

crushed ore is fed by a belt-driven plunger feeder of simple type to a tank of hot water in which the wax is melted from the gangue. The first tanks were constructed of steel, and steam jacketed. Later they were built of 3-in. wood planking at small cost. These tanks are 3 ft. deep, 14 in. wide, and 25 ft. long. In the bottom of the tank are placed two 12-in. screw conveyors, each 12 ft. long, operating as one screw, with stuffing boxes at each end, submerged centre-bearing, and driving mechanism outside one end of tank. A 2-in. pipe carrying exhaust steam for heating the water runs along each side of the tank just above the screw. The tank is filled with water and the steam turned through the pipes, rapidly bringing the temperature of the water to 170 to 190°F. The screw is started at the rate of six revolutions per minute, while the ore is fed in at one end of the tank. As the melting point of ozokerite is about 130°F., the wax at once commences to melt and rise to the surface of the water.

The success of the operation just described depends upon the wax being entirely liberated from the rock during the short period of its conveyance from one end of the tank to the other. Arriving at the farther end of the tank, the tailing is either lifted out by an inclined screw or drops into a cone attached to the end of the tank, from which it is discharged intermittently by a quick-acting valve operated by hand; the tailing being too coarse to admit of the continuous discharge used in cone devices for dewatering tailing.

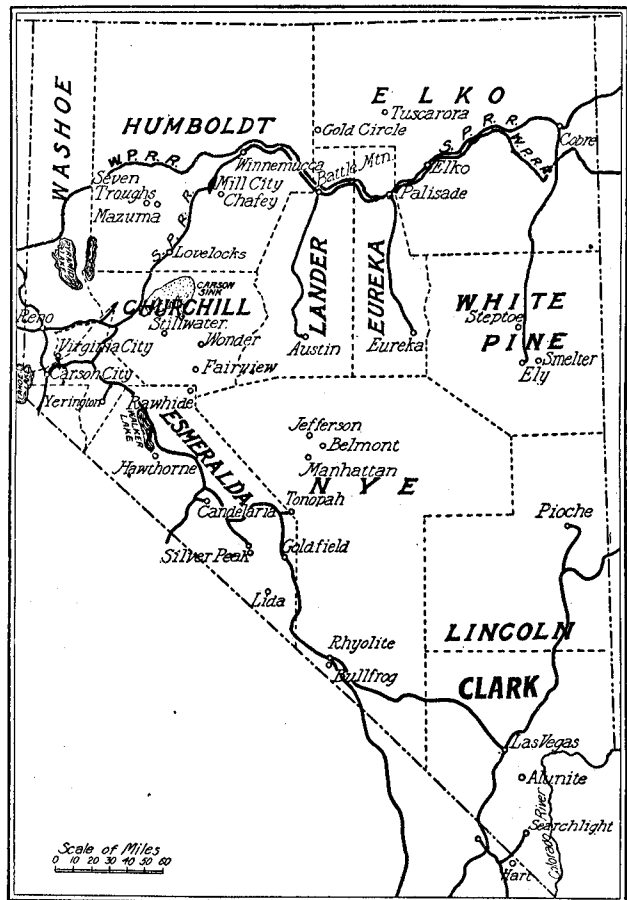
The wax was at first skimmed from the top of the tank into pans. After cooling and hardening, the earthy impurities which had settled to the bottom were chiseled off, when the cake was sacked for shipping. It was soon found that the cakes were not acceptable to the buyers because of bad condition due to the moisture entangled in the wax. This led to the perfection of a continuous method of refining. The wax is drawn constantly from the melting tank to a small steam-jacketed cone tank acting on the principle of a water-clarifying cone, the settled impurities being drawn off from the bottom. Steam coils are used in this cone to assist in keeping the wax melted and to drive off the entangled moisture. The melted wax overflows the cone to pass about more steam coils to further reduce the contained moisture, finally flowing into pans in which it is cooled to form cakes that are satisfactory. The capacity of one of these melting and refining units is from 25 to 50 tons of ore per 24 hours. The amount of coal required to heat the water and wax is remarkably small, so that the whole process may be said to be both efficient and economical.

About five plants for extracting ozokerite have been erected in Utah, resulting in the production of several hundred tons of wax. None of these are now operating. The reason that more has not been done is simple—no extensive bodies of commercial ore have been found. It is impossible to say just what percentage of wax the present known bodies contain, but it can be understood that with ozokerite at 16c. per pound f.o.b. New York City, 2% wax would be valuable. Prospecting for ozokerite is being carried on in many localities.

SEVEN TROUGHS DISTRICT OF NEVADA.

By F. L. RANSOME.

*The Seven Troughs district, which is about 30 miles northwest of Lovelock, a flourishing town on the main line of the Southern Pacific railroad, lies on the east slope of a minor range designated on the Fortieth Parallel Survey map as the Pah-tson mountains, but now popularly known as the Seven Troughs mountains, but occasionally referred to also as the Stonehouse range. The higher parts of the mountains are dotted with junipers and the larger ravines contain small perennial streams. Grass flourishes on some slopes and for over 30 years the region has been used as a range for sheep and cattle.



Map of Nevada.

The watering places maintained in connection with this pastoral occupancy have given to the new mining district its name.

Supplies are hauled by teams from Lovelock. Passengers may reach the district most conveniently from the same point by the ordinary stage line or by automobiles, which meet the transcontinental trains and ply over a little better road than is used by horse-drawn vehicles. There are four little towns in the district, three of which, Vernon, Mazuma, and Farrell, are situated at the east base of the range. Vernon, the southernmost of the three, was the chief settlement in the district early in 1908, but had lost its pre-eminence by August of that year, most of the activity then centering about Mazuma, 2½ miles north-northeast of Vernon, and about Seven Troughs, which is 1¼ miles west-northwest of Mazuma, higher up the same canyon. Farrell, three or four miles

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north of Mazuma, has at no time been as important as the other settlements.

The Seven Troughs mountains have a length of 24 miles and trend 20° east of north. The greatest width of the range is eight miles. Its crest culminates in a group of three summits. These attain altitudes of about 3000 ft. above the desert plains that surround the range on all sides but the north. The highest and middle summit is Granite peak. The one southwest of it, of schist, is designated Pahkeah peak on the Fortieth Parallel Survey map. A low broad pass, occupied according to this map by Miocene lake beds belonging to the Truckee formation, separates the north end of the Seven Troughs range from the longer Trinity range and from the Kamma mountains, a small group within which is the Rosebud mining district and the Rabbit Hole sulphur mine.

The known ore deposits of the Seven Troughs range are all in the Tertiary volcanic rocks, and consequently a small part only of the four days spent in the district could be devoted to the older formations. North of Mazuma the so-called Jurassic rocks appear first in Burnt canyon as a northeast-southwest belt of indurated clay slate about half a mile wide. This belt appears to correspond at this place to a low ridge, which, after having been completely buried under lava flows, has been uncovered again by erosion. The slate extends northeast and forms the rounded foothills just west of Farrell. It was found to be exposed westward along Stonehouse canyon nearly to its head. The dip varies and the slate is cut by dikes of a light-colored rock, presumably rhyolite. Near the head of the ravine the slate is intruded and metamorphosed by the 'younger granites', described by Hague and Emmons.

The intrusive granitic rock at the head of Stonehouse canyon is a fresh, medium-granular, rather dark gray rock, which evidently is not very quartzose and contains a large proportion of plagioclase. The microscope shows the rock to be a granodiorite.

The prevailing rock of the low, rounded hills on the edge of the Sage valley at Mazuma, and for a mile or more up Seven Troughs canyon is a pale reddish brown lava, much of which shows conspicuous flow lamination and a platy fracture. The rock is not a rhyolite but, pending chemical analysis, must provisionally be classed as a mica andesite, unusually poor in femic constituents. Much of it is a mica andesite vitrophyre. Associated with the mica andesite, which appears to occur in several thin flows, is at least one flow of vesicular basalt, some of which is exposed on the slope just north of the west end of Mazuma.

Directly under the vitrophyric andesite there is, as a rule, a flow of basalt. The thickness of this is not known but appears to vary greatly. Under this basalt and occupying the bottom of the Seven Troughs amphitheatre is a volcanic complex of rhyolite, basalt, mica andesite, tuffs, arkosic sandstones, and possibly other rocks of which the structural relations are as yet imperfectly known and which probably can be ascertained only by careful mapping and detailed microscopic work.

The most important group of mines is at Seven Troughs. Just southeast of the town, which lies on the south bank of the arroyo running down to Mazuma, are the Kindergarten and Wihuja mines, both on the same vein. The Kindergarten mine, owned by the Seven Troughs Kindergarten Mining Co., is developed by an adit and by an inclined shaft 280 ft. deep on the dip. A new vertical shaft, being sunk at the time of visit in August, 1908, was expected to cut the vein at a depth of about 300 ft. The Wihuja is a lease on the ground of the Seven Troughs Therien Gold Mining Co., and is opened by an inclined shaft to a vertical depth of about 212 ft. The Kindergarten and Wihuja workings are connected. Other leases on Therien ground, in operation but not productive in 1908, were the Bard and Jess (175 ft. deep), the Tyler, and the Sandifer leases. On the north side of the canyon, close to town, are the Mazuma Hills and Reagan mines, both productive. The Mazuma Hills mine is owned and operated by the Mazuma Hills Mining Co.; the Reagan is a lease on a vein lying east of the Mazuma Hills vein, but within the ground of that company. The Mazuma Hills mine is opened by a main adit 700 ft. long. Winzes from this adit connect with a level 100 ft. below and about 500 ft. long. There is also an upper disused adit about 100 ft. above the main level. The Reagan is worked through a shaft that was 165 ft. deep at the time of visit. Only the 65-ft. level, however, could then be examined, the bottom level being temporarily under water, pending the installation of pumps. South of the Mazuma Hills and Reagan mines is the Sandifer lease on Therien ground. Here, in the bottom of the canyon, a shaft is being sunk in expectation of finding ore in the southern parts of the Mazuma Hills and Reagan veins. North of the Reagan shaft, on the same fissure zone, are the Chadbourne and Bradley leases, whose shafts are respectively 135 and 165 ft. deep. Neither had been productive up to August, 1908. On the hillside a short distance above the mouth of the Mazuma Hills adit is the shaft of the Hayes-Mazuma lease. This was being sunk through rhyolite at the time of visit and was not in ore. Between the workings mentioned and the head of the ravine north of Seven Troughs are the Eclipse shaft, Providence adit, and various smaller unproductive openings made by lessees and prospectors. On the north side of Seven Troughs canyon, about a quarter of a mile below the town, is the adit of the Seven Troughs Tomboy Mining Co. This is a cross-cut running N. 50° E. At the time of visit it was 800 ft. long, and the intention of the company was to carry it 400 ft. farther. The adit first penetrates about 150 ft. of rhyolite and then goes through a seam of gouge into soft pyritized tuffaceous beds with a general low dip to the northeast. These are cut by many faults, probably of small throw, and contain some masses of basalt. About 350 ft. from the portal the adit goes through another seam of gouge into rhyolitic (or possibly andesitic) breccia cut by dikes of glass or obsidian. Lower down the canyon, near Mazuma, considerable tunneling has been done on the Badger group of claims. These workings were not examined. In Wildhorse canyon prospecting was in

progress in 1908 on the Wild Bull, North Pole, and other claims. The Wild Bull showed a little ore, but no shipments had been made. North of this canyon the only active prospecting appeared to be on the Snow Squall claim in Victor canyon, south of Farrell. It was reported that lessees had found good ore in sinking their shaft, but the workings were not visited. From the saddle south of Seven Troughs a long ravine runs south and then turns southeast, embouching at Vernon. In the upper part of this ravine is the Dixie Queen shaft 230 ft. deep and the Cleghorn Consolidated and Signal adits, from 200 to 300 ft. in length. Some lessees also were operating in 1908 on property of the Signal Peak Mining Co., high up on the ridge south of Seven Troughs, but owing to lack of time their shaft was not visited. About halfway down the canyon and about two miles south of Seven Troughs is the Fairview mine, reported at the time of visit to be 650 ft. deep. This mine is known to have had some bunches of very rich ore in the upper levels and is said to have shipped about \$65,000. No stoping was in progress at the time of visit and the shaft was being sunk through hard basalt. The mine is owned by practically the same people that control the Kindergarten and Therien properties at Seven Troughs. In contrast to the attitude of other mine-owners in the district they showed disinclination to impart information and refused access to the Fairview mine. Adjoining the Fairview workings on the north is the Harris lease, on Fairview ground, with a shaft 185 ft. deep. The dump is basalt, much of it being vesicular. There were two mills in operation in the latter part of 1908, one belonging to the Kindergarten company and situated at Seven Troughs, the other belonging to the Mazuma Hills company and situated at Mazuma. Both are 10-stamp mills with amalgamating plates, Wilfleys, and vanners. No attempt is made to cyanide the tailing or save it.

Most of the dikes and fissures near Seven Troughs have a nearly north-south trend. The veins as a whole consist of soft crushed material and do not outcrop above the surface. They represent zones of brecciation or of small fissures, along which movement has continued since the spaces originally formed were filled with quartz. Consequently the typical quartz of the district is friable or sugary, and generally contains or is mingled with many fragments of shattered rock. Clear solid masses of quartz, even of small size, are rare. The veins on the whole are rather narrow, ranging from a few inches up to about two feet in width. It is possible, however, that the average working width may be considerably increased when the district has better facilities for handling and treating ore.

The valuable constituent of the lodes is native gold containing a considerable proportion of silver, and consequently of a rather pale color. In most of the rich ore the gold is visible either as clusters of small irregular particles or as coarse crystalline aggregates. No complete well formed crystals were seen, but there is a noticeable tendency of the coarser gold to form crystal facets. The Mazuma Hills, Reagan, and Fairview mines have afforded some very showy specimens of bright yellow gold interlamin-

ated with firm quartz or enveloping fragments of altered country rock. Loose nugget-like masses up to an ounce in weight have been found in soft crushed vein matter in the Reagan lease. The rich bunches of gold are not uniformly distributed through the veins, and it is difficult in some cases to secure clean sorting. It was found, for example, that material thrown over the Reagan dump as waste or as low-grade ore to be treated later carried small quartz stringers, and that some of these, when broken across, contained coarse native gold.

The tenor of the ores, as is to be expected, has a wide range. A mill run from the Reagan lease in August, 1908, averaged about \$130 per ton. Picked ore from the Fairview, Mazuma Hills, and Reagan mines has yielded at the rate of several thousand dollars per ton. In the Kindergarten mine the ratio of gold to silver by weight is said to vary from 1:2 to 1:3 near the surface, but at the bottom of the mine to be nearly 1:1. Assay certificates of rich ore from the Reagan lease, seen in Seven Troughs, showed a ratio of nearly 2 of gold to 1 of silver. At one place on the lower level of the Mazuma Hills mine quartz carrying a little chalcopyrite is reported to have yielded on assay 200 oz. of silver and 0.3 oz. of gold per ton.

The three important veins near Seven Troughs are the Mazuma Hills, Reagan, and Kindergarten veins. The first two, known only on the north side of the canyon, strike about N. 10° E. and dip from 60 to 65° W. The Reagan vein lies about 40 ft. east of the Mazuma Hills vein. The Kindergarten vein, on the south side of the canyon, strikes N. 63° E. and dips south. The dip varies from 60° near the surface to 22° on some parts of the 40-ft. level. The dip at the bottom level is about 35° (vertical depth 212 ft.). The stope length of the ore-shoot is about 130 ft., and the average workable width of ore is probably about 2. At the northeast end of the mine the vein appears to be cut off by a zone of north-south fissures in which no ore had been found at the time of visit.

The country rock varies from place to place in each mine. The Kindergarten and Wihuja workings, as seen in 1908, are mainly in basalt. Part of this is a soft altered amygdaloidal variety, evidently an extrusive rock. Other parts are a dense olivinitic variety that apparently cuts the amygdaloidal flow rock. Masses of soft light-colored rock, either rhyolite or mica andesite, but too decomposed as a rule for satisfactory determination, occur at unexpected places on both sides of the vein. They probably represent intrusions somewhat displaced by faulting.

The Mazuma Hills vein follows a basalt dike that varies in width from a fraction of an inch to more than 6 ft. The general country rock is a nearly white altered rock that the microscope shows to have been originally a highly glassy rhyolitic tuff or flow breccia. It is now devitrified into a fine-grained, obscurely crystalline aggregate and contains minute disseminated crystals of pyrite. The best ore is on the foot-wall or east side of the dike, and appears to be for the most part minutely fissured and silicified rhyolite tuff; but some ore extends into the basalt. At one place there is a second vein, about 10