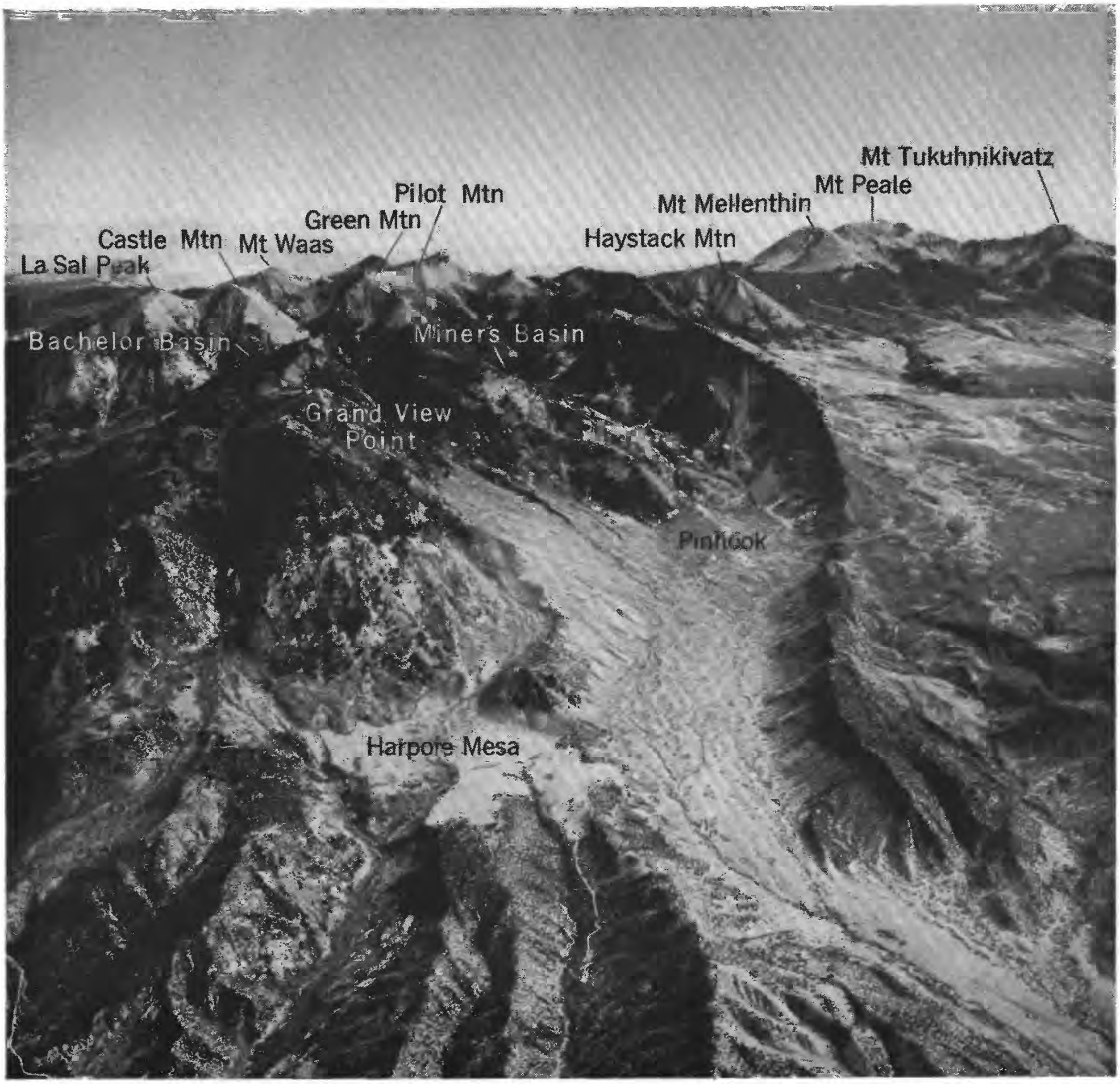


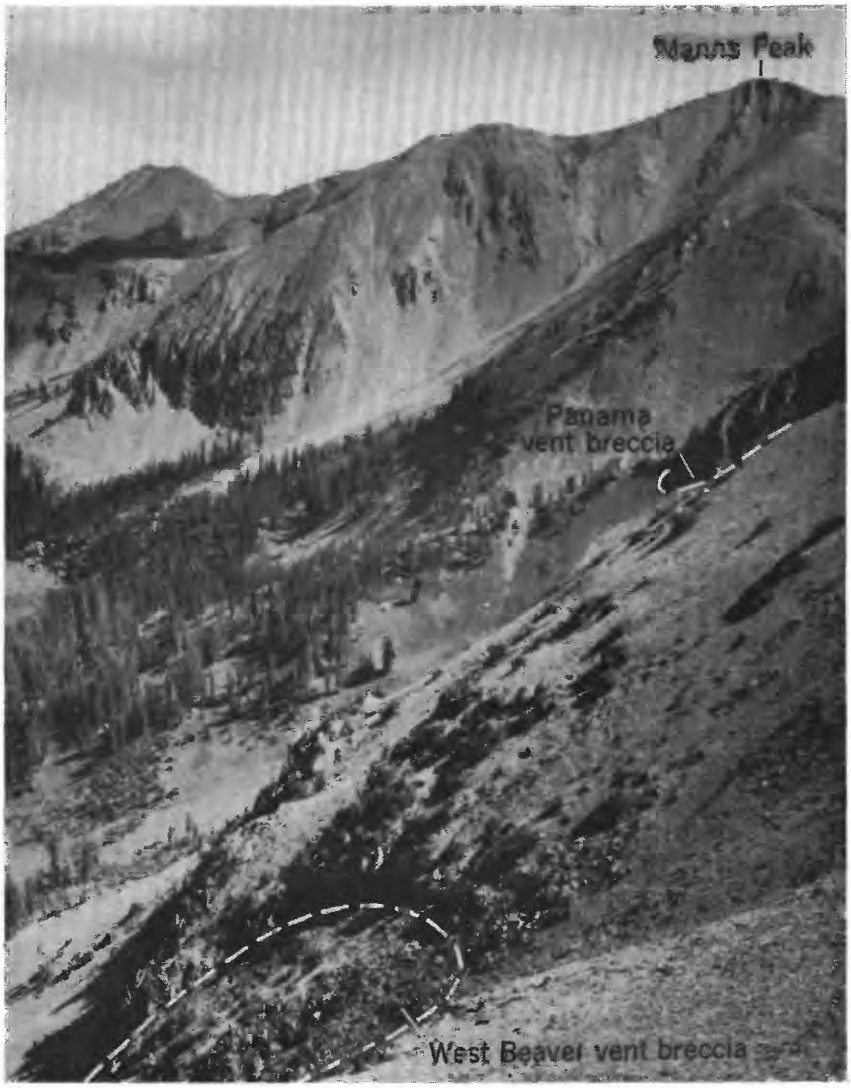
AERIAL VIEW OF NORTH AND MIDDLE MOUNTAINS

View is southeast. Hogback to right of Pinhook is sandstone of Glen Canyon group. The same sandstone dips northeast off Grand View Point, is offset by a fault in Bachelor Basin, and flanks the northeast side of La Sal Peak. Harpole Mesa is underlain by the conglomerate of Pliocene(?) age in Castle Valley. Mounts Tukuhnikivatz, Peale, and Mellenthin in Middle Mountain are laccolithic masses radiating from the stock which is in the basin between the three peaks.

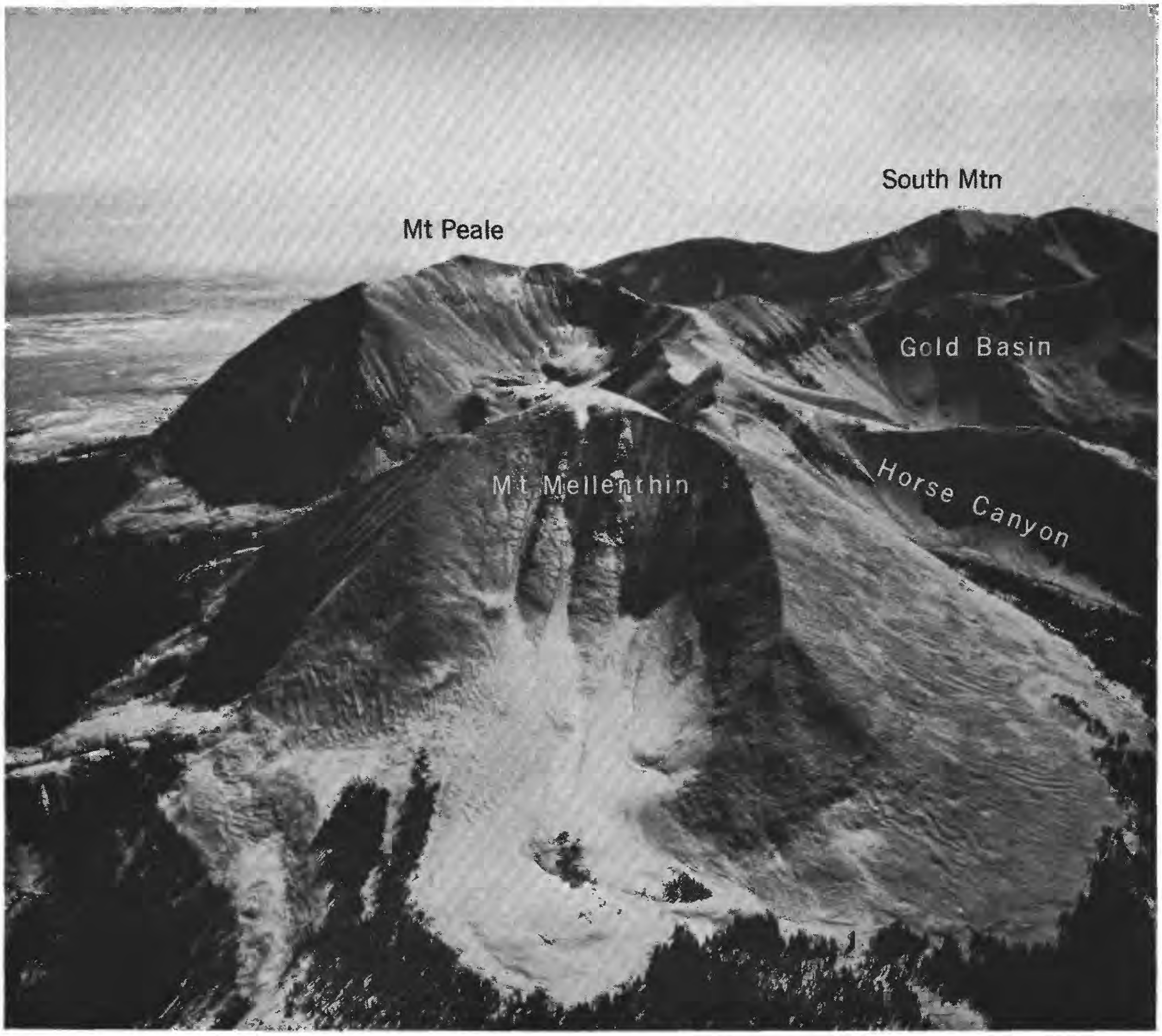
A. Northwest edge. Vertical contact between vent breccia (left) and porphyries of the dike-swarm complex.

B. East side. The crags are breccia containing concentric outward-dipping sheets of aphanitic lavalike rocks. The east edge of the breccia is at the base of the crags. The northeast edge is on the gully at the right.

GREEN MOUNTAIN VENT BRECCIA



VIEW NORTHWEST ALONG THE VERTICALLY SHEETED JOINTS IN THE SOUTH PART OF BEAVER BASIN



AERIAL VIEW OF MIDDLE MOUNTAIN

The stock is in Gold Basin. Mount Peale is capped with the Morrison formation but is underlain by porphyry in a laccolith injected southeast from the stock. Mount Mellenthin consists of two laccoliths injected northeast from the stock.

11. The upward surging fluids change the course of differentiation. The stock and its volcanic orifices are now a long gaseous diffusion column. The streaming fluids carry upward large quantities of silica, perhaps released in part by alteration of already solidified minerals by the streaming gases. This rising silica-rich fluid mixes with and transforms the residual syenitic liquor into a quartz-rich soda rhyolite porphyry, parts of which explode violently to the surface, other parts of which solidify in and adjacent to the roots of the volcanic diatremes as quartz-rich miarolitic soda rhyolite porphyry.
12. Crystallization of magma is completed, but gases continue to rise for a while through the hot solidified rock producing pneumatolytic and hydrothermal effects such as sericitization, chloritization, and deposition of ore minerals.

ECONOMIC GEOLOGY

GENERAL

Mineral deposits in the La Sal Mountains area are of three principal kinds: deposits of metals, mostly hydrothermal, in and amongst the intrusions; gold placer deposits at the base of the mountains; bedded deposits of uranium–vanadium and of manganese in the sedimentary formations around the mountains.

The uranium–vanadium deposits in this general region are mostly in the Morrison formation and Shinarump conglomerate. They have been described by Fischer and others (Fischer, 1937, 1943; Fischer and Hilpert, 1952). Manganese oxide occurs in sandstone of the Morrison formation at the northwest edge of Bald Mesa, in the SE¼ sec. 18, T. 26 S., R. 24 E. (Baker, Duncan, and Hunt, 1952, p. 127). These bedded deposits occurring in the sedimentary rocks were given little attention during the study represented by this report and will not be further considered here.

PLACER DEPOSITS

Gold-bearing gravel deposits have been prospected at several places on Bald Mesa and farther west on Wilson Mesa, and along Placer Creek.

The deposits along Placer Creek are bouldery glacial outwash and moraine, are little weathered, are in the bottom of Placer Creek, and are probably of Wisconsin age. A moraine in Placer Creek east of Pinhook is said to have been prospected by an adit that was driven inward nearly 1,000 feet without reaching the bedrock floor of the moraine. This adit is caved.

The gravel in the deposits on Bald and Wilson Mesas range from ½ inch to 2½ feet in diameter. They are deeply weathered, are high above the present streams draining the mountain, and must be pre-Wisconsin in age. These gravels, like those along Placer Creek, contain pebbles of soda syenite and other feldspathoidal rocks, metadiorite veined with actinolite and hedenbergite, and amethystine quartz and must have been derived from the central part of North Mountain. Thus, the deposits on Bald and Wilson Mesas not only are high above the present drainage, they now are separated from their source by a high ridge.

According to Hill (1913, p. 114):

> The gold, said to be worth from $19 to $20 an ounce, occurs in small wires or flakes, and none of that seen appeared to be much waterworn. It is distributed throughout the thickness of the deposits, which are said to be of about the same grade from the surface to bedrock. Besides the gold that can be recovered by washing, it has been found that the * * * porphyry cut by quartz stringers * * * contains a fairly large portion of the gold value of the gravels. Some of the miners assert that for every ounce saved by sluicing 10 ounces is lost in the * * * rock which goes over the dump.

The deeply weathered pre-Wisconsin gravel deposits on the tops of the mesas should offer more promise for prospecting than the comparatively unweathered gravel deposits of Wisconsin age along the present stream courses. The weathering could be expected to increase the percentage of fines and thereby free some gold from its matrix. Weathering of sulfides could be expected to free some gold from the sulfide minerals. The suggested importance of the weathering also is strengthened by the fact that the gold in the weathered gravels, as quoted above, occurs in wires and flakes and does not appear to be waterworn, and that it seems to be as abundant in the upper part of the gravel deposit as in the lower. However, water for sluicing would be difficult to obtain on the mesa tops.

Weathered gravel similar to that on Bald Mesa occurs on the benches along Beaver Creek at the northeast foot of North Mountain. These gravels were derived from Beaver Basin and should be as promising for prospecting as those on Wilson Mesa.

The occurrence of gold in these placer deposits encourages the hope that commercial deposits of gold may occur in the central part of North Mountain—the area in and adjoining the stock—for it is the gravels from this area which have yielded the best shows of gold in the placers.

METALLIFEROUS DEPOSITS IN THE INTRUSIONS

The evidence at hand strongly suggests that the content of copper, lead, zinc, selenium, and presumably gold in the intrusions is a function of the degree and kind of hydrothermal alteration (p. 338), but the radioactivity seems to be of magmatic rather than pneumatolytic origin (p. 338).

The radioactivity is greatest in the youngest intrusions, which are potash rich. These intrusions are mostly in the stock in North Mountain but include some of the feldspathoidal dikes that radiate from that stock. There is no evidence to suggest whether the materials responsible for the radioactivity of the stock are disseminated throughout the syenitic intrusions or are locally concentrated.

The other metals are most abundant in the zones of vertically sheeted joints that radiate from the North La Sal stock, especially in the pyritic and (or) quartzic facies, and in fissures in the stock. Although the deposits contain some silver and a little copper, their chief value probably is in their content of gold—which is thought to be mostly in the pyrite from which it is freed on oxidation. The tendency in prospecting thus far has been to drive crosscuts or drifts under the exposed parts of promising fissures or fissured zones, but some of the oxidized upper parts of the fissures or fissured zones might contain enough free gold to warrant development.

MINE DESCRIPTIONS

DILLON ADIT

The Dillon adit (pl. 45*B*) is at the west foot of Mineral Mountain at an altitude of almost 10,000 feet. A steep but satisfactory road has been built by the Fowler Mines from Pinhook to the portal in Miners Basin. The adit, about 1,200 feet long, is by far the largest adit in the La Sal Mountains. It is a drift along one or more zones of fissuring in the west edge of the North La Sal stock.

Judging by outcrops just south of the portal, the adit begins in sheared and pyritized diorite porphyry, but somewhere along the timbered area in from the portal, the adit enters pyritized shale beds, probably belonging to the Paradox member of the Hermosa formation. These beds are overturned so that they dip east towards the stock; they are cut by at least one reverse fault.

Two hundred feet from the portal, the adit enters metadiorite of the North La Sal stock. From here on to the breast, the adit drifts along shear zones in the porphyry. For 200 feet back from the breast, the adit exposes considerable masses of Precambrian rocks. These are plastic and claylike; large quantities of water seep from the roof in this part of the adit. Numerous small blocks of Precambrian rocks show along the walls of the drift in the metadiorite in the central part of the adit.

According to reports, the shale beds near the portal contain nonauriferous pyrite, but gold-bearing pyrite occurs in the wall rocks of the adit in the metadiorite. In the sheared roof is much iron oxide, evidently due to oxidation of pyrite, and gold has been found in this oxidized rock. Some fissures are stained with copper carbonate. Quartz veins and calcite veins are not abundant.

During the fieldwork it was determined that a Geiger counter would become contaminated, apparently by radon, when taken into the Dillon tunnel. On May 1, 1952, Henry Faul, Arthur Sakakura, and I visited the adit to obtain samples of the mine gas and to test for radon. The mine had been inactive through the winter and the portal was sealed with snow. Mine air samples were taken in glass containers of two sizes, 100 and 500 cubic centimeters. A portable field laboratory was set up at Moab, Utah, and the containers were evacuated there and carried to the mine.

In the laboratory the gas samples were transferred from the bottles by expansion and flushing with nitrogen into evacuated ionization chambers of 4-liter capacity. The radon content was determined by Henry Faul. The test consisted of measuring the total equilibrium intensity of electron- and negative-ion flow in the saturated chambers with a vibrating-reed electrometer. This intensity was compared with that obtained from an amount of radon derived from a reference solution prepared and calibrated by the National Bureau of Standards.

The mean radon content of air in the Dillon tunnel was found to be about 5,000 micromicrocuries per liter at mine temperature (34°F) and pressure.

A sample of water, collected at the portal, was found to contain about 625 micromicrocuries of radon per liter.

M. I. F. ADIT

The M. I. F. adit (pl. 45*C*), located on the west side of Mineral Mountain at an altitude of about 10,400 feet, is reached by trail from the portal of the Dillon adit. The M. I. F. adit is a 300-foot drift along a shear zone in metadiorite at the west edge of the North La Sal stock, probably the same zone of fissuring as in the Dillon adit but 400 feet higher.

The walls of the adit are brecciated and hydrothermally altered metadiorite, much of which is finely veined with actinolite and (or) hedenbergite.

Between 50 and about 100 feet in from the portal, the fissured zone of pyritized and brecciated metadiorite is about as wide as the adit. From 100 to 150 feet the shear zone is only an inch wide, or at most a very few inches wide, but it is wide most of the way from the bend 150 feet from the portal to the breast. Fifteen feet from the breast, however, the shear zone is interrupted by a rib of firm, only slightly altered metadiorite. The rib ends at a vertical shear plane, with vertical slickensides.

The metadiorite is thoroughly stained with iron oxide, some of which occurs in cubes. This evidently is an oxidized pyritic zone. Where the metadiorite is widely sheared, gold can be panned from the crushed rock.

HIGH ORE ADIT

The High Ore adit (pl. 45*D*) is on the east side of Mineral Mountain, in the High Ore Basin, at an altitude of 10,900 feet. It is reached by trail from Miners Basin. The mine consists of two principal drifts along mineralized fissures at the east edge of the soda syenite porphyry on Mineral Mountain. The north drift extends about 150 feet along the footwall of a fissure in syenitized metadiorite. The hanging wall side of the fissure forms the north wall of the drift and dips between 70° and 90° N. The footwall is crossed by three principal sets of fissures. One set trending N. 50° W. is tight. The other two sets, one trending N. 10° E. and the other trending N. 40° E., commonly contain thin veins, less than an inch wide, of quartz stained with copper carbonate. Most of these joints end against the hanging wall, but one that cuts the hanging wall is 2 feet wide.

At the portal and at the breast, the main fissure zone is 2 to 3 feet wide and consists of gouge stained with copper carbonate and lenticular openings lined with comb quartz. No doubt the openings were filled with clay gouge.

A branch of the main fissure trends south of west and has been explored by a drift about 100 feet long. Where the drift crosses the contact between the metadiorite and soda syenite porphyry the fissuring becomes tight and the copper carbonate staining ends. At the breast the soda syenite is fissured and stained with iron oxide in a zone about 3 feet wide.

The minerals observed in the main fissured zones in the High Ore mine include quartz, calcite, fluorite, chalcopyrite, pyrite, malachite, azurite, chrysocolla, hematite, limonite, goethite, and chalcedony. The wall rocks contain veins of hedenbergite and (or) actinolite. According to Hill (1913, p. 113), 7 tons of ore from the north vein is said to have brought $54 a ton in copper, silver, and gold.

A Geiger-counter traverse of the workings showed little or no radioactivity in the metadiorite. In the part of the south drift that is in the soda syenite porphyry the Geiger counter showed counts two to three times higher than background at the portal.

DEWEY ADIT

The Dewey adit (pl. 45*A*), in Golden Sceptre Gulch at an altitude of 11,400 feet, is reached by trail from the head of McCormick Park which in turn is accessible by jeep. The adit, which extends slightly more than 500 feet N. 85° E., follows a fissured zone that cuts across the dike-swarm complex. This zone is crossed by a set of joints that trend slightly east of north and dip 45°–70° W. These joints occur singly at widely spaced intervals and do not form a fissure zone; only a few are mineralized. For 350 feet in from the portal, quartz veins are common although hardly abundant. Most of them trend N. 10° E. Two of the quartz veins are 6 to 8 inches wide but most of them are less than 1 inch wide. Some of the quartz is coated with chrysocolla. Few of the veins extend from one wall to the other; most of them are cut off along the fissured zone along which the adit has been driven.

The drift is mostly in crushed and fissured soda syenite but exposes some metadiorite. About 75 feet from the face the drift crosses an explosion breccia 20 feet wide. Although the last 30 feet of the adit is in syenite porphyry, the breast may be in soda rhyolite and Precambrian rocks.

The minerals observed on the tailings dump at the portal of the Dewey adit include quartz, chalcedony, calcite, fluorite, chalcopyrite, pyrite, malachite, chrysocolla, and various iron oxides. Along the walls of the adit are sporadic masses of highly altered Precambrian rocks, mostly less than a foot in diameter, and a few veins of actinolite and hedenbergite.

The Dewey adit was opened during the nineties and was worked intermittently during the next 35 or so years. According to Hill (1913, p. 113), some of the veins are said to average $20 to the ton in gold, silver, and copper.

A Geiger-counter traverse of the drift indicated radioactivity to the extent of about two to three times background. The mine was generally dry at the time of the traverse; at only a couple of places was there drip from the roof.

McCOY ADIT

The McCoy adit (pl. 45*E*), in Beaver Basin at an altitude of about 10,640 feet, consists of an adit, shaft, and some open pits. A road leads to the mine from the road along the north foot of North Mountain.

The several openings are in what appears to be syenitized diorite porphyry at the northwest edge of a wide zone of much jointing and shearing. Syenite porphyry dikes trending southeastward parallel to the sheeted zone lie about 500 feet southwest of the mine, but none was observed in or about the openings.

The main adit is about 250 feet long. It enters along a northwestward-trending shear zone that involves porphyry and sedimentary rocks; the latter probably is the Paradox member of the Hermosa formation. Fifty feet in from the portal the shale beds dip 40° to 65° south of west; but they are much sheared and it is doubtful if these dips persist. Northwest of this shear zone the adit crosses into a block of little disturbed and only moderately altered porphyry. Even where the porphyry is not brecciated or much jointed it is bleached and has lost its femic minerals.

Thin veins of quartz, some stained with copper carbonate, and thin veins of bornite and chalcopyrite were observed along some of the fissures in the sheared porphyry. At the portal is a vein of calcite about 6 inches wide, but not much calcite was observed along the adit.

Water seeps from the roof of the adit along the shear zone near the breast; the rest of the tunnel was dry at the time of the survey.

At several places along the adit the hanging wall of the fissure zone is a plane sharply separated from brecciated and fissured porphyry making up the footwall. Slickensiding on the hanging wall parallels the dip.

The shaft, judged to be about 25 feet deep, was not surveyed. It is 100 feet higher than the adit and about 300 feet to the northwest. It is reported to connect by a crosscut with an adit about 50 feet southeast of the shaft.

Small amounts of gold and silver-bearing copper ore reportedly have been produced from the McCoy mine. A Geiger counter taken a short distance into the adit behaved erratically, as if the air contained radon.

List of some mine openings in and near the North La Sal stock

[Length of caved openings based on reports from local people; see pl. 40 for location of openings]

1. Dillon adit, Fowler Mines; adit 1,200 feet long (pl. 45*B*).
2. M. I. F. adit (south); 290 feet long (pl. 45*C*).
3. M. I. F. adit (north); 40 feet (caved); in metadiorite and Precambrian.
4. Double Standard shaft; depth 44 feet; partly caved; in soda syenite porphyry.
5. Double Standard adit; 50 feet(?), caved; in metadiorite and Precambrian.
6. Florence No. 1; 180-foot adit and 60-foot side drift; entrance caved; in metadiorite and Precambrian.
7. Florence No. 2; 90-foot adit; entrance caved; in metadiorite and Precambrian.
8. Newberg adit; 25 feet long; in metadiorite. Not shown on map; exact location not determined; near 6, 7.
9. Wheat adit (lower level), 120 feet long; entrance caved; in diorite porphyry with pyritic alteration.
10. Wheat adit (upper level), 35 feet long; entrance caved; in diorite porphyry with pyritic alteration.
11. High Ore adit (pl. 45*D*).
12. West Slope crosscut; 290 feet long; entrance caved; in diorite porphyry with pyritic alteration. See Tornado No. 1 (no. 14).
13. West Slope incline; 25 feet long; in diorite porphyry with pyritic alteration. See Tornado No. 1 (no. 14).
14. Tornado No. 1; 40-foot adit; entrance caved; in diorite porphyry with pyritic alteration. According to Hill (1913, p. 112): "The Tornado property has been worked to more advantage than any of the other properties in [Miners] Basin. Two zones of fracturing intersect near the main workings; one, the Tornado vein strikes N. 80° E., and the other, the Indiana, strikes N. 40° E. Along these zones there are numerous branching fractures filled with dark glassy drusy quartz up to three-fourths of an inch in width. Near the junction of the two systems the interlacing seams are more abundant. Pyrite has been deposited both with the quartz and disseminated in the altered monzonite porphyry wall rock. The Indiana zone averages about 10 feet in width and the Tornado from 15 to 20 feet. The former is opened by two short tunnels and the latter near its junction with the Indiana by a tunnel and a 50-foot shaft. A crosscut tunnel, now 270 feet long, has been started for the intersection but [West Slope crosscut?] has not yet reached it. All the altered pyrite-impregnated * * * porphyry cut by quartz stringers is classed as ore, with a reported average value of $15 to $20 a ton in gold. It is all oxidized, and only a few pyrite crystals remain unchanged to limonite. The material pans well, but it is said that the iron concentrates, made at the mill, ran $28 to the ton in gold."
15. Tornado No. 2; inclined shaft 30 feet long; entrance caved; in diorite porphyry with pyritic alteration. See Tornado No. 1.
16. Indiana adit; 60 feet long; entrance caved; in diorite porphyry with pyritic alteration. See Tornado No. 1.
17. Leland No. 1; 65-foot adit, entrance caved; mostly in colluvium, some diorite porphyry with pyritic alteration and may extend into syenite porphyry dikes.
18. Leland No. 2; 80-foot adit, entrance caved; mostly in colluvium, some diorite porphyry with pyritic alteration and may extend into syenite porphyry dikes.
19. Beibush adit; 65 feet long; entrance caved; pyritic altered diorite porphyry and possibly syenite porphyry dikes.
20. Bryant opencut; 35 feet long; caved; in pyritic altered diorite porphyry.
21. Ice cave; 480-foot adit, filled with ice; mostly in diorite porphyry.
22. McCormick adit; 120 feet long; entrance caved; a drift along contact at side of feldspathoidal dike. According to Hill (1913, p. 112): "This vein is not very well defined and is nowhere over 21 inches wide. The vein material is calcite, siderite, and a little fine quartz, partly filling the fracture, which in a few places shows stains of copper carbonate."
23. Alamo adit; 65 feet long; entrance caved; probably crosses syenite porphyry dike and may extend into explosion breccia.
24. Dewey adit (pl. 45*A*).
25. Upper Dewey adit; 35 feet long; drift along fissured dike wall in dike swarm.
26. Lower Dewey adit; 100 feet long; in soda syenite porphyry of dike swarm.
27. Skylark No. 1; 205-foot adit; entrance caved; in soda syenite porphyry. According to Hill (1913, p. 112), the Skylark No. 1 and No. 2 (see below, no. 28) "expose a vein varying from knife-blade thickness to 2 feet. This vein cuts both monzonite porphyry and a dike of syenite porphyry. It strikes N. 52° E. and stands nearly vertical. In its wider portions there is an abundance of glassy dark quartz with drusy cavities. Some of these druses are coated with greenish-blue chrysocolla, much of it dull and earthy. Masses of limonite, usually copper bearing, which are probably the alteration products of cupriferous pyrite or chalcopyrite, occur in the quartz. Narrow quartz stringers make off into the porphyry, which contains some disseminated pyrite near them."
28. Skylark No. 2; 35-foot adit; entrance caved; in quartz-veined soda syenite porphyry.

29. Venus adit; 50 feet long; in dike swarm.
30. Little Dot adit; 150 feet long; mostly metadiorite; may cut some syenite porphyry dikes.
31. McCoy adit (pl. 45*E*).
32. Shaft; 25 feet deep, in sandstone of Glen Canyon group; in sec. 3 (projected) T. 26 S., R. 24 E.
33. Johnson shaft; 80 feet deep, mostly in rounded gravel, glacial outwash, but bottoms in Mancos shale; on Bald Mesa, near center sec. 19, T. 26 S., R. 24 E. Gravel derived from North La Sal stock includes soda syenite, vent breccia, and soda rhyolite.
34. Crystal adit, in fissure in soda syenite; north side of Mineral Mountain.

Some other openings are shown on the map (pl. 40), but either they are small or their extent is unknown.

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