GEOLOGY AND MINERAL RESOURCES OF THE OSCEOLA MINING DISTRICT, WHITE PINE COUNTY, NEV.

By F. B. Weeks.

INTRODUCTION.

As a part of the general reconnaissance of the Great Basin region the geology of the region was studied by J. E. Spurr[a] in the summer of 1899 and by the writer in 1900. The geologists of the Wheeler Survey[b] also published some general observations on the region. A portion of October, 1907, was spent by the writer in making a more detailed study of the geology and mineral resources of the Osceola mining district.

GENERAL DESCRIPTION OF THE SNAKE RANGE.

The Snake Range, in which is located the Osceola mining district, is one of the most prominent and extensive mountain ranges between the Wasatch and the Sierra Nevada. It extends between latitude 38° 30′ and 40° 30′, a distance of 135 miles parallel to and a little west of the Utah-Nevada boundary. (See fig. 5.) As an orographic feature it comprises the Deep Creek or Ibanpah Range and the connecting hills designated as Kern Mountains on the map of the Wheeler Survey. The Snake Range is about 10 miles in width. The interior portion has been eroded into sharp ridges trending in general with the range, and the east and west flanks descend in steep slopes or bold escarpments to the valleys below. Snake Valley occupies a broad depression on the east and opens into the southwest end of Great Salt Lake desert. Spring Valley, west of the Snake Range, extends from the Cedar Range on the south to the so-called Kern Mountains on the north. The difference in elevation between the valleys and the highest part of the range is about 6,000 feet. The rugged character of the range makes it a formidable barrier to east and west travel. There are only four natural passes which afford a

[a] Bull. U. S. Geol. Survey No. 208, 1903, pp. 25–36. Spurr, geol. only
[b] Rept. U. S. Geog. Surv. W. 100th Mer., vol. 3, 1875, pp. 240–242. Wheeler survey - geol. only

practicable route for wagon roads. The highest summit of the range is Wheeler Peak (locally known as Jeff Davis Peak), which has an elevation of 12,000 feet. In the region of the Osceola mining district the range presents an abrupt face to the west and a long, gentle slope to the east.

Upon a basement complex of granite and schist, only a small area of which is exposed, there has been deposited a series of Paleozoic

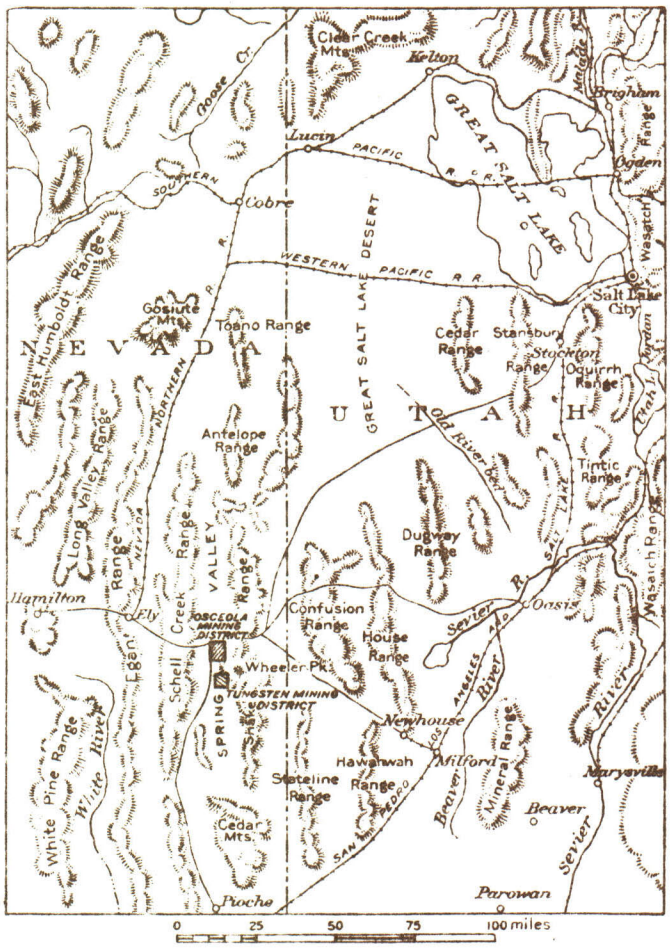

FIG. 5.—Map showing location of Osceola and Tungsten mining districts, White Pine County, Nev.

sediments from 8,000 to 10,000 feet in thickness. As shown by their fossils the strata were laid down in Cambrian, Ordovician, and Carboniferous time, a long interval of nondeposition occurring throughout the Silurian and Devonian periods. Some beds of unknown age may represent the Mesozoic era, but the evidence is inconclusive.

On the lower slope of the range in certain areas there are sands and gravels which lie above the Lake Bonneville beds and which were probably laid down in late Tertiary time. At the north end of the range terraces of the Pleistocene Lake Bonneville have been noted. It seems probable that from Carboniferous time to the present the greater part of this area has been subject to erosion.

Considerable bodies of igneous materials are exposed in the northern and central portions of the range. These igneous masses intruded Carboniferous strata and so, in part, at least, are Mesozoic or younger.

The prominent structural feature of the range is a dome in the region of Wheeler Peak, which both to the north and to the south passes into anticlinal folds whose axes in general trend with that of the range. This structure has been subsequently modified by compression and faulting and by the intrusion of igneous masses, so that the sedimentary beds generally have steep dips and are in many localities separated by considerable displacements. This is especially true in the region of the Osceola mining district.

OSCEOLA MINING DISTRICT.

SITUATION AND PHYSICAL FEATURES.

This mining district is about 35 miles east of Ely, Nev., the southern terminus of the Nevada Northern Railroad. It includes the crest and western slope of the Snake Range in the vicinity of Osceola. The east-west wagon road through the district is the principal route of travel between Utah and central Nevada. Near the summit on the eastern side the road forks, a branch leading over the Sacramento Pass and descending to Spring Valley on the west.

The principal drainage lines in the mining district are Dry Gulch and Mary Ann Canyon and along them and in their alluvial fans occur the most important placer deposits. The stream beds are dry during most of the year. About one-fourth mile above Osceola, near the wagon road, are several small springs and a small stream flows from the mouth of the New Moon mine. The elevation of the district ranges from 6,000 to 9,600 feet above sea level. The region is arid, the principal precipitation being in the form of snow.

GENERAL GEOLOGY.

The distribution of the rocks in this district is shown in the sketch map forming fig. 6, and a general section is given in the following table.

General geologic section of the Oscoola mining district.

No. in fig. 7.	Age.	Character.	Thickness.
			Feet.
1	Recent	Gravel, coarse to fine, gold bearing	Up to 80
2	Upper and middle Cambrian	Gray to white, rather pure limestones and dark-blue crystalline limestones.	1,000
3	Lower Cambrian	Green sandy shales, *Olenellus* zone	150
4	do	White, blue, and purple quartzites, gold bearing	2,000
5	do	Purple argillite	750
6	do	Conglomerate	100 to 150
7	Archean (?)	Granites and schists, with intruded granite porphyry.	

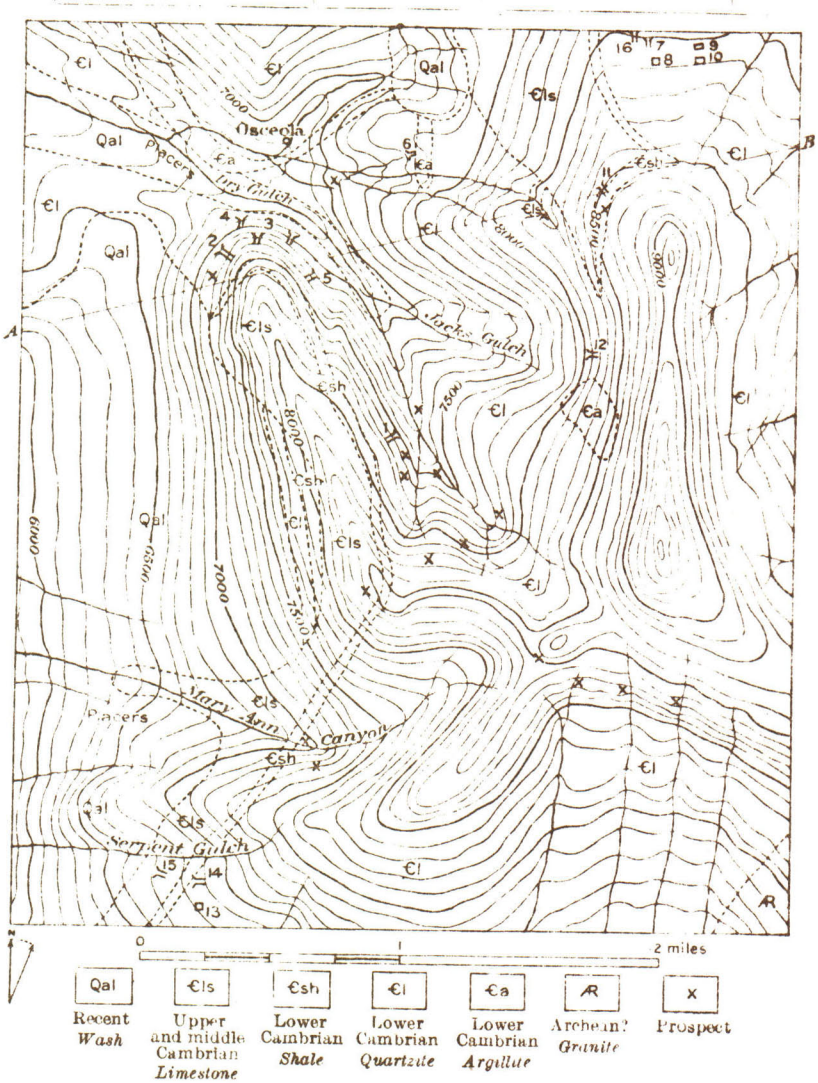

FIG. 6.—Sketch topographic and geologic map of the Oscoola mining district. Contour interval 100 feet. Mines: 1, Cumberland; 2, Golden Eagle; 3, Crescent; 4, Time Check; 5, Exchange; 6, New Moon; 7, Gold Hill; 8, Gold Crown; 9, Queen; 10, King; 11, Whitney group; 12, Mulligan group; 13, Drummer shaft; 14, Mayday; 15, Serpent; 16, June. Dotted lines are boundaries of rock areas.

Fig. 7 is a cross section showing the structural relations along a line crossing Dry Gulch.

A short distance south of the mining district and near the crest of the range is an area of granite and schist overlain by a coarse conglomerate which grades into a compact argillaceous rock resembling argillite. The argillite is succeeded by a series of quartzites which pass into shales containing an *Olenellus* fauna. It appears from these observations that there is exposed here a small area of the basement complex rocks. Their structure has, however, been broken by an intrusive mass composed largely of gray and red granite porphyry which, north of the road crossing the range to Osceola, has penetrated through strata of possible Carboniferous age.[a] On the divide north of Wheeler Peak certain observations made in an area of poor rock exposures indicate that the granite porphyry cuts through the granites and schists of supposed Archean age.[b] These Archean rocks are much finer in grain and generally more basic than the intrusive rocks. By the presence of sheared zones and general

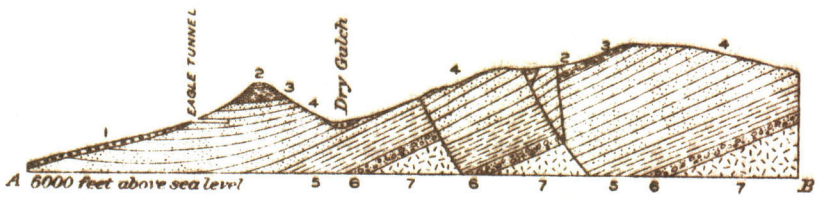

FIG. 7.—Structure section along line *A–B*, fig. 6. 1, Recent; 2, upper and middle Cambrian; 3 to 6, lower Cambrian; 7, Archean (?).

schistose structure they bear evidence of stresses and strains which were not observed in the intrusive granite porphyry.

The conglomerate which overlies the basement complex is about 100 feet thick and is formed of large subangular pebbles and bowlders derived from the older rocks. The conglomerate pebbles gradually become more rounded and smaller in size, argillaceous material forming a considerable portion of the rock, which passes into a massive bedded argillite. The argillaceous series is about 700 to 800 feet thick and is well exposed on the eastern slope of the high ridge that forms the crest of the range east of Osceola.

In this region the dip ranges from 25° to 40° NW.[c] and where the strata are cut by the intrusive porphyry they have been altered for the most part into a bluish-gray, generally schistose rock that has been called "silvery slate." This series is overlain by gray and white fine-grained quartzites. The beds have been thoroughly silicified and contain many veinlets of probably secondary quartz. They have

[a] Spurr, J. E., Bull. U. S. Geol. Survey No. 208, 1903, p. 32.
[b] Idem, pp. 26–27.
[c] Directions given in this paper are magnetic.

also been subjected to compression and numerous extensive belts of cross fracturing have been developed in which the quartzite has been broken into small angular fragments. The quartzite series has been estimated to be 2,500 feet in thickness. In the upper part of these beds occur the gold deposits and from the erosion of their outcropping edges the placer deposits in and along the sides of the gulches and in the alluvial fans have been formed.

The quartzite is succeeded by about 150 feet of green sandy and argillaceous shales. Where the outcrop of these beds crosses the south end of the ridge facing Spring Valley fossils of *Olenellus* type were found. These are the lowest beds in which fossils are known to occur, though careful search was made for them in the argillite.

Above the shale series occur dark-blue and gray limestones about 1,000 feet thick. The individual beds range from 1 to 3 feet in thickness, but in the crest of the ridge facing Spring Valley there are about 100 feet of thin-bedded and shaly blue limestones. The dark-blue limestones immediately overlie the shales and for the most part are crystalline or semicrystalline and contain numerous calcite veins. The gray limestone is comparatively pure and ranges from dark gray to white in color. Fossils have been collected at several horizons in the limestone series on the east and north slopes of the ridge facing Spring Valley and these have been determined as forms characteristic of the middle and upper Cambrian.[a]

Within the area of this mining district there are no other sedimentary rocks except the recent deposits in which occur the placers. These deposits are from a few inches to 80 feet thick. The gravel ranges from fine to coarse and contains few large bowlders.

HISTORY OF MINING DEVELOPMENT.

In 1877 work was begun on the placer deposits of Dry Gulch. A few quartz locations were made prior to that time. It is reported that 300 to 400 miners were working on the placers during 1877 to 1880 and during the latter year 400 placer and lode locations were on record. The important placer properties in Dry Gulch became the property of the Osceola Gravel Mining Company, subsequently known as the Osceola Placer Mining Company, in the early eighties. Prior to 1890 this company had constructed two ditches approximating 34 miles in length, at a cost of about $200,000. The operations of this company and of individuals continued until about 1900, when on account of light snowfall and the loss in efficiency of the ditch from leaky flumes and other causes work was discontinued.

The alluvial fan which spreads out from the mouth of Mary Ann Canyon, in the southern part of the district, is locally known as

[a] Fossils mentioned in this report have been determined by Mr. Charles D. Walcott.

Hogum. Here pay gravel was found several years after the discoveries in Dry Gulch and the deposits have been worked intermittently since that time.

Several attempts have been made to work the gold-quartz properties on a small scale. Three mills of 5, 10, and 20 stamps have been erected and operated, but none of them has been commercially successful. It is admitted that more than 50 per cent of the values went down the gulch with the tailings. Since field work was completed the 20-stamp mill has been partly repaired and a run of several hundred tons of ore from the Cumberland mine has been made. The results are not known.

From all accounts that have been obtained, it seems safe to estimate that the production of gold from this district approximates $2,000,000, of which about one-tenth was probably derived from the quartz mines.

through 1907?

MINING.

The slopes being steep, underground development is through tunnels, there being not more than half a dozen shafts in the district. In one or two mines an upper and lower tunnel have been connected by winzes. The quartzite is exceedingly hard and no timbering is required in the tunnels. In winzes and stopes a few stulls are all that is needed.

Some ore has been sacked and shipped to the smelters, but the greater part has been locally milled. Stamping and amalgamation constitute the principal method of treating the gold quartz. A small cyanide plant was constructed several years ago but was abandoned, apparently before receiving a satisfactory trial.

The Boston and Nevada Mining and Milling Company employs half a dozen men and about the same number are engaged from time to time in doing assessment work for nonresidents. The average wage for miners is $3.50 per day of eight hours.

All the mines and placers have been located by prospectors and working miners. No extensive consolidations have been made and the camp remains an aggregate of small mines and prospects on which, with the possible exception of the Osceola placers, but little outside money has been expended. The ores so far discovered have not been of high enough grade to attract lessees.

EXTENT OF PRODUCTIVE TERRITORY.

There seems to be no ground for assuming that the productive territory extends beyond the limits of the area shown on the map (fig. 6). So far developments indicate that the deposits are confined to fairly well defined zones in the quartzite. It has been thought by some that the same mineral belt extends northeastward to the recently opened

Black Horse district. It may be that the effects of the same dynamic forces which developed the lode systems in this district extended to the Black Horse district, but a slight examination of that region indicates that although the lithologic characters of the strata are in general similar, the beds at Black Horse were deposited during a later period and the ores are very different in character.

The fissures appear to be confined to the quartzite. They were not observed in the overlying shales and limestones and the underlying argillite has not been exposed in the underground workings. To the east and south of the area mapped the argillite series is well exposed and shearing with more or less movement along the bedding planes is a prominent feature, the beds being locally altered to a silvery slate.

DISTRIBUTION OF MINES.

The areas of greatest mineralization are (1) the ridge on the west and south sides of Dry Gulch, (2) the slopes of Mary Ann Canyon, and (3) the north end of the main mountain ridge. (See fig. 6.) In the Dry Gulch area are situated what is locally known as the Gold Exchange group, including the Woodman, Golden Eagle, Star, Time Check, Crescent, Exchange, and January. There also are the Butterfield and the Cumberland mines. In the region of Mary Ann Canyon are the Serpent, Mayday, Drummer, and other prospects. On the north end of the main ridge at an elevation of about 8,000 feet are the King, Queen, Gold Hill, June, and Gold Crown claims, locally known as the Summit group, and a little to the west are the Whitney and Mulligan groups.

UNDERGROUND DEVELOPMENT.

The most extensive underground workings are in the Gold Exchange group. The tunnels in these mines have a total length of about 1,000 feet, and connect with one or two shafts and several stopes and winzes. In Mary Ann Canyon several prospects have tunnels from 50 to 125 feet long. In the Summit group the tunnels range from 50 to 350 feet in length. The Whitney and Mulligan groups have about the same amount of development. The three tunnels in the Cumberland mine have a total length of approximately 1,700 feet.

STRUCTURE OF THE GOLD DEPOSITS.

There appear to be only two types of auriferous deposits in the district—(1) regular zones of fracturing or sheeting and (2) irregularly shattered masses of quartzite adjacent to these zones of fracture. In most places there is no distinct line of demarcation between the two types. There are no massive veins solidly filled with quartz such as are characteristic of many other regions.

The most characteristic structure is the sheeted zone. In this district these zones consist of narrow, nearly parallel fissures forming lodes ranging from several inches to 15 feet in width. In the wide belts, which may be considered as compound sheeted zones, there are generally one or more zones of closely spaced fissures. The sheeted zones contain some fracture planes which show slickensiding, but the displacement appears to be slight. This may be due to the brittle character of the fine-grained quartzite that forms the country rock. Beds which are broken into fine brecciated masses lie between massive beds of quartzite which apparently were not affected by the compressive stress.

Circulating waters carrying silica in solution have filled the fissures of the sheeted rock. The original openings were small, and they are as a rule completely filled. The most important exception is the Cumberland lode, in which the vein material contains many vugs lined with gold, fluorite, and other minerals.

The lodes are in places conspicuously exposed, forming bold outcrops of quartz. They are somewhat more resistant to erosion than the country rocks, but can not be followed on the surface for a very great distance. There are also lodes in the mines which do not appear at the surface. It is therefore impossible to describe in detail the lode systems, as there is a relatively small amount of underground work and the limits of the fracture zones have not been reached.

The Osceola lodes form two intersecting groups of approximately parallel fissures. In the northeastern part of the district the strike is northeast. In other parts of the area the strike varies but little from east and west, except that in the southwestern part there appears to be a northeast-southwest system of fracture zones which cut the east-west lodes. In general the lodes do not converge but maintain their direction until they can no longer be distinguished from the irregular jointing which occurs in all the rocks. The two systems seem to have formed simultaneously and they do not appear to fault each other. In Mary Ann Canyon the fissures intersect without noticeable displacement. The intersection is usually marked by an irregular broken zone, as may be seen on the outcrop and in the upper and lower tunnels of the Mayday mine.

The lodes are steeply inclined, nearly all being above 70° and many vertical. So far as the underground workings show they are fairly regular in dip. Adjacent fissures in general dip in the same direction. This is well shown in the Gold Exchange group. In many places the lodes for considerable distances are so ill defined that the dip can not be determined. It may be said in general that the east-west lodes are vertical and that the northeast-southwest lodes dip at high angles.

No systematic relation between dips, distribution of fissures, and general structure of the district has been found.

PERSISTENCE.

Very little can be said definitely regarding the persistence of the lodes in depth. The deepest underground workings are not more than 300 feet below the surface and the fissures extend to this depth. The ore shoots and sheeted zones are not necessarily coextensive, for the highly productive areas have generally proved to be moderate in extent. Detailed information concerning the length of the lodes is wanting. In the Gold Exchange group the principal lode has been fairly well traced for a distance of half a mile, the west end being cut off by erosion and the east end passing into undeveloped ground. In the Summit group not one but several fissures which appear to replace each other have been traced at irregular intervals for more than half a mile.

ORIGIN OF THE FISSURES.

The character of the stresses that fissured the strata is not easily determined. It is clear, however, that they were such as could be relieved by fracturing with only slight displacement. The hypothesis which seems to accord best with field observations is that in the readjustments, which followed the intrusion of the magma, stresses were set up that resulted in the shearing of the argillite and the fracturing of the fine-grained, brittle quartzites along vertical or highly inclined zones. Fissuring and the intrusion of the igneous magma appear to be genetically connected and were followed by ore deposition from circulating waters.

CHARACTER OF THE ORE.

The lodes of the Osceola district contain a relatively small amount of metallic or gangue minerals. Inasmuch as these minerals occur as the filling of narrow fissures or cracks in the fractured zone which usually constitutes a lode, or as the incomplete replacement of the country rock, the gangue of the ores is similar in character and composition to the rocks adjoining the fissures. Pyrite is very sparingly disseminated in grains so minute as scarcely to be distinguishable by the unaided eye. Ferruginous clays are common in the fissures. In certain lodes, particularly that in the Cumberland mine, the quartz is here and there honeycombed and contains many vugs lined with fluorite and other minerals as well as free gold. More commonly the gold occurs in flakes and also finely disseminated in quartz seams and veinlets.

So far as known gold is the only metal of commercial value in the Osceola ores. From the information available it is impracticable

to estimate definitely the average gold content. Commercial assay returns show a wide range in value. Three samples taken by the writer gave assay values of $5, $32, and $77 per ton, the last representing the face of a tunnel about 4 by 6 feet. Other samples taken by the writer ranged in value from 80 cents to $4.50 per ton and represented portions of lodes not less than 3 feet in width. The return from a shipment of several tons of selected ore from the fractured country rock adjoining a fissure zone gave a value of $28 per ton. It is evident that the gold content of the lodes varies greatly, as in other known gold-bearing veins. It is not unlikely that careful prospecting will develop ore bodies of sufficient size and value to render their exploitation profitable.

OXIDATION.

The greatest depth of underground workings does not exceed 300 feet, and the sulphide zone has not been reached, so far as known. No water is found in any of the mines except in the New Moon tunnel, which crosses a fault in the argillite series. Under present climatic conditions there is very little precipitation, so that the mines are practically never wet. The district stands high above the adjacent valleys, and other conditions suggest unusual depth of ground water.

The greater number of lodes contain a considerable amount of material oxidized to a yellow or brown clay, that does not appear to be easily carried away. Oxidation, however, does not seem to have changed the composition or obliterated the structure of the lode materials to any marked degree. No evidence was obtained that there had been a secondary enrichment of the lodes from the surface downward by leaching of the ore. Such action, however, may have taken place under more humid climatic conditions, such as are believed to have existed in this region in recent geologic time.

ORIGIN OF THE ORES.

No extended discussion of the origin of the gold-bearing ores of the Osceola district can be presented here, as the examination of the mines was not made in sufficient detail to determine many questions that have an important bearing on their genesis, and it has not been possible to study the field collections prior to the preparation of this paper. From general analogy with other deposits it is considered that the ores were deposited from circulating waters within fissure zones formed by compressive stresses. If, as seems likely, the greater part of the mineralization occurred by deposition from ascending waters the silica and the fluorine in the fluor spar locally developed were derived from the originally molten magma that probably underlies the region at no great depth, in geologic terms. In an adjoining area

tungsten-bearing veins in granite porphyry contain a considerable amount of fluorite. Evidence bearing on the source of the gold is inconclusive. That it was leached from the quartzite strata is not improbable, for there is some evidence that they are gold bearing. It may, on the other hand, have been separated from the intrusive magma and brought up through the fissures by magmatic waters.

DETAILED DESCRIPTION OF MINES.

GOLD EXCHANGE GROUP.

The Gold Exchange group comprises eleven lode claims, of which three are fractional. They extend from the west face of Pilot Knob Ridge around the north end, following the south and west slope of Dry Gulch. The slope is steep, but good mountain roads have been constructed to the several tunnel openings. A 20-stamp mill has been erected on the Star ground, which adjoins the Golden Eagle (No. 2 on map, fig. 6) on the west. Water from the west-side ditch has been used in operating this mill. The Star, Golden Eagle, Crescent (No. 3 on map), and Exchange (No. 5) are patented ground; the other claims are held by annual assessment work.

The underground workings on this group, except a portion of the lower tunnel on the Star ground, are in the upper part of the quartzite series. The average dip is 40° NW. and the strike is N. 10° E., but both dip and strike vary within short distances. There are many vertical or highly inclined fault planes, but the displacements observed do not exceed a few feet. The shale series overlies the quartzite and above the shales are the limestones capping the ridge. Near the mill a fault has thrown down the limestones and below these outcrops the slope is covered with débris.

The quartzite strata have been subjected to stresses resulting in two fracture zones, one having an east-west direction, the other northeast and southwest. The east-west zone is the principal one and within it occur many small displacements, the rocks showing well-marked slickensides. This zone can be traced on the surface as a succession of "blowouts." In some of the beds the fracturing extends beyond the usual limits of the lodes, but the other strata retain their massive character. The shattered beds were broken into small angular fragments.

There are two lode systems within this group, one within the Time Check and Crescent (Nos. 4 and 3 on map) and the other within the Golden Eagle (No. 2), Exchange (No. 5), and January ground. They are approximately parallel and are several hundred feet apart. The latter is apparently the more extensive and has produced the larger amount of ore.

The gold is concentrated within fissure zones of varying width and is also disseminated to a greater or less extent in the beds of finely shattered quartzite. It is not known to what extent these beds have been mineralized, as no drifts have been made in them. They evidently contain some pay ore, for in places chambers several feet in extent have been stoped. The gold is rarely visible, being very finely disseminated.

In accordance with the locally held idea that these ores are free-milling they have been treated in the ordinary stamp mill with amalgamation tables. These properties have not been worked since 1899 and at this time it is impossible to obtain definite information as to the average value of the material milled or the percentage saved. It is generally conceded, however, that there was considerable loss—possibly as much as 50 per cent of the assay values. On account of the high degree of fineness of the gold and the fact that it is not all in the free state it is believed by many that a much greater percentage of saving would result from cyanide treatment.

SUMMIT GROUP.

The Summit group of claims is situated on the crest of the range about 1 mile south of the wagon road which crosses the mountains from Osceola. Some underground work has been done on each of the claims which comprise this group.

The Gold Hill tunnel (No. 7 on map) is 309 feet in length and its direction is south. It is entirely in the quartzite strata, which strike N. 10° E. and dip 45° NW. They are generally massive bedded and contain several clay seams and fractured zones about 6 inches in width. On the eastern side of this claim there is another tunnel about 100 feet in length, having a direction S. 60° W., with a drift to the south from the face of the tunnel about 100 feet long. In these workings is exposed a broad zone of fractured and brecciated rock whose limits are not known. Considerable ore from this tunnel is said to have been milled, but no satisfactory estimate of value could be obtained.

The June tunnel (No. 16 on map) varies in direction and has a total length of 240 feet. The tunnel cuts a fault trending N. 26° E. East of the fault, in the direction of the face of the tunnel, the beds show little disturbance but contain many soft seams from which gold can be obtained by panning. To the northwest, or toward the mouth of the tunnel, the quartzite is very finely brecciated. In this fracture zone assays ranging from $8 to $15 are said to have been obtained, but no definite statement as to the width of the zone furnishing such assay values could be given. This fracture zone appears to have a general direction of N. 30° E.

The Gold Crown, Queen, and King (Nos. 8, 9, and 10 on map) are developed to a small extent. Average assays of $14 are said to have been obtained from these claims.

Within the Summit group there appear to be at least three fracture zones separated by intervals in which the quartzites are relatively undisturbed. The amount of mineralization varies greatly within these zones and extensive prospecting will be necessary to determine the distribution of the values.

WHITNEY GROUP.

The Whitney group (No. 11 on map) has been prospected by several tunnels cutting the shale and quartzite nearly at right angles to the strike. The strata are in places much broken and shattered and in others are undisturbed. Certain fault planes, indicated by slickensided surfaces, have been followed as walls in the tunnels. These fault planes dip 60° S. Considerable ore has been mined and milled from these workings, but no satisfactory statement of its value could be obtained.

MULLIGAN GROUP.

At the north end of the Mulligan group (No. 12 on map) there is an incline following what appeared to be a fault fissure nearly filled with vein quartz. The fault strikes N. 80° E. and dips 65° S. About 600 feet south of this incline is a tunnel which at the time of visit was closed, but the material on the dump showed that there must be considerable underground work in a formation of very finely crushed white quartzite. At the south end of this group is a 200-foot tunnel entirely in a crushed white quartzite.

CUMBERLAND MINE.

The Cumberland mine (No. 1 on map) has three tunnels having a common direction of S. 80° W., at vertical intervals of 100 to 200 feet. The lower tunnel is 500 feet in length and follows a fault zone in which are many small fissures showing slickensided surfaces and dipping both to the north and south at high angles. In some places a fault plane dipping steeply to the south has been followed until it became nearly horizontal in the roof and then another steeply inclined fault plane farther on in the tunnel has been used as a wall. In some places, for distances of 10 to 20 feet, the quartzite strata are unbroken and have the normal strike and dip. Many beds not showing distinct fault planes have been crushed into confused masses of small fragments. Clay seams are abundant, and some of them follow bedding planes.

The second tunnel was not examined. The third and upper tunnel is 650 feet in length. At 450 feet from the entrance is a winze 50 feet in depth and an upraise to the surface. In this upraise there is an ore shoot 3 to 4 feet in width which pitches 75° S. The greater part of this ore shoot has been worked out. Its hanging wall is a well-defined fault plane. The lower edge of the shoot is cut in the back of the third tunnel, but its pitch carries it to the south of the first and second tunnels, and no prospecting has been done to determine its extension in this direction. It is reported that most of the ore mined and milled from the Cumberland came from this upraise, but no definite information as to its average value could be obtained. The ore contains much free gold, partly in vugs with fluorite. Many beautiful specimens have been found in these ores.

OTHER PROSPECTS.

In the southwestern part of the Osceola district, in the region about Mary Ann Canyon, there has been considerable prospecting since 1900. This area is locally known as Hogum. The granite porphyry is exposed on the western edge of this area and small veins, generally of quartz, extend from it into the adjoining sedimentary strata. The derivation of the vein filling from the intrusive mass is more clearly shown here than in the other parts of the district. Although the structural features of this area have been affected by the intrusion of the igneous magma, they nevertheless are closely connected with those of other parts of the district previously described.

The Mayday claim (No. 14 on map) is developed by a tunnel 130 feet in length following the strike of the vein, which is S. 70° E. The gangue material is nearly all quartz and it pitches to the southwest, or in the direction of the granite porphyry, which is exposed about one-eighth of a mile farther south. The vein contains many gouge seams and small displacements. In the area between this vein and the granite porphyry the quartzite is fractured and broken into small angular fragments.

The Drummer claim (No. 13 on map) is developed by a shaft 18 feet in depth following an offshoot from the granite porphyry. This vein is about 4 feet wide and is formed of fine-grained granite porphyry and quartz. Its general direction is N. 30° E.

The Serpent claim (No. 15 on map) has two tunnels 50 and 80 feet in length. The entrance to the upper tunnel is in the limestone, which dips 45° NW. and strikes N. 30° E. The vein strikes N. 50° E. and dips 45° SW. The ore-bearing portion ranges in width from a 10-inch vein to a thin parting. The best ore, said to have been found where the pay streak averaged 4 inches wide, assayed $400. Coarse gold was observed on exposed faces of the vein.

The lower tunnel is 25 feet below the upper tunnel and has a direction S. 80° E. The vein is from 6 to 8 inches in width and dips 25° SW. The returns from the milling of this ore were reported as $17 to $20 per ton. Considerable lead ore is found in a parallel vein.

PLACERS.

The placer deposits of Dry Gulch range from a thin covering of the edges of the quartzite strata in the upper part of the gulch to deposits 25 to 30 feet in depth in the lower part, below which the débris spreads out into an alluvial fan. Hydraulicking and ground-sluicing methods were employed to recover the gold. The values were more or less disseminated through the gravel, the principal pay deposits being as usual near bed rock. Large nuggets were rarely found, the gold being in general very fine. There still remains a considerable area of ground to be worked, but lack of water has thus far rendered further operations impracticable.

In the southwestern part of the district, in the area locally known as Hogum, the placer deposits occur in channels buried under the material of the alluvial fan below the mouth of Mary Ann Canyon. They usually occur in a stratum overlying a so-called cement or false bed rock, of which there appear to be several at different levels. The channels are worked by sinking and drifting. The material is raised by a whim, shoveled into sluice boxes, and washed with a small quantity of water from the ditch. Here, as in every other part of the district, the gold is fine and nuggets of much size are seldom found. Frequently small potholes are encountered in the false bed rock. These have the gold concentrated around their edges, but not within them. During the summer of 1907 the Gold Bar Placer Company employed from two to four men and the operations are said to have given a satisfactory return on the investment. The pay stratum was reported to have yielded from $6 to $8 per cubic yard.

Placer mining has also been carried on east of the divide, above the town of Osceola, in Mill and Weaver creeks. This area lies to the northeast of that shown on the map and was not studied in detail. The gold is derived from the erosion of the quartzite strata, as in all other parts of the district.

GENERAL SUMMARY.

The lode systems of the Osceola district are known to be extensive. All of them carry gold, but the values are irregularly distributed along the fissure zones. Systematic and extensive prospecting must be done to determine the average value of these lodes. It seems certain that the average product of the lodes will be a low-grade ore

which must be worked at a small cost and in large quantity to be profitable.

Water for milling purposes and placer mining can be obtained from the several creeks heading around Wheeler Peak, which are also available for the generation of electricity. As it will require the waters of all these creeks to fully develop the resources of the district there should be such a combination of interests as would permit the development of the water and power for the use of the various mining companies. Future development and prosperity depend on a concentration of local interests on a basis that will attract capital.