DESCRIPTION OF THE RIDDLE QUADRANGLE.

By J. S. Diller and G. F. Kay.

INTRODUCTION.

Location and area.—The Riddle quadrangle is in southwestern Oregon, between 42° 30' and 43° 30' north latitude and 123° 30' and 124° 30' west longitude. It is 35 miles from north to south and 20 miles from east to west, and its area is 910 square miles. The quadrangle is named from a village within its borders and embraces parts of Douglas, Jackson, and Josephine counties. (See Fig. 1.)

Outline of the geography and geology of the region.—From Alaska to Lower California the western coast of North America is bordered by a belt of mountains from 100 to 200 miles wide. This belt as a whole has been named the Pacific Mountain system. It separates the Pacific Ocean from the interior plains region, and its general character is shown in Figure 2.

For its entire extent from Alaska to Lower California the Pacific Mountain system may in general be divided lengthwise into three parts—two long lines of mountain ranges and an intervening belt of valleys that may be called the Pacific Valley belt.

In Oregon the Willamette Valley lies in the Pacific Valley belt, between the Coast Range on the west and the Cascade Range on the east. (See Fig. 2.) Between the head of the Willamette Valley and the north end of the Great Valley of California, the next large member of the Pacific Valley belt, there is a tract of generally mountainous country with transverse drainages, where for 200 miles the thousand longitudinal division of the Pacific system into two ranges and an intervening valley is less evident than elsewhere. The Umpqua Valley, Rogue River valley, and Shasta Valley, lying between the Cascade Range on the east and the Klamath Mountains toward the coast, are not continuous. Nevertheless they represent the Pacific Valley belt interrupted by transverse ridges, spurs from the Klamath Mountains to the Cascade Range. Across one of these spurs, as shown in Figure 2, lie the Riddle quadrangle, between the Umpqua Valley and that of Rogue River.

The Klamath Mountains, which extend from southwestern Oregon for 160 miles into California, are composed of rocks which, like those of the Sierra Nevada, are older and generally harder and more complicated in structure than the rocks of the overlapping portions of the Coast Ranges in Oregon and California. It is this difference in the rocks of which they are composed that forms the basis on which the mountain ranges are distinguished.

The Cascade Range is made up essentially of Tertiary volcanic rocks, the Sierra Nevada and Klamath Mountains consist mainly of Paleozoic rocks, and the Coast Ranges of Oregon and California are for the most part composed of Mesozoic and Tertiary sediments. The general distribution of the rock groups and their relation to the mountain ranges and to the Riddle quadrangle is shown in Figure 2.

During early Mesozoic time the Paleozoic rocks were greatly compressed and uplifted into mountains. Then followed a long period of comparatively little change of sea level, and the streams by long-continued erosion washed away the mountains and reduced the landscape to an approximate plain or peneplain, which, on account of its topographic importance, has been designated the Klamath peneplain.

Climate.—The Riddle quadrangle has the relatively warm, dry climate characteristic of the Pacific Valley belt. But the Coast Range and Klamath Mountains oppose Riddle, being nearly 3,000 feet in altitude, do not shut out completely the prevailing moderate winds (south and southwest in winter and northwest in summer) from the sea that temper the heat and cold and increase the precipitation on the windward side.

There are no Weather Bureau stations within the Riddle quadrangle, but an average of observations for 20 years at Grants Pass, near the southern border, and at Roseburg, near the northern border, which differs but little, will closely approximate the mean monthly temperatures and rainfall for the intervening towns of the Riddle quadrangle.

The characteristic feature of the climate is that there are two seasons—a warm, dry season and a cool, wet season. About 80 per cent of the precipitation occurs in the six colder months from November to March. Most of the precipitation is in the form of rain. Light snows fall in the valleys and soon disappear. Snows are heavier in the wooded hills and linger.

In brief, the climate of the Riddle quadrangle is mild, without harmful extremes, and well suited not only for comfortable residence but for intensive agriculture and fruit culture.

Vegetation.—Except in the narrow alluvial valleys that are used for farms and orchards and in a few sterile tracts of serpentine rocks the Riddle quadrangle is well forested throughout. In many places on the hill slopes the timber is interspersed with buck brush (Ceanothus velutinus), California live (Ceanothus thyrsiflorus), and other forms of the same genus, making an abundant chaparral, but generally along the ridge summits the forest is open and pteridaceous. Mammutia appears here and there among the shrubbery, and sandstone with its reddish bark and evergreen leaves is a bright feature in the forest.

For the large part of the area are evergreen coniferous. Those of commercial value are chiefly Douglas fir (Pseudotsuga taxifolia). Cedar and hemlock are also commercially valuable. There are small amounts of sugar pine (Pinus lambertiana), yellow pine (Pinus ponderosa), silver fir (Abies grandis), and alpaca (Abies amabilis), and spruce. Among the broad-leaved varieties the oak, ash, maple, mountain manzanita (Chamaecyparis ledifolia), aspen, cottonwood, and baldcypress are most common.

Population.—The Riddle quadrangle has a population of about 5,000, most of whom live in the valleys. Glenville, the only city, has a population of 548. Canyonville (population 136) and Riddle (population 260) are the only other incorporated towns.

Industries.—An odd will be found in the large forested areas, lumbering is the principal industry of this area. The leading center is Glenville, but large mills are scattered throughout the quadrangle.

Facilities for transportation are afforded by the main line of the Southern Pacific Railroad and the Pacific Highway, which run across the western portion of the quadrangle. Wagon roads traverse all the principal valleys and connect with trails among the mountains.

Mining is a scarcely less important industry than lumbering. Both lode and placer mines are in operation, and during the rainy season the placers are especially active.

In the valleys agriculture and fruit growing are carried on. Wheat, oats, barley, rye, and corn are cultivated, but mainly for “grain hay.” Alfalfa, clover, timothy, and other grasses are used for grazing and hay.
are grown successfully by irrigation. The hills and mountains east of the quadrangle are more clear cut during much of the year and furnish an abundant supply of water for irrigating farms and orchards. The principal fruits raised are apples and pears, but peaches, grapes, cherries, and many kinds of berries and other fruits also are grown in large quantities.

**TOPOGRAPHY.**

The larger features of the topography of the Riddle quadrangle are portions of the South Umpqua and Rogue River drainages basins and a divide between them which is a spur of the Klamath Mountains.

Strewn—South Umpqua River drains the northern half of the quadrangle. Above Roseburg the river bed has an altitude of about 1,000 feet. By a series of gentle rapids across the bands of hard rocks and long reaches on the softer rocks the South Umpqua descends nearly 300 feet in a distance of about 40 miles to Missouri Bottom, which, at a distance of only 47 miles from the sea has an altitude of nearly 700 feet. The stream has worn down in its course to a gentle grade and along most of its course is now widening its flood plain, but this plain, though nearly a mile wide in Missouri Bottom, is not yet so large and flat as to allow the river to meander. Further downstream, in the Roseburg quadrangle, meandering has already begun, and the river may be said to be mature. Still farther down, where the river runs northward in the Coast Range from Coos Valley to Eelton, it has developed a remarkable succession of meanders, now deeply incised in the canyon which the river has cut across the Coast Range to the sea.

The only large tributary from the north to the South Umpqua River in the Riddle quadrangle is Days Creek, which follows the trend of a belt of soft rocks. The largest tributaries are on the south side of the stream, and they increase in size from east to west. By far the largest and most noteworthy of these branches is Cow Creek, which is especially remarkable on account of its curved course. In the upper 25 miles it runs southwestward, making a small angle with the general trend of the rocks, and for the greater part of this distance has built up an agricultural valley half a mile in width. Near Glendale Cow Creek enters a narrow canyon-like valley, which it traverses for 25 miles, curving in succession from west to northwest, north, and finally northeast as it enters the broad valley cut in soft rocks about Riddle, where it joins the South Umpqua. The open valleys in which it flows southwestward from the head and northeastward to the mouth are in strong contrast with the intermediate canyon, in which Cow Creek curves from one course to the other in a descent of 700 feet and affords a convenient pass for the railroad to the bottom of the South Umpqua Valley.

Rogue River crosses the southwest corner of the Riddle quadrangle at an altitude of 500 feet and at a distance of about 50 miles from its entrance into the ocean. The river valley at this point is narrow, and the small flood plain disappears a few miles farther downstream, where the river enters a canyon that continues with but little interruption nearly to the ocean. Above the point where Rogue River appears in the Riddle quadrangle the river valley is more open and at two landforms is markedly widened by the development of broad flood plains—in one locality, about Granite Pass, on soft decomposed granite rocks and in the other on the soft alluvium and pink tuff of the Rogue River valley.

Three tributaries of Rogue River drain large portions of the Riddle quadrangle. Of these, Eau Claire, flowing south, lies in Jackson County; and Jumpoff Joe and Grave creeks, flowing west, in Josephine County. Each stream has developed broad flood plains of considerable size, and each heads against a narrow, steep divide.

**Divide.**—The main divide between South Umpqua and Rogue rivers extends nearly due west from the summit of the Cascade Range to the sea. In the Riddle quadrangle it is the county boundary between Douglas County, on the north, and Josephine and Jackson counties, on the south. Although the crest shows a gradual decline from about 4,000 feet on the eastern border of the Riddle quadrangle to 2,000 feet on the western border, it rises near the middle of the quadrangle, in Onion Springs Mountain, an old volcanic peak, to 5,594 feet. Its lowest pass, where it is crossed by the Pacific Highway east of Glendale, has an altitude of 1,549 feet.

Although the crest in general follows the belts of harder rock from northeast to southwest, the belts are too small and irregular to exert a controlling influence. The position of the crest is due more largely to variation in the opposing tributaries of South Umpqua and Rogue rivers. As these rivers are about equidistant from the divide in the Riddle quadrangle, their lateral streams average about the same length, but the fact that the South Umpqua has already cut down its valley 100 feet lower than that of Rogue River shows that the South Umpqua must have some advantage over the Rogue. The explanation may be found in the fact that the South Umpqua has softer rocks to erode and carries a larger volume of water, but on the other hand it has a much longer course to the sea. It does not appear probable that the divide in the Riddle quadrangle has been greatly shifted, or that either stream has been able to capture much area from the other in the general process of erosion.

The peaks that rise above the generally narrow divides in the Riddle quadrangle range from about 3,000 to more than 5,000 feet in altitude. The higher peaks bear the gentler slopes, because they are remnants of an earlier plains of erosion, the Klamath peneplain, formed near sea level before the Klamath Mountains were raised to their present altitude. This feature is illustrated in the southwestern part of the quadrangle by Suntan, Walker, and Elk mountains, and by the divide surrounding the head of Jack Creek. Onion Springs Mountain, the highest summit in the quadrangle, is the flatter, and gentler slopes are prominent above 4,000 feet on the main divide about Green Mountain, Skeleton Mountain, and Angels Camp and in the Cow Creek divide from Silver Butte to Grayback.

West and southwest of the Riddle quadrangle this feature of flat summits belonging to the Klamath peneplain is much more fully developed in Table Mountain, west of Nichols Station, and in a more extensive area at an altitude of about 4,000 feet in Josephine County.

In the southwestern part of Josephine County there are high bodies of surficial gravel in close relation to the Klamath peneplain, and very small areas of similar gravel occur on the main divide of the Riddle quadrangle, near the head of Big Boulder Creek, at about the level of the Klamath peneplain.

**SEDIMENTARY ROCKS.**

**PALEOZOIC ROCKS.**

**Devonian (7) System.**

In the southeastern part of the quadrangle lies an area of highly metamorphosed sedimentary rocks consisting chiefly of mica slates and mica schists. These rocks are well exposed on the wagon road that follows Evans Creek and in the creek bed from a point about 2 miles above Winser to and beyond the mouth, in the Grants Pass quadrangle, where they are thought to be of Devonian age.

The igneous rocks comprise both intrusive and extrusive rocks and occupy much the larger part of the area, though more widespread in the southern than in the northern half. Associated mainly with the igneous rocks but also to some extent with the sedimentary rocks are ore deposits, chiefly of gold but some of copper. Much of the gold has been taken from placers, although gold-quartz mines have produced gold to the value of several million dollars. In the northwestern part of the quadrangle, in the vicinity of Nickel Mountain, interesting deposits of nickel silicates are found in metamorphosed basic eruptive rocks.

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The quartz veinlets are absent.

Bedded and intruded igneous rocks.

The conglomerate consists chiefly of small sandstone is light gray, and the layers are usually not more than 1 foot thick. The conglomerate occurs in thin beds; the pebbles are predominately silicious. The chert occurs in small lenticles. Although diligent search has been made at many places in the rocks of the Dothan formation, few diagnostic fossils have been found. Radiolarians occur in the chert lenticles, and at various horizons there are problematical rocks and lenticles. Apart from these, the only definite fossils from Dothan rocks within the quadrangle were found on O'Shaughniss Creek 1 mile east of Canyonville and in a small area on Doe Creek and Thompson Creek, northwest of Nickel Mountain, where Aucella erosivum occurs. The same species has been found just west of the quadrangle, near Nichols station, in a large area of the Dothan formation that extends into the Riddle quadrangle.

The Dothan formation is thought to be equivalent in age to the Franciscan formation of California.

The Dothan formation consists predominantly of sandstone, but it includes also shale, conglomerate, and chert. The strata are as a rule thin-bedded, yet in places with beds of thickness of about 100 feet are seen. Most of the rocks are distinctly lithified, and in places they have a schistose structure. Many of the strongly lithified rocks contain vesicles of quartz paralleled to the schistosity. Where the schistosity is not strongly lithified it breaks with a somewhat rough surface. The sandstone is gray and weather to a yellowish brown. The shale is usually gray to dark gray and is distinctly schistose. The conglomerates in thin beds; the pebbles are predominately silicious. The chert occurs in small lenticles. Although diligent search has been made at many places in the rocks of the Dothan formation, few diagnostic fossils have been found. Radiolarians occur in the chert lenticles, and at various horizons there are problematical rocks and lenticles. Apart from these, the only definite fossils from Dothan rocks within the quadrangle were found on O'Shaughniss Creek 1 mile east of Canyonville and in a small area on Doe Creek and Thompson Creek, northwest of Nickel Mountain, where Aucella erosivum occurs. The same species has been found just west of the quadrangle, near Nichols station, in a large area of the Dothan formation that extends into the Riddle quadrangle.

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The relation of the Galice formation to the Dothan formation has not been fully established, although they are believed to be conformable. Near the eastern edge of the formation there is a considerable thickness of igneous rocks, a large part of which consists of interbedded volcanic rocks. The contact between these rocks and the volcanic rocks is thin sheets of volcanic rock within Dothan sandstone. This structure is well shown on Middle Creek. Near the northeast corner of the Riddle quadrangle, beyond the volcanic rocks, the Dothan area widens across the strike of the Galice, and the Dothan rests unconformably over the Galice. The Knoxville and Horsetown formations of the Cretaceous system overlap the Dothan formation, and the stratigraphic evidence indicates strongly that the Dothan (Jurassic) is separated from the Cretaceous by a great unconformity.

The Cretaceous rocks of the Riddle quadrangle include the Galice, Horsetown, and Chico formations. The largest area is in the northern portion of the quadrangle, in the valley of South Umpqua River and Cow Creek, but there are two small areas in the southern portion which indicate that a large part of the quadrangle was once covered by an unconformably overlapping blanket of Cretaceous rocks that has since been eroded.

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Character and relations.—The Dothan formation consists chiefly of massive conglomerate overlain by sandstone and a small amount of shale. In contrast with the rocks of the Dothan formation those of the Galice are generally not firm. Limestone. However, the degree of lithification alone is not sufficient to differentiate them, for in places the Knoxville formation is as completely lithified as the normal Dothan, and on the other hand the Dothan is locally as firm as the normal Galice. The cementing material most prominent in the rocks of the Knoxville formation is calcareous cement, but here and there silicious cement is abundant.

The Dothan formation consists of massive conglomerates overlain by sandstone. The rocks in the Riddle quadrangle are not well exposed but is believed to be a marked unconformity. This relation is indicated especially by the way the Knoxville overlaps the Dothan about 3 miles south of Riddle.

The Knoxvile formation carries a fauna similar to that of the same formation in California, of which Aucella pobielli and A. crassimurisia (Fig. 6) are characteristic and widely dis-
Fossils are common and are of types found in the Chico quadrangle of the Rogue River valley, where Triassic and other characteristic forms are abundant. The Chico is of Upper Cretaceous age.

CENOZOIC ROCKS.
TERTIARY SYSTEM.
UPPER TERTIARY.
QUATERNARY SYSTEM.
HORSE TERRACE GRAVEL.

There are three areas of early Tertiary (Eocene) rocks within the Riddle quadrangle—one along Cow Creek, near the northwestern corner, and the other two on the edge of Sams Valley, in the southeastern corner. They are separated by the broad belt of Paleozoic and Mesozoic rocks that forms the main divide between Rogue River and the South Umpqua.

On Cow Creek these rocks include shale in places but consist for the most part of soft yellowish sandstone, massive and in some places pebbly, passing into conglomerate. They have a total thickness of about 1,000 feet and form prominent bluffs. The stratification is well preserved and generally horizontal, but dips as high as 30° have been observed. The dip of the formation is easterly, beneath the lavas of the Cascade Range, and together they occupy an area of about 100 square miles.

KEYED Igneous Rocks.

The oldest igneous rocks of the quadrangle are of several kinds and differ somewhat in age. They occur in irregular-shaped areas and in dikes. Some are intrusive, others show undoubted effusive characteristics. In the field the chief types were mapped as: 1, Cardita planicosta; 2, Turritella uvasana.

Since the high gravel was deposited South Umpqua River and Cow Creek have cut down their beds about 500 feet. The streams have much gentler grades at the present time than formerly and consequently are depositing fine material. They are now widening their floodplains, especially in the softer rocks, and giving to the Riddle quadrangle the arable land that is so valuable for human industry.

RELATIVE AGE OF THE IGNEOUS ROCKS.

The oldest igneous rocks of the quadrangle are the ancient rhyolite and related rocks associated with the Paleozoic sediments of the May Creek formation. Some of the greenstone lavas and possibly some of the intrusive greenstones may also be of Paleozoic age. Next younger are the basaltic lavas, including some of the pillow lavas, and they are closely associated with the Eocene marine fossils, among which 1, Cardita planicosta; 2, Turritella uvasana.

Most of the greenstones show considerable alteration; zeolite and kaolinite are derived from the feldspar; and mica and talcite from the dark minerals. In the hornblende gabbros there is considerable chlorite and sericite. Many of the hornblendes gabbros in the southeast of the quadrangle differ from the normal gabbro chiefly in having primary hornblendes as the principal dark mineral.

A chemical analysis of the normal gabbro from Eastman Gulch shows that the geologic samples contain more basic phases of gabbro than those already mentioned, including olivine gabbro and possibly peridotite and pyroxenite. However, as will be shown later, much of the serpentine of this area, as well as in other areas in this quadrangle, has come from peridotite and related rocks that are clearly intrusive in the gabbro and hence is younger than the gabbro.

The table shows that the basaltic lavas and greywacke are in many places, particularly in the northern half of the quadrangle, are notably vesicular and that they are locally closely associated with volcanic tuffites and other basaltic rocks. The higher water content of the pyroxene rock is probably due to partial alteration. The igneous rocks of the Riddle quadrangle are of several types. The oldest igneous rocks of the quadrangle are the ancient rhyolite and related rocks associated with the Paleozoic sediments of the May Creek formation. Some of the greenstone lavas and possibly some of the intrusive greenstones may also be of Paleozoic age. Next younger are the basaltic lavas, including some of the pillow lavas, and they are closely associated with the Eocene marine fossils, among which 1, Cardita planicosta; 2, Turritella uvasana.

In many places the augite has been altered to hornblende, and it is not always possible to distinguish between this secondary hornblendes and primary hornblende. The olivine is probably the prevalent rock of this area. A specimen of olivine gabbro from sec. 2, T. 30 S., R. 6 W., is a dark to light gray rock with grains 1 millimeter in diameter. The rock is considerably altered. It is made up chiefly of olivine and augite in about equal amounts and contains secondary hornblende, chlorite, zeolite, and talc. A chemical analysis of this rock is shown in column 3 of the table. As compared with the two gabbros from the Placer-Winnemucca area it carries somewhat more silica, less magnesia, much less calcium, and more sodium.

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The gabbroic rocks of the northeastern part of the quadrangle are best studied in the valleys of Umpqua Creek and Thompson Creek. They include normal gabbro, hornblende gabbro, olivine gabbro, and intermediate rocks, all of which are closely related. Some fine-grained diorite, which appears to be intrusive, but fine-grained, compact basaltic rocks, which in many places, particularly in the northern half of the quadrangle, are notably vesicular and that they are locally closely associated with volcanic tuffites and other basaltic rocks. The higher water content of the pyroxene rock is probably due to partial alteration. The igneous rocks of the Riddle quadrangle are of several types. The oldest igneous rocks of the quadrangle are the ancient rhyolite and related rocks associated with the Paleozoic sediments of the May Creek formation. Some of the greenstone lavas and possibly some of the intrusive greenstones may also be of Paleozoic age. Next younger are the basaltic lavas, including some of the pillow lavas, and they are closely associated with the Eocene marine fossils, among which 1, Cardita planicosta; 2, Turritella uvasana.

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the rocks contain considerable alkali feldspar. Locally biotite is present as one of the ferromagnesian constituents. In many respects these rocks show relationship to the quartz diorite and related rocks described below.

Some fairly fresh quartz diorite was taken from the bed of Mangan Creek, 5 miles north of where it joins the Rogue Umpqua River. This rock is made up of grains 1 millimeter in diameter and contains plagioclase of the composition andesine-labradorite or the chief constituent. Grains of quartz are abundant, and quartz less so. Accessory apatite and magnetite and secondary kaolin and chlorite are present.

<table>
<thead>
<tr>
<th>Banded iron formation and related rocks.</th>
<th>Quartz diorite and related rocks.</th>
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### 1. Chemical analysis of quartz diorite from Nickel Mountain.

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<th></th>
<th>SiO₂</th>
<th>Al₂O₃</th>
<th>Fe₂O₃</th>
<th>CaO</th>
<th>MgO</th>
<th>Na₂O</th>
<th>K₂O</th>
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</tr>
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<tbody>
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<td>Anal.</td>
<td>60.35</td>
<td>12.76</td>
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<td>6.20</td>
<td>3.29</td>
<td>5.63</td>
<td>1.27</td>
<td>5.12</td>
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5. The Biddle quadrangle contains several fairly large irregularly-shaped areas of intrusive quartz diorite or related rocks, and similar rocks, though usually somewhat finer grained, are found in the area.

### TABLE.

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## References

1. Normal quartz diorite from sec. 29, T. 10 S., R. 6 W. George Steiger, analyst.

2. Dacite porphyry from sec. 5, T. 30 S., R. 6 W. George Steiger, analyst.

spar, all coarsely crystallized; in a few dikes quartz, feldspar, the mouth of Sykes Creek, was found to contain pyroxene, related to the ferromagnesian phases of the quartz diorite. This rock is strongly porphyritic, also consists mainly of plagioclase and quartz in grains averaging 0.1 millimeter in diameter. As compared with the granodiorite, the basalt produced but little change in the rocks it intruded. Near the mouth of Days Creek the intruded slate was somewhat hardened. 

**STRUCTURE OF THE REGION.**

In all rocks of the region older than the Cretaceous the prevalent strike is northeast, parallel to the trend of the rock belts. Much of the dacite porphyry taken from a dike cutting serpentinite in sec. 5, T. 50 N., R. 6 W., is a compact rock showing pheno­crysts of feldspars and quartz in a light-colored amphibole-groundmass. The phenocrysts make up nearly half the rock. The feldspar phenocrysts are chiefly plagioclase, more calcic than oligoclase, but a small amount of orthoclase is also present. The plagioclase is considerably decomposed.

The olivine phenocrysts, which are less abundant than those of feldspar, have a maximum diameter of about 0.5 millimeter. Their outline is very irregular and show corrosion. No pyroxene minerals are present. The groundmass, which is somewhat porphyritic, contains plagioclase, minor amounts of feldspar and quartz in grains averaging 0.1 millimeter in diameter. 

Analysis of this dacite porphyry is given in column 4 of the table above. As compared with the granodiorite, the dacite carries more silica, less lime, and more potash.

**GEOL O GIC HISTORY.**

**PROTEROZOIC (?) ERA.**

The geologic history recorded in the terraces of the Riddle quadrangle should be profusely commented upon. One of the oldest rocks of the region older than the Cretaceous should be found in the southwestern part of the quadrangle, and successively younger rocks should be found toward the southeast. From the evidence presented in the structure sections and in Figure 5 it has been seen that the tuffaceous tuff is a rock of the Paleozoic strata. The oldest rocks (the Paleozoic strata) are in the southeastern part of the quadrangle. Younger rocks (Jurassic and Cretaceous) are in the northeastern part, and still younger rocks (the eolian sands) are in the northwestern part. The southern part of the quadrangle is limited to the eastern half of the quadrangle. The characteristics of this rock are well shown in a specimen taken from a dike 20 feet wide cutting Cre­taceous shale on South Umpqua River just below the mouth of Days Creek. The rock is compact and dark gray, has a dull luster, and con­tains a few inclusions of typical dark-gray mineral. It is holocrystalline, and the minerals present are plagioclase, biotite, magne­lite, and epidote. The plagioclase consists of very nar­row lath-shaped crystals, some of which have a length of more than 0.1 millimeter. It is apparently holocrystalline and somewhat more calcic than oligoclase. The biotite is almost colorless, and the prismatic euhedral to subhedral crystals range in size from a very small fraction of a millimeter to about 0.3 millimeter. The larger crystals give the rock a somewhat porphyritic aspect. The epidote occurs as irregularly-shaped grains somewhat uniformly distributed. The chemical composition of this rock is shown in the following analyses:

**EFFECT OF THE INTENSIVE ROCK FORMATION UPON THE INTRUSIVE ROCKS.**

The oldest intrusive, the gabbro and related rocks, appear to have produced distinct changes in the rocks penetrated by them. For instance, the slate in immediate contact with the gabbro is not noticeably different from the slate at some distance from the contact. The peridotite in the Nickel Mountain region, where it intrudes the granodiorite, produces distinct schistosity in the latter. The granite of the North Fork Mountain region also produces distinct schistosity in the granodiorite. The gabbroic schist produced near the summit of Mount Shasta, the greenstone, is changed, as a rule, to hornblende schist. This alteration is perhaps best seen in the area of greenstone taken from the Black Butte intrusive and from the North Fork Mountain region.

The granodiorite produced much greater changes than any of the other intrusive rocks. Where large dikes of this rock intrude gneiss, the gneiss is changed, as a rule, to hornblende schist. This alteration is perhaps best seen in the area of greenstone taken from the Black Butte intrusive and from the North Fork Mountain region. The hornblende schist is also well developed as inclusions in the granodiorite in the Red Mountain region and elsewhere.
Gradual uplift by faulting of the Klamath Mountains altered the major stream courses once located at intervals during the Tertiary period, but the vigorous streams were able to cut down their beds as rapidly as the land rose and thus maintain the terrace elevations directly across the ranges to the ocean.

The remnants of the Klamath peneplain are the oldest topographic feature of the Klamath region, and they are not discernible in the Riddle quadrangle but are distinct to the southeast into the Wallowa and the coast. All the rest of the area east of that which has been uplifted since the pre-Cretaceous is of younger age than the Klamath peneplain.

The great uplift of the Klamath Mountains in middle Tertiary and later time represented the stream beds and enabled them to cut down later valley beds from the rocks of the earlier valleys, many hundreds and in some cases even thousands of feet below the peneplain level. As the uplift was irregular, with middle interstices, so was the erosion. There were pauses in the downward cutting, and the streams widowed not only the earlier valleys, as already noted, but also the later valleys. Where the rocks are hard and the erosion relatively slow, as along Rogue River below the southwest corner of the Riddle quadrangle, the valleys are narrow and canyon-like, but where the rocks are soft, as in the area of Crentracas shales along the South Umpqua and about Riddle and along Rogue River in the Medford region, the valleys are wide and level.

About Granite Pass and in Pleasant Valley there are apparent but not real exceptions to this rule. The rock of the region is at a considerable distance below the surface, but near the surface it weathers rapidly and becomes soft. It is thus easily eroded, and as a result the valleys are at an early stage in the cutting process.

At one stage in the valley cutting the deepening decreased and the widening for a time prevailed, so that along each of the principal stream courses was formed a distinct terrace, which is generally capped by alluvial gravel. In the South Umpqua Valley, this gravel is represented by the gravel-sand deposit, a few miles southeast of Riddle at a level of 200 feet above the stream. Further up Cow Creek, beyond the limits of this quadrangle, it is represented by the gravel of Jack and Cain gravel beds at a terrace about the same height above the stream, but still further upstream, between West Fork and Brenen, the gravel is only 150 feet above stream grade. Along Rogue River there are corresponding terraces, as illustrated by the gravel of the Big Four mine.

The stream beds have deepened and widened their valleys to their present form.

**ECONOMIC GEOLOGY.**

**GOLD.**

The history of gold mining in southwestern Oregon dates back for more than 70 years, the first discovery having been made about the middle of the nineteenth century. From that time to the present this portion of the State has yielded a considerable percentage of the total gold production of Oregon. From 1900 to 1912 Oregon produced $15,665,228 in gold of an assessed value of $8,459,486 and $7,205,742 in silver of an assessed value of $3,456,202. Of the placer gold, 93.6 per cent has come from the Umpqua River district.

The only nickel mineral known to occur in these deposits is the brown carbonate of nickel. The nickel deposit is on the periphery of the range and is not real except in a few places.

The deposits of gold are very similar in mineral content, modes of occurrence, and associations to the deposits of New Coalinga, whose ores are the second largest producers of nickel in the world, but no commercial deposits have yet been found at Riddle. Numerous surface workings were made, all worked out, and not more than 600 feet of total run is estimated. It is believed that more than 3,000 and 4,000 tons of material has been taken from the several openings and placed on the dumps. Only a few small shipments of ore were made to the smelters, and these merely for experiments.

The nickel alluvium is associated with anatase, a variety of petrodit that contains chrysoberyls and clinopyroxene. Olivine constitutes more than two-thirds of the whole rock. Chromite and magnesium are present, and, in the form of disseminated nickel, for the most part in the matrix of the rock. The nickel deposit is on the periphery of the range and is not real except in a few places.

The mineral content of the deposits of nickel includes nickel, iron, and magnesium. The nickel deposit is on the periphery of the range and is not real except in a few places.

The nickel deposit is on the periphery of the range and is not real except in a few places.
chrysolite slate and may have had much to do with the development of the copper ore in the greenstone. The ore is chiefly pyrite with a mixture of chalcopyrite and pyrophyllite. The strike of the ore body is northeast, like that of the rock belts in that region, and the dip is steep to the southeast. The plane of the ore body is one of faulting, as shown by the slickensides of the hanging wall. The pyrite ore occurs near the surface, where there is much gossan, containing more or less of the blue and green carbonates of copper. The mine is developed by a number of open cuts and short tunnels at the top of a ridge and down the north slope, but the possible extent of the occurrence of such beds of ore is not yet sufficiently demonstrated.

A deposit somewhat similar to that of the Copper Queen occurs in greenstone on the northwest slope of Green Mountain, 15 miles east of Glendale. The country rock is typically greenstone that has been greatly shattered and altered but still preserves its original structure and composition sufficiently to show its diabasic character. It is cut by serpentinite. The greenstone belt is nearly a mile wide from the summit of Green Mountain. The copper-bearing rock impregnates the greenstone and forms lenses. It is usually incised in deep-green chloritic material. The chief copper mineral is chalcopyrite, which is intermingled with a large portion of pyrrhotite and pyrite, but the deposit, although opened several years ago, has not resulted in the stage of commercial production.

Work has also been done on several copper prospects, one of which, the Joseph Bell prospect, is of considerable interest. This prospect is on the southwest slope of Cedar Springs Mountain, at an altitude of about 4,200 feet. Some ore has been carried by pack trains to Glendale, on the Southern Pacific Railroad, a distance of more than 20 miles. The country rock is serpentine, which has been greatly fractured and sheared and which locally, where it has been decomposed, contains magnesite with some strontianite. The ore consists of native copper, copper glance, cuprite, and the copper carbonates. It occurs in a faulted zone in the serpentine, which shows numerous slickensided surfaces carrying vertical striae. Within the workings the faulted zone varies in direction and the plane of shearing is very irregular. On this plane have been found flat pieces of native copper as large as the hand, also copper glance and cuprite as nodular masses and as scattered fragments.

WATER RESOURCES.

The waters of South Umpqua River, Cow Creek, and tributaries of Rogue River, which drain the west slope of the Cascade Range, are used for irrigation and for placer and hydraulic mining. One of the largest ditches takes water from the head of Grave Creek and has been used chiefly to supply the Columbia mine, near Placer post office.

The only stream-gaging station in the Riddle quadrangle was on Cow Creek at Riddle, where the following observations of discharge were recorded: August 20, 1911, 32.8 second-feet; December 19, 1911, 304 second-feet; September 9, 1912, 120 second-feet.

At present little water power is developed in the Riddle quadrangle, but on Rogue River near Gold Hill and at Prospect there are power plants with transmission lines leading into the Riddle quadrangle, where the power is used for lighting and mining. Riddle is lighted by electricity from the Prospect plant of the California Oregon Power Co.

September, 1923.