## GEOLOGIC ATLAS OF THE UNITED STATES

### TENMILE DISTRICT SPECIAL FOLIO

**COLORADO**

**INDEX MAP**

- **AREA OF THE TENMILE DISTRICT SPECIAL FOLIO**
- **AREA OF OTHER PUBLISHED FOLIOS**

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- TENMILE DISTRICT SPECIAL

**WASHINGTON, D.C.**

**ENGRAVED AND PRINTED BY THE U.S. GEOLOGICAL SURVEY**

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**DOCUMENTS**
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 sealevel. 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, contours, of all slopes, and to indicate their general size and shape. This is done by lines connecting points of equal elevation above mean sealevel, the lines being drawn at regular vertical intervals. These lines are called contours, and the uniform vertical space between each two contours is called the contour interval.

The manner in which contours express elevation, or, in other words, the bearing of the following sketch and corresponding contour map:

The sketch represents a river valley between two hills of nearly equal height. The stream is绘图 showing contours and topography.

2. Contours define the forms of slopes. Since contours are continuous horizontal lines conforming to the surface of the ground; they wind around the peaks and ridges, crossing the recesses of valleys, and changing their course where the contour and forms of natural features within its limits and at the sides and corners of each sheet the names of adjacent sheets, if published, are printed.

3. Contours show the approximate grade of the surface or the vertical space it would guide the traveler; see also the investor or owner who desires to ascertain the position and surroundings of property to be bought or sold will have the engineer's or architect's surveys in laying roads, railways, and irrigation ditches; provide educational material for schools and children; and serve many of the purposes of a map for local reference.

**THE GEOLOGIC MAP.**

The maps representing actual geology show 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 map shows their underground relations, as far as known, and is as complete 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. The formation sequence is as follows:

Igneous rocks—These are rocks which have cooled and solidified from a molten state. They are generally hard, dense, and of uniform texture. Igneous rocks form the basic material of the earth's crust and are important as building stones and as source of raw materials for the manufacture of a wide variety of products.

Sedimentary rocks—These are rocks that have been formed by the deposition and consolidation of sediments. They are divided into three main groups: clastic sedimentary rocks, chemical sedimentary rocks, and organic sedimentary rocks.

Metamorphic rocks—These are rocks that have been changed by heat, pressure, or chemical activity. They are formed from pre-existing rocks and can be classified into three main groups: foliated, non-foliated, and recrystallized.
DESCRIPTION OF THE TENMILE DISTRICT QUADRANGLE.

GEOGRAPHIC RELATIONS.

The area shown on the Tennille district special map is included between the meridians 108° 8’ and 108° 16’ of longitude west from Greenwich and the parallels 38° 30’ and 38° 40’ of north latitude. It covers about 55 square miles, and adjoins on the north the western portion of the area represented on the Map of the Tennessee Range, Sheet VI of the Leavitt atlas, Monograph XII. This special district lies immediately north of the Tennessee Range, on the southern edge of the West Fork of the Tennessee River, and west, connecting the Mosquito Range with the northern part of the Sawatch Mountain, and is bounded on the east by the steep western slope of the Mosquito Range. Immediately north of it is the little-known mountain group called the Gour Mountains, which is a northern extension, set off on a smaller scale, to the westward, of the Mosquito Range.

The principal drainage is northward through Tennille River, which flows northward from the northern end of the Mosquito Range into Blue River, the main south fork of Grand River, in Middle Park. The southwestern portion of the area is drained by the east or main fork of Eagle River, which flows westward across the northern flanks of the Sawatch Range and joins Grand River just before it enters its great canyon on the southern side of the White River Plateau.

Situated as it is near the crest of the Rocky Mountains this district is one of the most elevated mining regions in the state and is higher than the average near a thousand feet higher than the neighboring Leavitt district. Its large valleys are between 10,000 and 11,000 feet above sea level, the bottoms of the side valleys often reaching 12,000 feet, while its culminating peak, Jacko Mountain, in the center of the area, has an altitude of 13,235 feet. The only higher point within this area is Flecker Mountain (13,917 feet), a striking portion of the main crest of the Mosquito Range, the slopes of which rise at an angle of 35° from the glaciated amphitheaters and valleys at its base. In contrast with these steep and rugged slopes, which form only a narrow strip along the eastern edge of the area mapped, the rest of the region is characterized by smooth and rounded topographic forms, the surface being made up of gently sloping beds largely covered by glacial gravels and soil. The soil supports in places a considerable growth of coniferous trees of nearly minute varie- ties, which are seasonal in the northern portion of the western portion, forming a forest covering sufficiently dense to obscure the rock outcrops. The main valley of the Leavitt River, which rises in a fine glacial amphitheater just south of this quadrangle, traverses the eastern portion of the area from the west, at first broad and open, but becoming narrower and deeper as it descends. In the upper part of this valley are situated the small mining towns of Robinson and Kokomo-Reson, which are about 15 miles north of Leavitt and 9 to 10 miles west and a little south from Breckenridge, on the further side of the Mosquito Range. The earlier town of Carbondale, once situated still higher up the valley, at the mouth of McNally Gulch, has now entirely disappeared. Since the completion of the map a second railroad, the Denver, Leavitt and Summit, has been built through this valley, nearly parallel with the tracks of the Denver and Rio Grande.

The portion of the area which drains into Ten- mile River is in Summit County, and the much smaller southwestern portion which drains into Eagle River is in Eagle County, Colorado.

DEVELOPMENT.

Gold-bearing placers were discovered in the valleys of this region in the early sixties by prospectors who came from the placers duggins around Breckenridge and probably by them that the name Tennille was given to the stream, this being about its distance from that town. A few vein deposits in the area were afterwards opened, but no impor- tant mining development took place until 1878, when the discovery of rich silver deposits in

stratified limestones around Leaville had directed the attention of prospectors to this, then some- what isolated, district, and the more considerable number of more or less oxidized bodies of pyrite, blende, and galena were opened along the east and south part of the Tennessee Range. The most important and the richest ore bodies were found in the Robinson mines, which is said to have produced more than 1,000,000 of dollars in gold and silver. During the decade from 1888 to 1898, after the richer oxidized ores had been for the most part worked out, a number of new mines have been thrown open, the muffled pyrites ore being too poor for profitable exploitation. Since 1898 there has been an increase in the amount of activity, as dressing and concentration plants have been built to enrich the ore as it comes from the mine, and the demand for pyrites ores by the smelters has greatly increased.

The severity of the climate and the consequent disproporrtionate length of the winter season has always been an obstacle to the ready development of the very considerable mineral resources of the district.

GENERAL GEOLOGY.

The Mosquito Range, which adjoins this area on the south, is, as has been shown in the report of the survey on the region around Leaville, a recent offshoot of the Sawatch Range. This uplift has been produced as the result of lateral compression acting upon a pre-existing structure, and is a simple fault, together with interbedded or intrusive sheets of igneous rock; the whole has been pushed up into a series of corrugations or folds, and finally broken by great faults. In the vicinity of Leav- ville and southwest the displacement has been distributed along several parallel fault planes, on which the uplift is almost invariably to the east. To the north of Leaville this movement, which is of the order of 400 feet, has been concentrated upon a single plane — the great Mosquito fault, which has a direction nearly due north along the steep western face of the Mosquito Range as far as the northern edge of the area included in the present map, and then bends sharply westward, following a northwest course along the southwest base of the Gour Mountains, nearly to Grand River.

From the uplifted area immediately east of this fault the overlying sedimentary formations have, for the most part, been removed by erosion, and the surface is in the form of a broad amphitheater with a great ramp of Mesozoic strata is now exposed. West of the fault plane the post-Cambrian sedimentary beds, with their characteristic undulating ridges and depressions, extend parallel to the fault, with angles away from the Sawatch uplift and are more or less tilted and broken in the neighborhood of the Mosquito Range. The areas east of the Mosquito fault are marked by rocks belonging to the crystalline complex described in the Leaville report (Monograph IX) of probable Archean age. In the preparation of the present map no systematic study of these areas was made, the only portion being examined under observation being those nearly adjoining the fault; and no attempt has been made to discriminate upon the map the different types of fossil evidence, they serve to delimit. Their structure, however, indicates that they are of Devonian or older age. Nevertheless, in the absence of direct evidence, it has not been possible to discriminate them by Devonian color on the sheet showing structure sections. Neither do they the Silurian beds outcrop at the surface in the area mapped.

ARCHEAN.

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CARBONIFEROUS SYSTEM.

Blue or Leaville Limestones. — This is the distincively calcareous member of the Carboniferous system which corresponds to the Lower Carboniferous in the Laramide and its equivalents. It is in the Mississippi Basin. It is the principal ore-bearing horizon of the Leaville, Red Cliff, Aspen, and other mines. Although not exposed at the surface in this district, it outcrops not far westward, in the Eagle River Valley. In the Mosquito Range it is a typical dolomite, of black or gray color near the top, and lighter colored near the base. It is in general heavily bedded and of relatively fine structure. Some of the carbonaceous cretions of black chert, is often fossiliferous near the top, and passes upward into alternations of black chert, red, and green, and lenticular bands of black color, near the top, and lighter colored near the base. It is in general heavily bedded and of relatively fine structure. Some of the carbonaceous cretions of black chert, is often fossiliferous near the top, and passes upward into alternations of black chert, red, and green, and lenticular bands of black color, near the top, and lighter colored near the base. It is in general heavily bedded and of relatively fine structure.
calcareous and argillaceous beds. This formation in the Tenmile district contains a predominance of coarse gray and red sandstone, in some places passing into conglomerates, with many irregularly developed beds of limestone. The corresponding members of the Weber grits the following distinctions have been noted. The red color is more abounded than would appear from a hasty inspection of the hill slopes, where their outcrops are readily visible by the debris from the harder rocks.

The limestones of the Maroon formation consist, however, in its most conspicuous feature, the indescribable color of its brown, yellow, and greenish hue, easily distinguished from any similar product. The limestone, a typical example of the formation, is a soft, calcareous material, finely interbedded with shale, and often bedded in thin laminae. The color is often brownish, and the structure is commonly fine-grained and woody. The limestones are often rich in fossils, including brachiopods, bryozoans, and corals. The darker parts of the lime- stones are usually more impure, containing more clay and mud than the lighter parts.

In the Tenmile district, the limestones are often exposed in layers, and the colors range from white to gray and brown. The fossils are commonly abundant, and include brachiopods, bryozoans, and corals. The limestones are often rich in impurities, such as clay and mud, and are often bedded in thin laminae. The color is often brownish, and the structure is commonly fine-grained and woody.

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The Gold Hill porphyry is darker than the one previously described, owing to the development of smaller crystals of both hornblende and biotite. The hornblende does not develop in the rocks near the outcrop along the eastern edge of Carbonate Hill, which indicates that the granitic rocks are of different ages. Small quartz crystals are present in this rock, but are smaller and less numerous than in the typical porphyry. After the porphyry was deposited, the crystals grew larger, forming a larger and more complex rock. The quartz crystals in this rock are in the form of long, slender, needle-like crystals that are well developed and extend across the entire rock. The quartz crystals are white and have a glassy appearance.

The exposure at Gold Hill provides a clear view of the porphyry rock and the surrounding area. The porphyry is a porphyritic igneous rock that is characterized by its large, rough, and scaly phenocrysts of feldspar and quartz. The groundmass is fine-grained and composed of the same minerals. The porphyry is thought to be a result of a volcanic eruption that occurred in the area during the early part of the Cretaceous period. The porphyry provides evidence of the volcanic activity that occurred during this period and provides insight into the geology of the area. The porphyry is also a valuable source of minerals, as it contains valuable metals such as copper, gold, and silver.

The Gold Hill porphyry is a significant geologic feature in the area and provides evidence of the volcanic activity that occurred during the early part of the Cretaceous period. The exposure at Gold Hill provides a clear view of the porphyry and the surrounding area and provides insight into the geology of the area. The porphyry is a valuable source of minerals and provides evidence of the volcanic activity that occurred during this period.
have a reverse dip of 65° E. These facts and the general crumbling of the mass of the sedimentary beds, show that the faulting was accompanied by a normal faulting, in which the upper portion of the strata moved north and east, the angle made by the fault plane as it changes from a northerly to a northwesterly direction, and in this angle the weight of the hanging wall block would be greater than anywhere else, and might have caused a change of hade in its plane and a local overturning.

Beyond the west fork of Tenmile River it appears that the fault plane separating Carboniferous rocks from Archean rocks has a strike of 45° S. in a general northwesterly direction. It may be that this is not simply a continuation of the Mosquito fault, but that it is the eastern limb of a fault which extends in a southeasterly direction giving the Mosquito fault, and two miles in a general northwesterly direction. In this case the angle between the strike of the fault and of the trend of the carrying velocity is a fault block parallel to the Mosquito fault. If this is so, it may be that the fault is one of the many that are not clearly visible, and which are only indicated by the presence of the fault in the area. In this case the general direction of the strike of the fault is from the northeast to the southeast.

The Mosquito fault is a gently dipping fault, and the direction of the hanging wall block is from the northeast to the southeast.

GEOLOGICAL DISTRIBUTION. Although outcrops of ore have been found in rocks of other horizons, the ore from actually working the deposits has been in the lower horizons of the Mississippian formation. Ore is generally found in the upper part of the Mississippian formation, and in the upper part of the section it is not uncommon to find veins of copper and quartz in the upper part of the Mississippian formation. This is because the copper and quartz veins are parallel to the strike of thefault plane, and the fault plane is the boundary between the Mississippian and the underlying rocks.

ROCKY MOUNTAIN.

History. The rocks of the Rocky Mountain region are composed of three principal types of rock, namely, slate, schist, and gneiss. The slate and schist are the two most common types of rock in the region, and are often interbedded with the gneiss. The slate is a fine-grained, foliated rock, while the schist is a coarser-grained, foliated rock.

The ore deposits of the Rocky Mountain district are found in the upper part of the Mississippian formation, and are often associated with the slate and schist layers. The ore is usually found in veins or lodes, and is often associated with quartz veins. The ore is also found in lenses, and is often associated with sandstone and shale layers.

The ore is found in two principal types of ore bodies, namely, lode ore and vein ore. The lode ore is found in veins or lodes, while the vein ore is found in veins or lodes, and is often associated with quartz veins. The ore is also found in lenses, and is often associated with sandstone and shale layers.

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the workings from the New York shaft, which is situated about 100 feet south of the Champion tunnel, the ore body was cut off by a fault, under and parallel to the damming surface, but was lost in the debris at the Mouth of the Tonnah River, beyond which it has not yet been found. This fault is not detected on the surface by valley gravels, but in tracing the outline of the different geological formations, it was observed that they apparently make a sharp bend in the strike to the southeastern part under this valley; it appears probable that this bend is structurally connected with the fault. In the Oldenbach, on the west side of Robinson flat, a fault plane has been developed which appears to be a part of this fault, or at least of the same sequence.

Ore deposits in sedimentary beds extending along or parallel to stratification planes from creek faces or flat places outcrop are uncommon. Such structures have received the local name of "verniers" as applied to the gold deposits in the northwestern portion of the Black Hills of Dakota.

QUEL GROUP.

History.—Soon after the discovery of the Robinson mine attention was called to the other occurrences near the crest of the southeastern end of Elk Ridge, just north of Kokofo Gulch, and by these men many of the ore deposits had been made extending nearly due south to Kokofo Gulch. These were the White Quail (17), Afterthought (20), and Badger (89) veins, the Reuben and Eagle (21) tunnel, and the Colonel Sellers (22) shaft and incline. As finally noted, the Reuben tunnel, which started about 500 feet vertically below the mouth of the White Quail incline, drained the ground above its level in the various mines and produced richly gilded and silver ores from that camp and from the Red Cliff mining district.

With increasing depth and consequent greater expenses of extraction, the proportion of oxidized ore, and with it the yield in silver, fell off, while the price of silver also began to decrease, so that gradually work in the various mines was suspended.

A few years after, W. R. Wurfel, whose study of the deposits convinced him that by judicious development and concentration of the ore on the mines would be of advantage, led a lease on some of these properties, and in 1889 drove a tunnel (17) to reach the ore bearing horizon from the last mentioned tunnel, the Scull Gulch 11. At 1500 feet from its mouth this tunnel cut the Quail ore body 2100 feet on the dip below its surface, which has since the cutting of this tunnel two other tunnels have been driven at vertical depths below the first of about 125 and 225 feet respectively, into which the ores are considered to be reached from the Scull Gulch 11. At 3000 feet in width by nearly 1200 feet in width this tunnel is thus open, a very large proportion of which has been found to be mineralized, to such extent, though but a limited proportion of the ore has proved rich enough for profitable extraction.

Geological structures.—From the White Quail incline southeastward the Quail limestones have a regular NW-SE strike, and a dip of 30° to 35° to the NW, or toward Snow Creek, and are thus traced continuously nearly to Kokofo Gulch. In this extent it is undulated by a sheet of fine-grained hornblende-diorite, called the Quail porphyry, which is also found in the same geological position below Kokofo Gulch on East Sheep Mountain. The limestone has an average thickness of 15 to 25 feet, with a maximum of 22 feet. There is generally a thin seam of black coaly schistose beds, called the coal bed, which is about 5 feet thick in the Eldorado shaft, and 3 feet thick in the Tonnah mine. This coal bed extends up the mountain, and in some places outcrop to the surface, and is about 1000 feet thick in width by nearly 1200 feet in width the tunnel is thus open, a very large proportion of which has been found to be mineralized, to such extent, though but a limited proportion of the ore has proved rich enough for profitable extraction.

A short distance north of the Quail incline a transverse slice of coarse-grained Elk Mountain porphyry cuts off the limestone, and the quartz porphyry sheet. Beyond this, toward Elk Mountain, the numerous and irregular interruptions of porphyry complicate the structure, so that it is difficult to decipher it correctly from surface outcrops alone. An outcrop of limestone and porphyry 1000 feet east of the crest of Elk Ridge northward to the town of Robinson, all broken up, and covered with the breccia of the hill in a direction east of the town and cut off by another body of porphyry beyond the limit of the outcrop. This porphyry is assumed to be the ore in that position. Its surface is richly gilded and silver ores from that camp and from the Red Cliff mining district.

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The entrance of the porphyry is in the direction of the dip, and their width varies in the unaltered zone from 10 to 50 feet, being often much greater in the oxidized zone above the tunnel level (100 to 120 feet).

In this oxidized zone the pyrite is changed to limonite, and the zinc has been almost entirely dissolved out and removed, while the galena when in considerable amount is often only partially altered to carbonate or sulphate. Silver seems to occur mainly as chalcocite. Oxide of manganese often forms an important constituent of the oxidized zone, and in some limestones, manganese minerals were observed in the unaltered zone. The quartz vein material or jasperite resembles, both in color and texture, the limestone in which it has replaced. It generally occurs on the outer edge of the ore shoots, forming a transition between the unaltered limestone and the replaced limestone. It contains up to 98 or 99 per cent of siliceous. The succession from solid sulphides through quartz impregnated with sulphides to barren jasperoid, and then through what the miners call "short line" to pure limestone. Including this siliciiferous material, the width of this replaced zone is in one place as much as 500 feet. The zinc ore, which is usually the ore in gold, silver, and lead. The gold ranges from one-fifth ounce up to 3 ounces to the ton, the silver from 150 to 600 ounces to the ton, and the lead from 400 to 5000 ounces to the ton. In some cases the zinc varies from 15 to 25 per cent, and the silver and zinc about the same amount. In a concentration of 6 to 1, the resulting product contains 60 to 70 per cent of zinc, 3 to 4 per cent of nickel, and 25 to 30 ounces of silver to the ton. Singular variations occur in the silver contents on either side of the jasperite fault; as from 50 to 60 ounces to the ton, 30 to 35 ounces to the ton, 20 to 25 ounces to the ton, 15 to 20 ounces to the ton, 10 to 15 ounces to the ton, and 5 to 7 ounces to the ton, which would seem to indicate a transposition of gold and silver for the second period and interval of time.

Ore bodies of similar character occur at the same position on East Sheep Mountain in the Snowbank group of mines, and in the Japon Mountain limestones on the south slope of Japon Mountain in the Selma (14), Free America (15), and Wintergreen (16) mines. In the latter the sulphide of iron is largely in the form of pyritic fillet.
an inclination northward, and thus the drift passed gradually from a lower to a higher bed, in some cases from sandstone to porphyry, or vice versa.

At the same time it might also have crossed one of the vertical fault planes, by which a change of country rock would also be brought about. It was assumed by some of those working the mines that the vein was following a porphyry dike, but no certain evidence of the existence of such a dike could be found, and the explanation here adopted seems to account for existing conditions in a satisfactory manner. This is that the alternating layers of sandstone and porphyry have been cut by a series of parallel and closely spaced fault planes of slight displacement, the average distance between which is about 10 feet and increases from the medial zone outward. The throw of the individual faults in this fault zone is in most cases downward on the southeast; it could not be determined whether this is universally the case. The mineral solutions have entered along these fault planes, more abundantly in the medial zone, and have filled the fractures and decomposed and, to a certain extent, replaced the country rock on either side. In fig. 4 is given a section across the vein, somewhat diagrammatic in its nature, though based on observations and measurements taken at the different levels of the mine.

The figure also shows the horizontal faults made since the ore deposition, which apparently conform to the stratification planes, though, as represented in the section, they diverge slightly from them. As is usually the case with faults of this nature on a hillside, it is the upper part of the ground, nearest the surface, that has moved downhill relatively to the rock masses beneath. The positions of these horizontal faults as given on the section (fig. 3) are represented by broken lines, since they have been observed at only a few points on this plane, and their actual location between these points is more or less hypothetical. It is probable that the actual movement has taken place on some of the thin shale beds that occur between the sandstone strata, and is very possibly not confined to a single plane, as represented in the section. The movement of the lower fault is apparently much greater than that of the upper, and it is possible that the true continuation of the main ore-bearing fissures below this plane was not discovered, although considerable cross-cutting has been done on this level.

The most important lesson to be drawn from a study of this vein is the importance of cross-cutting in fissure veins, whether or not the walls of the main fissure are defined by distinct walls or clay selvages. The ore in this mine was much richer than that derived from the deposit in limestone, carrying often over 100 ounces of silver to the ton, and some values in gold. This is also true of other vein deposits in the district, of which, however, but few have been worked to any considerable extent.

Small fissure veins in porphyry have been found on East Sheep Mountain, in the little Chingo (50), and on Gold Hill, in the Grand View (52) and adjoining shafts, which carry a little argentiferous galena ore. The Grand View (54), Chingo Boy (20), and other tunnels, driven to prospect the veins on the latter hill, found some ore on the Gold Hill fault, which they cut on passing from sandstone into porphyry, but this ore was apparently dropped into the fault plane from some undiscovered ore body.

CONCLUSIONS.

The evidence afforded by the mine workings thus shows that there have been two periods of faulting in the district, one previous to the ore deposition and one subsequent to it. During the first were formed the transverse fissures, which later became fissure veins where they traversed only sandstones and porphyry sheets, but which, when crossing limestone strata, merely served as water channels to admit the ore-bearing solutions that attacked and replaced the limestone. The evidence shows further that the deposits formed in the latter manner are by far the largest and most important ore bodies in the district; that these ore bodies have produced only a comparatively small proportion of ore which would yield a profit under previously existing conditions, and that enormous amounts of low-grade pyrrhotites are still remain untouched in the mines, which it may yet be found profitable to work under improved methods of treatment.

It is to be remarked in a general way that, throughout this portion of Colorado, wherever there has been a considerable development of intrusive porphyries there has been a large concentration of metallic sulphides somewhere in the vicinity, and that the favorite beds of deposition of these minerals has been in the limestone strata, rather than in the less soluble sandstones and porphyries. In the neighboring districts of Leadville, Red Cliff, and Aspen, where the ores are both richer and in greater amount, this concentration has taken place mainly in the lower Carboniferous or Leadville limestone, and in some cases also in the beds immediately under it. In the greater part of the Taconic district, however, the Leadville limestone occurs at a depth of over 2000 feet from the surface, and it is questionable whether it would pay even to prospect for it with the diamond drill, for while this limestone may be mineralized to some extent, the probability that the drill would reach it where there arc ore bodies is only one among a number of adverse chances, and if ore were found in this way, it would still be an open question whether it would pay to work it at so great a depth.

SAMUEL FRANKLIN EMMONS,

Geologist.

July, 1896.
forming another graduation into sedimentary deposits. Some of this glacial wash was deposited in tunnels and channels cut in the bedrock by the action of the glacial rivers and streams, and the most prominent 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 each formation is a unit of geographic mapping.

Several formations considered together are designated as 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 division of a series of formations. The rocks forming a system and the other large groupings are given the same name, as, for instance, Cambrian system, Cretaceous system, and so forth.

In the formation and mapping of a rock mass are classified into systems. The rocks composing a system and the other large groupings are given the same name, as, for instance, Cambrian system, Cretaceous system, and so forth.

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