CONSULTING ENGINEERS
CROCKER BUILDING SAN FRANCISCO, CAL.

REPORT ON SUMMERFIELD TUNGSTEN MINE

By

OSCAR H. HERSHEY.

The Summerfield tungsten mine is situated at an altitude of about 7200 feet, on the east slope of the Pilot Mountain Range, 23 miles by road easterly from Mina, Mineral County, Nevada. About September 1st, 1924, the Lezeart Coal Mine Syndicate secured a 5-year lease on the Gunmetal group (consisting of the Gunmetal, Gunmetal Nos. 1, 2 and 3, Summerfield Fraction and Summerfield Fraction Nos. 1 and 2 claims) from the owners, Messrs. S. M. Summerfield and Fritz Elges and two others. Mr. Walter X. Osborn is manager. There is also an option to purchase the Good Hope Nos. 1, 2 and 3, Isabela, Sol, Gun Metal Extension and Gun Metal Extension No. 1 claims for, I think, $35,000.00 and a stock interest. Mr. Osburn has expended about $27,000.00 in building roads, camp buildings and a mill. The last has an ore crusher,

ball mill and two Stebbins dry concentrators. It was recently started. If the ore is dry 40 tons may be put through in 24 hours, if damp but 30 tons. At present about 2.5% ore is being milled and when everything runs well Mr. Osborn thinks he makes a 75% saving and makes concentrate that carries 75% WO_3. There are no injurious elements present except a little more molybdenum than desirable. Mr. Osborn estimates the mining and milling costs with present plant at about $5.00 per ton and thinks that this could be cut to $3.50 per ton with air drills and a 100-ton mill. We made a little calculation as follows: 1% ore at $9.50 per unit WO_3 and 75% saving would yield $7.125 per ton. Making 75% concentrate the concentration would be 100 to 1 and the concentrate contain $712.50 per ton. On this he will pay $5.00 per ton hauling to Mina, $50.00 freight and 2% brokerage, a total of $69.25, leaving $643.25 on which he will pay 20% royalty. That leaves $514.60 from which he has to pay a mining and milling cost of $500.00 per ton of concentrate, leaving a profit of $0.146 per ton of ore. If the costs could be cut to $3.50 per ton with a 100-ton mill the profit would be $1.646 per ton. It is evident that 1% ore is a minimum to figure on. At present Osborn aims not to mill less than 2% ore and wants to keep it up near 3%.

I mapped the surface geology of an area about 1800 feet long and 800 to 1000 feet wide, covering the important showings on the Gunmetal group. Part

at 20-foot intervals. The scale of the map is 50 feet to the inch. This mapping determined the position and extent of the scheelite-bearing outcrops and, together with mapping of the formations in the tunnel and cross-cuts (which aggregate 850 feet) made the structure very clear. The main difficulty I had was in determining the average content of the different orebodies. To properly sample them would take two men a month. The only report I found at the mine was one made by Mr. E. W. Bedford under date of September 9th, 1919, but it was not accompanied by his maps and assay sheets. He says he took over 200 samples extending over the entire area at the surface, that they ranged from 0.2% to 6.0% WO_3 and averaged 1.3%. Mr. Osborn found a map that shows assays from many of the outcrops and for some distance in the tunnel. It has no name except that it was traced by King & Malone of Reno, Nevada. It has a date, January 14, 1918. These assays agree with what I would expect from my knowledge of similar scheelite-bearing deposits elsewhere in Nevada, and with Mr. Osborn's impressions as to distribution of values. I will base my conclusions on them. I think it is safe to say that the deposits are not richer than these assays indicate.

In the latter part of this report I will develop the probability that the ground under a 5-year lease contains ore as follows:

1.	270 tons	15% ore
2.	4090 "	3% "
3.	10000 "	2% "
4.	680 "	1.5% "

15,040 tons

The present mill can dispose of this tonnage in less than a year and a half.

There is also probable:

177,900 tons 1% ore.

This ore cannot be worked at a profit with the present plant. A 100-ton mill would crush it in about 5 years. If Mr. Osborn's figures are correct a profit of perhaps $1.60 per ton could be made on this ore, a total of $284,640.00, less cost of new plant. At best it does not appear a very promising proposition. When the position and shape of the orebodies are considered, I would not like to work 1% ore and expect to more than come out even. I would consider the most attractive feature a possible source for scheelite concentrate. 100 tons would yield a ton of 75% concentrate per day for 5 years. But there are plenty of other mines in the United States to produce it at the present price per unit, so that it would be better to purchase the concentrate in the open market than take chances on producing it here.

GENERAL GEOLOGY.

A thick series of limestone beds has been intruded by a small batholith of granite. The present surface appears to be near the original top of the granite and erosion has completely removed the limestone from over it in an area only about 800 feet square. The north and south contacts are probably steep but long arms of the granite project into the limestone toward the east and west. The suggestion is that the roof of the granite was corrugated along east-west lines, permitting roof pendants of limestone to project down into the granite troughs. The limestone was probably originally blue-gray in color, but in an extensive area the heat from the granite magma recrystallized it into a white marble. At certain places along the contacts the marble was altered to beds of garnet, epidote and other contact metamorphic silicates. For convenience I will refer to all this material as garnet rock. Irregularly disseminated through it are small grains of white scheelite causing the WO_3 content to vary from a trace to several percent. The bodies rich in coarse garnet are usually low in scheelite. Where the contact rock consists largely of greenish silicates the scheelite is more abundant and in a few small bodies occurs in crystals up to a half inch or more in diameter, making 15 to 20% ore. Such ore is here considered "high grade."

Where contacts are straight and steep there is usually little or no garnet rock. The roof pendants were favorable sites for the formation of garnet bodies,

hence long narrow strips of them occur in an area about 300 feet wide and 700 feet long. The garnet bodies were formed only in certain beds of the limestone series. Thick beds of relatively pure marble were favorable. Thin beds of siliceous and in part shaly limestone rarely formed garnet rock. Hence, the garnet bodies dip with the beds and may be called garnet beds. This is especially clear on the north contact. Along certain beds the garnet rock extends from the contact from 20 to 100 feet, and the contact at the intervening beds is essentially barren. The beds on the north side of the granite dip westward 10° to 30°, usually 15° to 20°. Hence, a given orebody dips in that direction. In order to estimate the probable tonnage of an orebody, it is necessary to make a longitudinal section along the line of the tunnel and treat the ore as a chimney inclined at a low angle. The exposures at the surface and in the tunnel warrant this. I am afraid Bedford did not realize this and it has led him to much exageration as to the tonnage above the tunnel level.

Another complication arises from the presence of two important faults. They meet near the mouth of the tunnel but diverge westward. In some sections they dip steeply north, in others steeply south, but the net result is steep north dips. They are accompanied, where in the granite, by long narrow belts in which the granite has been altered to a nearly white material underground which outcrops with a reddish stain. It is claimed that this material in places carries a little scheelite, but only in one place could ore be

pointed out in the altered granite, a small pocket of 15% ore, evidently an inclusion. The tunnel largely follows the north fault, which in places evidently corresponds closely to the original contact and in others runs in the granite or in the limestone. However, careful mapping makes the relations clear and this fault should not in the long run figure very strongly in the operation of the mine.

DETAILS OF OREBODIES.

The most important orebody outcrops at the mouth of the tunnel in an area 65 to 100 feet long and 50 to 60 feet wide. It is due to the fact that the garnet rock has been formed in a heavy bed of limestone to a distance of 50 to 60 feet from the contact. The bottom of the bed reaches the floor of the two branches of the main tunnel 30 feet from their portals. It extends along the north side of the tunnel to the 10-foot winze, a distance of 200 feet. In a longitudinal section it is evident that it is a bed 75 feet thick. It is probable that the garnet rock extends along this bed at least to where, the surface indicates, a broad arm of granite extends north. A comparison of the surface and the tunnel level indicates that this arm of granite does not dip eastward. Hence, I feel warranted in carrying the garnet beds to a line drawn from the present end of the tunnel. The garnet body under consideration would have dimentions of 50 x 75 x 475 feet and contain (using

11 cubic feet per ton) 161,931 tons. Most of this would be below the tunnel level and the lowest point under the end of the tunnel would be 175 feet.

The first 110 feet of the tunnel follows a zone of sheeting in the garnet rock from 1 to 4 feet thick, most of which lies against the north fault, here dipping northward 70° to 80°. This zone seems to be richer in scheelite than most of the garnet rock. Even after the sheeting has disappeared the hard garnet rock against the fault is abnormally rich in a zone several feet wide. The assay map before mentioned has a series of assays along this belt running from the mouth to the north cross-cut as follows:

1.	1.5%
2.	1.5%
3.	2.0%
4.	1.2%
5.	1.5%
6.	1.25%
7.	1.00%
8.	2.5%
9.	2.7%
10.	0.7%
11.	1.5%
12.	2.5%
13.	2.0%
14.	2.8%
15.	2.8%
16.	2.5%
17.	2.0%
18.	1.5%
19.	--
20.	2.0%
21.	2.0%
22.	2.5%
23.	3.0%
24.	2.0%
25.	2.4%
Average	1.97% - say 2.0%

The assay map does not indicate the average width sampled but the abnormally rich band may average

3 feet thick. Using our longitudinal section we find that there may be a shoot of 2% ore 50 x 3 x 500 feet or 6818 tons. Nearly all of this must be below the tunnel level. I am assuming that the 2% streak will continue down as far as the garnet bed probably does. It is not ore in sight. Very little ore in the property can be considered in reserve or developed as the terms are usually used. What I am determining is probable ore.

According to Mr. Osborn the raise started up on 4 to 5 feet of 3% ore along the south border of the garnet bed. This ore extended about 12 feet above the roof of the tunnel and then a low-dipping bed of limestone cut it off. This bed reaches the floor of the tunnel about 35 feet beyond the raise, but a 10-foot winze developed the "rich" streak. By sorting ore from the drift, raise and winze 21 tons of ore were secured, milled at the Toulon mill and yielded 8% WO_3. Mr. Osborn has begun driving near the top of the garnet bed. He says that from the raise to the winze 4 feet width will average 3%. I will extend the 3% ore back to the 2% section considered above and assume that it extends up and down as far as the garnet bed probably does. We will then have 25 x 4 x 450 feet or 4090 tons of 3% ore. That leaves 151,023 tons of the garnet bed. This probably averages 1%. That is Mr. Osborn's opinion and I think the evidence fairly supports it. One branch of the tunnel is largely in it and pans 1% to 1.25% per Osborn. A cross-cut runs 50 feet north mostly in the garnet rock. Bedford says 34 feet averages 1.4% WO_3. Four samples ran

1.5%, 1.5%, 1.8% and 1.9%. Osborn says much of it assays 1.25%. On the whole I think 1% may be accepted without much question.

From the winze west the contact is barren for 110 feet. Then a small bed of garnet rock appears, dipping west about 25°. At the face of the west drift from the 110-crosscut there is a 4-foot garnet bed that is now being mined and carries better than 2% per Osborn. Where it appears in the 112 cross-cut there are bunches fair-grade ore and I will concede that the whole may average 2%. From a study of the longitudinal section I will concede the probability of a chimney of 2% ore 30 x 4 x 300 feet or 3272 tons.

Immediately under the above beds there is an east-west streak of ore 20 feet long, 6 to 12 inches wide, some of which is 15 to 20% ore. This represents the recent "rich strike". Suppose I concede 6 inches of 15% ore, extending 300 feet up and down there will be but 272 tons.

A short distance farther west in the tunnel there is a bed of garnet rock that dips westward 15°, is 15 feet thick, has been driven in for 15 feet and according to Mr. Osborn is 1% ore. At the surface it is 25 feet in length and three assays that were probably made on samples taken from it are 1.0%, 1.7% and 1.5% WO_3. I will concede the probability of a shoot 25 x 15 x 350 feet or 11,931 tons of 1% ore. More than half of this will be above the tunnel level.

The remainder of the tunnel shows barren limestone dipping west 15°.

Near the 7340-foot contour there are two beds of garnet rock that extend 35 feet north from the north fault and assays of 0.8% and 1.0% may refer to them but the data are too meager to base an estimate upon. Garnet bodies farther west along the north contact seem to be very low-grade. A triangular body in the angle between the main granite belt and the north arm already mentioned yielded assays of trace, trace, trace, 0.1%, 0.1% and trace, which proves that some of the garnet rock is certainly not ore under any conditions. A narrow band of garnet rock follows the east border of the granite arm. Three samples ran 0.5%, 0.5% and 0.4%.

The garnet rock in the roof pendants appears to be of better grade. About 250 feet west of a point over the face of the tunnel there is a shallow shaft in garnet rock that is about 150 feet long and 1 to 20 feet wide. Five samples that were taken in the shaft assayed 0.6%, 1.0%, 1.0%, 1.5% and 1.5%, averaging 1.1%. The shaft was probably sunk at the richest point and as this is coarse garnet rock I am not inclined to consider it 1.0% ore. Osborn agrees with me. A short distance farther down the slope there is a coarse garnet body 175 feet long and 5 to 30 feet wide. Assays near the west end ran 0.5% 0.25%, 0.8%, 0.5% and 2.5%, and towards the east five samples ran a trace only. This body is evidently non-commercial except for one small pocket of 2.5% ore.

About 100 feet farther south the south fault is accompanied by garnet rock 325 feet long and 5 to 25 feet wide, averaging probably 15 feet. Assays

ran 0.8%, 1.0%, 1.0%, 1.25%, 1.5%, 1.0%, 2.0% and 0.4%. As these average 1.1% I doubt that the body will average 1% ore, for I think these surface assays slightly exaggerate the values of the ore. A smaller body has a cut at which a 2.5% assay was secured, but the body is too small to be worth figuring on.

The 30-foot shaft is on a band of contact rock that runs northwest between two garnet belts. It appears to be 75 feet long, 1 to 5 feet thick and dips northeast 70°. Bedford says the ore in the shaft averages 1.7% and that assays of 6.0% were secured at 22 feet depth. I will concede the probability of 50 x 3 x 50 feet or 681 tons of 1.5% ore. A cross-cut from the tunnel was driven 175 feet toward this shaft and would nearly reach a point under it in another 100 feet. The cross-cut would be about 50 feet below the bottom of the shaft. The ore may not extend that deep.

Northwest from the shaft there is a band of garnet rock 300 feet long and 2 to 10 feet wide. Assays on the eastern portion ran 1.5%, 1.0%, 0.6%, 0.8%, 1.0%, 0.9% and 1.0%, averaging 0.97%. I am not inclined to consider it ore. I agree with Mr. Osborn that the surface samples were probably taken at cuts and other unusually favorable places and that the garnet rock as mined would not come up to the average of the samples. The 175-foot cross-cut from the tunnel has passed under this last described garnet band and is in granite to the face. This preves that the garnet bodies in the roof pendants cannot be depended upon to go deep. The granite probably underlies all the limestone-garnet central areas at relatively shallow depths.

South of the 30-foot shaft there is a belt extending east-west 300 feet and 30 to 75 feet wide in which coarse garnet rock is strongly developed. The beds dip northward 10° to 15°. Taking this into account and constructing cross-sections it appears that one may count only on an average depth of 15 feet and average width of 40 feet, making 16,363 tons. Assays in the eastern portion of this area ran 1.0%, 1.5%, 1.2%, 1.4%, 1.0%, 1.2%, 1.6%, 1.6%, 1.7%, 1.8%, 2.0%, 1.5%, and 1.0%, an average of 1.4%. This I am inclined to think is a body of 1.0% ore. It could be quarried on the surface and hauled to the mill or the 175-foot cross-cut could be driven under it and a raise put up to the quarry. There may be lower beds of ore under the one I recognize but the granite is evidently not far below the surface and arms of it penetrate the ore.

I did not examine the Good Hope group in detail as I understood the showings on it are limited. At one place Mr. Osborn called my attention to the outcrop of what he considers 4.0% ore, but it seems to be a chimney of very limited extent. My impression is that the value of the Good Hope group is dependent largely upon what is done with the Gunmetal group. The owners of that group might want to add the Good Hope group to make a large property but I see no reason why the Lezeart Coal Mine Syndicate should purchase it.

I will summarize the preceding estimates of probable ore in the Gunmetal group into the following table, generalizing the figures somewhat:

1. 50 x 3 x 300 feet	= 6800 tons	2% ore	=	$129,200.00
2. 25 x 4 x 450 "	= 4090 "	3% "	=	116,565.00
3. 47 x 75 x 475 "	=150,000 "	1% "	=	1,425,000.00
4. 30 x 4 x 300 "	= 3,200 "	2% "	=	60,800.00
5. 20 x .5 x 300 "	= 270 "	15% "	=	38,475.00
6. 25 x 15 x 350 "	= 11,900 "	1% "	=	113,050.00
7. 50 x 3 x 50 "	= 680 "	1.5% "	=	9,690.00
8. 40 x 15 x 300 "	= 16,000 "	1% "	=	152,000.00
	192,940 tons			$2,044,780.00

Respectfully submitted,

(SIGNED) OSCAR H. HERSHEY

San Francisco, Calif.,
February 6, 1925.