Geology of the National Mining District, Nevada

By Waldemar Lindgren.*

During a brief reconnoissance in this vicinity, undertaken for the U. S. Geological Survey, the various formations and mineral deposits have been investigated. In view of the widespread interest in the National camp, remarkable on account of the extremely rich character of the ore in its principal mine, some of the conclusions arrived at are made public, with the proviso that they are preliminary and need to be substantiated by further study of the rocks in the laboratory.

The northern end of the Santa Rosa range, from the Oregon line for almost 16 miles south to Canyon creek, is made up of a succession of basalt flows, interbedded with tuffs. Some of these flows are scoriaceous, others massive; they are well exposed north of Eight-Mile creek, where the whole series, over 2000 ft. in thickness, dips east at gentle angles. They form part of the great volcanic area of the Columbia river lavas and extend far to the north, east and west of National. They were erupted in early Tertiary time, a time of intense volcanic activity all over the Cordilleran region. The interbedded tuffs, volcanic muds and sandstones of volcanic origin are well shown in several cuts and tunnels near National.

At one time during this great epoch of volcanism the character of the lavas changed. Instead of black basalts, light-colored and siliceous rhyolites were for a time the lavas which poured out of the volcanic vents. The thickest of these flows now forms Buckskin mountain, which has an elevation of 8700 ft. At the same time dikes and masses of rhyolite and obsidian (volcanic glass), generally trending north and south, forced their way up through the basalts and tuff beds, in places disturbing them greatly; big blocks of basalt are sometimes imbedded in the rhyolite. Such rhyolite intrusions are the dikes on Radiator and Auto hills and the great mass, which extends for a couple of miles from the ridge overlooking Three-Mile creek, occupies the west side of Charleston hill and reaches nearly to Eight-Mile creek.

A third and latest intrusion is that occupying the northern end of Charleston hill above the National mine. This dark, fine-grained rock, which is of importance because of the ore bodies in it, may provisionally be called an andesite.

After the eruption of rhyolite and andesite followed the formation of the mineral veins. But there is also reason to believe that volcanic action continued after this and that the rhyolite, except possibly in its highest point, became covered with successive flows of basalt, such as are exposed to the east of Buckskin peak. The basalts are thin-flowing lavas and easily spread out in even sheets, while the rhyolites are thick and viscous, and are apt to pile up in heavy masses like the flows of Buckskin peak.

Basalt dikes may in fact be found, cutting those of rhyolites, and showing that the volcanic activity was complete and long continued.

Shortly after the eruptions of rhyolite and andesite, fissures were opened trending north and south, mainly along the dikes, sometimes also breaking into the basalt flows and the tuffs. The fissures are generally small, rarely over a few feet in width, and commonly much less. The fissure filling is mainly quartz, with drusy structure, and the characteristic combination of metals is antimony (as stibnite or sulphide of antimony), iron (as pyrite or marcasite), gold and silver. Lead, copper and zinc are generally absent. Cinnabar has been observed at a few places. The veins throughout bear evidence of having been deposited by hot, ascending springs at a moderate depth below the surface.

The majority of the veins are clearly dependent upon the rhyolite eruptions; they sometimes carry considerable amount of stibnite, and the silver values usually prevail over those of gold. Thus far none of them has yielded any considerable amount of shipping ore.

The case of the National vein is somewhat different. It is as stated mainly contained in an andesite rock, but it also cuts into basalt and rhyolite. Though its ore yields some antimony (both as stibnite and ruby silver), the quartz is distinctly different from that of other veins, being more massive and milky and less drusy. There is in fact some reason to believe that its mineralization took place a little later than that of the veins following the rhyolite dikes.

This quartz vein, of very moderate thickness, contains along a well-defined shoot a most remarkably rich bonanza ore, consisting of coarse and hackly pale gold (possibly electrum) firmly imbedded in the white quartz. An interesting characteristic is that within the bonanza shoot, rich and barren quartz may intermingle capriciously. The gold is not a secondary deposit; in fact, there is scarcely any evi-

Sectional Map of Nevada, Showing Location of National.

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dence at all of such secondary solution and redeposition of the gold by descending surface waters, while there is evidence that some of the silver has been leached by surface waters and redeposited as ruby silver. There is also some secondary marcasite. The shoot has been followed for a distance along the dip of the vein of about 800 ft., the lowest level being opened by a crosscut from Charleston gulch. The production of this extraordinary bonanza since its discovery two years ago is said to have been no less than $2,000,000, mainly in gold. Most of the ore had a tenor of from $10 to $40 per pound. Some high silver values were found at the surface, but the apex of the gold shoot was not encountered until about 60 ft. below the surface. No placers have been found in Charleston gulch or in Eight-Mile creek, in spite of the fact that a great deal of rock has been removed by erosion. Hence it is probable that this gold shoot never reached the surface, and that no other of a similar nature existed within the rock volume carried away by erosion. The almost inevitable conclusion is that such shoots must be scarce below the present surface.

Transvaal Steel and Coke Prospects.

By Rowland Gascoyne.

For many years it has been known that there exists in the Transvaal some extensive deposits of iron ore, especially in the northern part of the Province. Generally speaking, however, these huge deposits contain deleterious elements rendering them of little value and difficult to smelt. There are, however, other deposits of iron ore carrying as high as 90% of iron oxide with silica as the next most prominent constituent, absolutely free from titanic and other deleterious compounds. These deposits occur at the surface, are of unproved thickness and seem to consist of transformed coal measure sandstones, the transformation from sandstone into iron ore having been apparently caused by the sandstones becoming leached from the neighboring lava flows.

The extent of these iron deposits has not been ascertained but, generally speaking, iron ores of various grades and kinds abound in some localities of the Transvaal. A short time ago the Government called in an expert to examine these deposits and report generally upon the economic possibilities of starting an iron and steel industry in the Transvaal. The report was published some 18 months ago and was generally adverse to any step being taken to utilize these iron ores at present. The report pointed out that the local manufacture of scrap into steel was an industry that could well be started in the Transvaal and the necessary steps for commencing this industry are being taken in hand principally by Sheffield people, the company having been registered for that purpose in England several months ago.

At the time these iron and steel prospects were being investigated the possi- ing a coke suitable for metallurgical purposes was also inquired into, and as this is a question of which a great deal has been said in the Transvaal a brief review of the results obtained from the tests made regarding the coking properties of Transvaal coals may not be without interest.

Of course in the Transvaal coke has been used for many years at the mines, more particularly for assaying purposes, but the total consumption of imported coke by the mines is less than 2000 tons per year, for which about £7 per ton is obtained. Coke of an inferior quality has been made for years in the Transvaal and a somewhat better quality has lately been produced from Natal coal, the mines using more local than imported coke, for which about half the price of the imported article is charged. Outside the mines there is little coke consumed but of late coke breeze has been manufactured as a by-product for use in suction gas plants. The only real market likely to arise in the Transvaal for coke is in connection with an iron and steel industry and, to a less extent, with tin and copper smelting. It was in connection with making a suitable coke for smelting purposes from local coal that the coal seams were examined and tests on a satisfactory scale conducted.

The coke hitherto made in the Transvaal has been produced principally from lump or round coal, being charged into rectangular-shaped brick ovens, and fired until most of the volatile matter was driven off. The time required varied from 36 to 48 hours. The coke thus produced retained the laminar structure of the coal and when the coal was well selected the appearance of the coke was fairly satisfactory. Its ash content was somewhat high, never less than 10%, but the best was nearly as good as many of the German imported cokes sold locally as Durham and, for the limited smelting work done in the Transvaal, the local coke gave satisfaction.

The recent tests with regard to the coking qualities of Transvaal coal were conducted at Middelsborough, England, the preliminary work in connection therewith being under the supervision of the local Mines Department, Mr. Harbord, the expert called in to report upon the steel and iron prospects of the Transvaal, also taking the coke question in hand in England. The preliminary steps taken were to test by analysis 17 different samples of coal, voluntarily sent in for that purpose from 14 different collieries in various parts of the Transvaal and Orange Free State.

The next step taken was to select those samples of coal giving promise by analysis and preliminary tests of producing a satisfactory coke for transmission to England, where Mr. Harbord made the necessary arrangements with Messrs. Bell Bros. of Middlesborough, Yorkshire, to have the 10-ton samples tested. The selection was made by the Transvaal Government mining engineer from the following collieries: Coronation, Oogies, Tavistock, Premier, African Freehold Coal Lands and Spitzkop, all in the Middelburg district except the last named which is a small colliery in the Ermelo district.

The coke from Coronation, Oogies and Tavistock collieries was the best but was of second-rate quality. The coke from Premier coal was too high in ash while that from the African Freehold coal lands and Spitzkop was too inferior in quality to be of value for any purpose.

Taking the individual cokes produced Mr. Harbord reports as follows: The ash in the Coronation coke is high compared with high-class English coke but it compares very well as regards composition and physical properties with second-class coke used in some blast furnaces and foundries. If the coal was finely ground and compressed perhaps a harder quality might be produced, for many purposes this would be a gain in coke as in several instances in England coke of no better quality is used. The Oogies coke was very similar to that made from the Coronation coal in both physical properties and composition. From Tavistock coal the coke was quite good but as the band of coal from which it was supplied was only 7 ins. thick the value of the coke as a commercial proposition is doubtful. Similar objections may be raised to the Premier coke which was obtained from a coal band only 5 ft. thick. The high percentage of ash contained in this coke makes it unsuitable for a good many purposes. With regard to the coals produced by the African Freehold Coal Lands and Spitzkop colliery neither are suited for the manufacture of coke and may be dismissed from further consideration.

Taking the cokes as a whole, those from Coronation, Oogies and Tavistock collieries may be considered as suitable to be used for blast-furnace and foundry purposes. They may be regarded as fairly strong cokes, but not so dense and hard as English cokes, but if the coals were finely ground and compressed before being put into the ovens, the coke in this respect may be considerably improved. None of the coals have produced a first-class furnace coke, but the best samples may be regarded as making good second quality cokes, capable of being used in suitable blast furnaces. A coke of better quality is not ar-

Cementing Materials.—The [illegible] material of quartzite is silica, which in filtrating, has enveloped the [illegible] grains of the sandstone and [illegible] into a solid dense quartzose [illegible] quartz of granite is not of this [illegible] ter, but occurs as separate [illegible] grains, the feldspar, mica and [illegible] minerals making up the remainder of the rock mass. Sometimes [illegible] to have been silicified in the [illegible] vein, or perhaps constituting [illegible] of the vein itself. In some [illegible] there has generally been [illegible] amount of replacement, the [illegible] mica and hornblende having [illegible] moved and quartz having taken [illegible] place.

The Rand output in September [illegible] 700,625 fine ozs. of gold, valued [illegible] 976,065.