift. - Gravel, sand and boulders of a great variety of crystalline, igneous and sedimentary rocks cover the surface of a large part of the valley from Chico in the west to the Blackfoot river in the east. The gravel is generally finer and coarsely sub-rounded and passable by water. The gravel is usually accompanied by granite and sandstone, and hornblende porphyry. The sand and gravel occur in small areas along the banks of the river, and are generally fine and well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded.

Aftersnow. - The Suitton deposits of sand and gravel are generally well rounded and well sorted, and are generally well rounded. The sand and gravel occur in small areas along the banks of the river, and are generally fine and well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded.

Basic breccia. - The basic breccia is generally dark colored, and consists of pyroxene, pyroxene, hornblende, quartz, and feldspar. It is generally fine and well rounded. The sand and gravel occur in small areas along the banks of the river, and are generally fine and well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded, and are generally well rounded.

Acid breccia. - Acid breccia is generally dark colored, and consists of pyroxene, pyroxene, hornblende, quartz, and feldspar. It is generally fine and well rounded. The sand and gravel occur in small areas along the banks of the river, and are generally fine and well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded, and are generally well rounded.

DESCRIPTIIONS OF THE IGNEOUS ROCKS.

A large part of this area is covered with igneous rocks. They also enter into the composition of one of the most prominent formations in the Livingston range. They consist of sub-basaltic breccias or agglomerates with a weight of 1,000 pounds. The basaltic breccias are generally fine and well rounded. The sand and gravel occur in small areas along the banks of the river, and are generally fine and well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded, and are generally well rounded.

LITURGICAL DESCRIPTIONS.

The sandstones of the Laramie coal measures are not very satisfactory in the vicinity of Livingston and in Bridger canyon. They are generally fine and well rounded. The sand and gravel occur in small areas along the banks of the river, and are generally fine and well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded, and are generally well rounded.

The crystalline schists. - Granite, gneiss and schistose rocks constitute a part of the southern half of the region. They consist of granite, gneiss, and schistose rocks. The quartz veins trend northwest and parallel with the main mass of the schistose rocks. The quartz veins are generally fine and well rounded. The sand and gravel occur in small areas along the banks of the river, and are generally fine and well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded, and are generally well rounded.

Gold-bearing gravel. - The gravel derived from the crystalline rocks of the summit of the Snowy range have been worked at Emigrant gulf and at Bear and Crevier gulches. At Emigrant gulf the gravel was brought down to the main valley and deposited by the waters of Emigrant creek. They have yielded large amounts in the valley and are generally well rounded. The gravel of Bear and Crevier gulf have been deposited in the Snowy range, and have yielded large amounts in the valley and are generally well rounded. The gravel of Bear and Crevier gulf have been deposited in the Snowy range, and have yielded large amounts in the valley and are generally well rounded. The gravel of Bear and Crevier gulf have been deposited in the Snowy range, and have yielded large amounts in the valley and are generally well rounded. The gravel of Bear and Crevier gulf have been deposited in the Snowy range, and have yielded large amounts in the valley and are generally well rounded.

B.COAL.

Two important coal fields are embraced within the limits of this area. - The Cimarron field in the north and the southern part of the region to the north of the mountains of Livingston to which the name of the Chico coal bed has been applied. Under these beds the coals occur in Laramie strata. The strata vary from rather light, dark coals with a high percentage of lignite, to dark coals with a high percentage of lignite. The coals of the Cimarron field are generally fine and well rounded. The sand and gravel occur in small areas along the banks of the river, and are generally fine and well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded, and are generally well rounded. The boulders are generally fine and well rounded, and are generally well rounded.

The present value of the coals in this area is very great. The coals vary in thickness from 4 to 18 feet. The coals vary in thickness from 4 to 18 feet. The coals vary in thickness from 4 to 18 feet. The coals vary in thickness from 4 to 18 feet. The coals vary in thickness from 4 to 18 feet.
mines. The Horse workings yielded an annual output of about 23,000 tons in 1888. Three seams are worked, their total thickness being 15 feet. The coal is a bright bituminous fuel yielding a fine coke. The block coal meets with a ready sale and the screenings are used in ovens near the mines.

On the east bank of the river, at the Bowers mine, the coal seams form a narrow belt, faulted against the greas at the mouth of Trail creek and covered southward by a basaltic lava cap. The seams dip into the mountain at an angle of 40° to 60°, the bed now worked showing 8 feet of clean brilliant coal.

The Bowers coal field—This embraces a part of the great belt of coal-bearing Laramie strata that follows the front of the Rocky mountain system throughout the state. Although the Laramie rocks extend outward from Livingston, but one opening is worked, all the other mines of the field being west of that town. In this part of the field the coal measures are nearly vertical and the outcrop is S-shaped as the strata curve around the end of the Canyon mountain anticline. There are no productive workings westward until the Yellowstone-Missouri divide is crossed, beyond which the Timbervine mines are located. The strata here dip at 45° north into the hill. Two seams have been worked at this place, but the output is now almost wholly from two. The upper of these two seams is 4 feet thick, separated into three benches by partings. The coal is hard, little broken in the seams, and bears handling well. The lower of the two seams worked is 6 to 8 feet thick and rests upon a poorly defined floor of bone and shale. The coal is much eroded, very soft, crumbling in the fingers, quite bituminous, and can be lighted with a match. It is used for blacksmithing at the mines. The output from this seam is mixed with the harder coal of the seam above for the market. The output was 44,000 tons in 1889.

The mine seams are worked at the Mountain-Side and Chestnut mines, though the coals change somewhat in character.

A small synclinal basin of the Laramie coal measures occupies the valley of Trail creek a few miles south of Timbervine. Two seams have been worked.

West of Chestnut the coal-bearing strata curve about the anticline of Rocky canyon, reappearing in Bridger canyon where one of the seams has been worked. Although the coal strata extend northward along the east front of the Bridger range, no openings have been made there.

JOSEPH F. IDDINGS, Geologist.
WASHINGTON, W. V, Geologist.
ARNOLD HAGUE, Geologist in Charge.
January, 1893.
## Columnar Section

### Section at Yellowstone Canyon Near Livingston

<table>
<thead>
<tr>
<th>Period</th>
<th>Formation Name</th>
<th>Columnar Section</th>
<th>Character of Rocks</th>
<th>Character of Topography</th>
</tr>
</thead>
<tbody>
<tr>
<td>CRETACEOUS</td>
<td></td>
<td></td>
<td>Light gray or yellow sandstone, thinly bedded and cross-bedded, containing with gray clay shale and lenses of fine sands, which resemble in structure. Plant remains and fresh water shells occur in the shale.</td>
<td>Generally low rent rough country, in which the sandstones form low ridges and ridges, and the shales form steep cliffs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Sandstones with beds of conglomerate formed of gravel, some of which are fossiliferous, and lenses of fine sands, which resemble in structure. Plant remains and fresh water shells occur in the shale.</td>
<td>Usually low rent rough country, in which the sandstones form low ridges and ridges, and the shales form steep cliffs.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Alternating beds of sandstone and crumbly, green or purple shale.</td>
<td>Cut-off country, the sandstones forming low ridges. This part of the section generally forms valleys.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Lenticular intervals of sandstone, argillaceous and tuff beds, representing volcanic eruptions.</td>
<td>Long ridges or mounds projecting above barren slopes, which are generally smooth.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Dark layers or green sandstone containing plant remains with local beds of conglomerate.</td>
<td>Ridges formed of the sandstone beds, the outcrops being often concealed by debris.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Light gray or yellow sandstone with shale beds and workable quartzite. Plant remains with brachiopod shells.</td>
<td>Stools or ridges rising above gentle slopes of Montana shales.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Light gray, arenaceous shale with thin beds of sandstone. Marine fossils.</td>
<td>Foot-hill country, sandstones forming ridges projecting above smooth, gentle slopes of shale beds.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Calcareous shale with interbedded sandstones. Marine fossils.</td>
<td></td>
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<td>Black limestone shale.</td>
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<td></td>
<td>Quartzite underlaid by sandy shale passing into conglomerate at the base. Fresh water fossils in limestone near the top.</td>
<td>Prominent foot-hill ridges.</td>
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<td>thinly bedded impure limestone. Marine fossils of Jurassic types.</td>
<td>Narrow valleys between mountain slopes and foot-hills.</td>
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<td>Very massive, heavily bedded, structureless limestone, generally crystalline and of a light gray color.</td>
<td>Sound eroded mountain summits.</td>
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<td>Alternating shale and limestone containing fossils.</td>
<td>Garden of sage and grass.</td>
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<td>Dark colored, arenaceous limestone, passing into massive limestone of the base.</td>
<td>Bold, bluff walls.</td>
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<td>Alternating shale and thinly bedded limestones, resting upon massive, recrystallized limestone, passing into limestone conglomerate at the base.</td>
<td>Steep slopes, cliffs and bluffs.</td>
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<td>Crumbly sand and clayey limestone with thin quartzites.</td>
<td>Depression and low ridges.</td>
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pour out of cracks and volatiles and flow over the surface as lava. Sometimes they are thrown from vents as ashes and pumice, and are blown over the surface by winds and streams. Often lava flows are interbedded with ash beds.

Lava flows are divided into two types, the flood type and the shield type. The flood type is characterized by a thin, agitated flow of lava, while the shield type consists of a large, thick, smooth-flowing mass.

Igneous rocks are formed through a process called differentiation, which involves the separation of minerals based on their density. The lighter minerals rise to the surface, forming a crust, while the denser minerals remain in the magma chamber, creating more dense rocks.

Igneous rocks can be classified into three types based on their cooling conditions: intrusive, extrusive, and metamorphic. Intrusive rocks solidify slowly underground, forming igneous rocks with large crystals. Extrusive rocks cool quickly at the surface, forming volcanic rocks with smaller crystals. Metamorphic rocks are rocks that have been subjected to high pressure and temperature, causing them to recrystallize.

Igneous rocks are often used as building materials due to their durability and strength.

To summarize, igneous rocks are formed through the process of differentiation, and can be classified into three types based on their cooling conditions: intrusive, extrusive, and metamorphic. These rocks are often used as building materials due to their durability and strength.