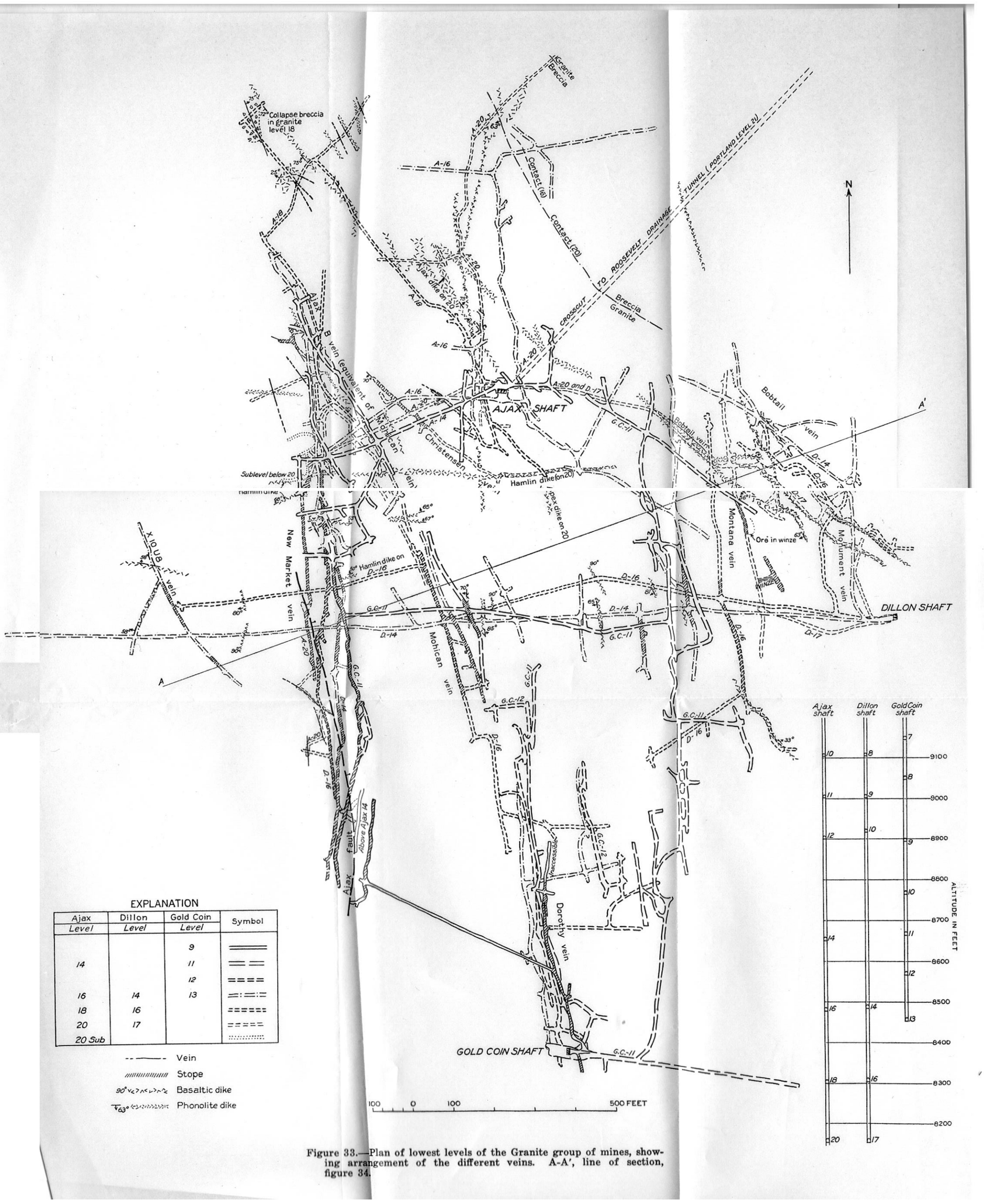

EXPLANATION

Ajax Level	Dillon Level	Gold Coin Level	Symbol
		9	
14		11	
		12	
16	14	13	
18	16		
20	17		
20 Sub			

Vein

Stope

Basaltic dike

Phonolite dike

Figure 33.—Plan of lowest levels of the Granite group of mines, showing arrangement of the different veins. A-A′, line of section, figure 34.

the intersection of fissure zones, and the ground northwest of the intersection may have been opened to receive ore.

The largest ore bodies on the upper levels, partly shown in figure 34, are in honeycombed granite at the intersection of groups of fissures of northwest, northeast, and north trends between levels 3 and 8. Some of the fissures follow phonolite dikes. Below level 7 the lowest of these bodies divides into veinlike branches, which trend northwest for a maximum distance of 150 feet and grade into pyrite veinlets in ordinary granite. These fissures are nonproductive southeast of their junction with the group of northeastward-trending dike-filled fissures, and it appears that during the north-northeast shearing movement that preceded ore deposition the block southeast of the dike-filled fissures moved as a unit, while the cross-fissured ground between the dikes and the northwestward-trending fissures beyond them were opened by tension.

On levels 9 and 10 the B and C veins veins of the northwestward-trending group (fig. 34) were productive, but between levels 11 and 13 the ground was practically barren. The B vein of the Ajax workings is essentially continuous with the Mohican vein (fig. 33), which trends north-northwest in the Gold Coin workings and the intervening Bonanza claim. This vein was stoped between Ajax levels 18 and 14 (Gold Coin 11), a vertical distance of 500 feet. The ore shoot pitched north-northwest, and its upper part may have been continuous with ore in the Dorothy vein. Its north limit was approximately at the Hamlin dike. The north-northwest trend of the Mohican fissure favors the downward continuity of ore on the whole. The stope length of the ore shoot increases downward between levels 16 and 18 and may continue to increase for some distance farther, but in view of the relations of the Mohican fissure to the adjacent fissures, it would not be surprising if a steplike offset of the vein were encountered below level 20; if so, the offset continuation is likely to prove productive.

The Newmarket vein has been by far the most productive in the lower part of the mine. It has been stoped continuously from level 9 (Gold Coin) to a sublevel 160 feet below level 20

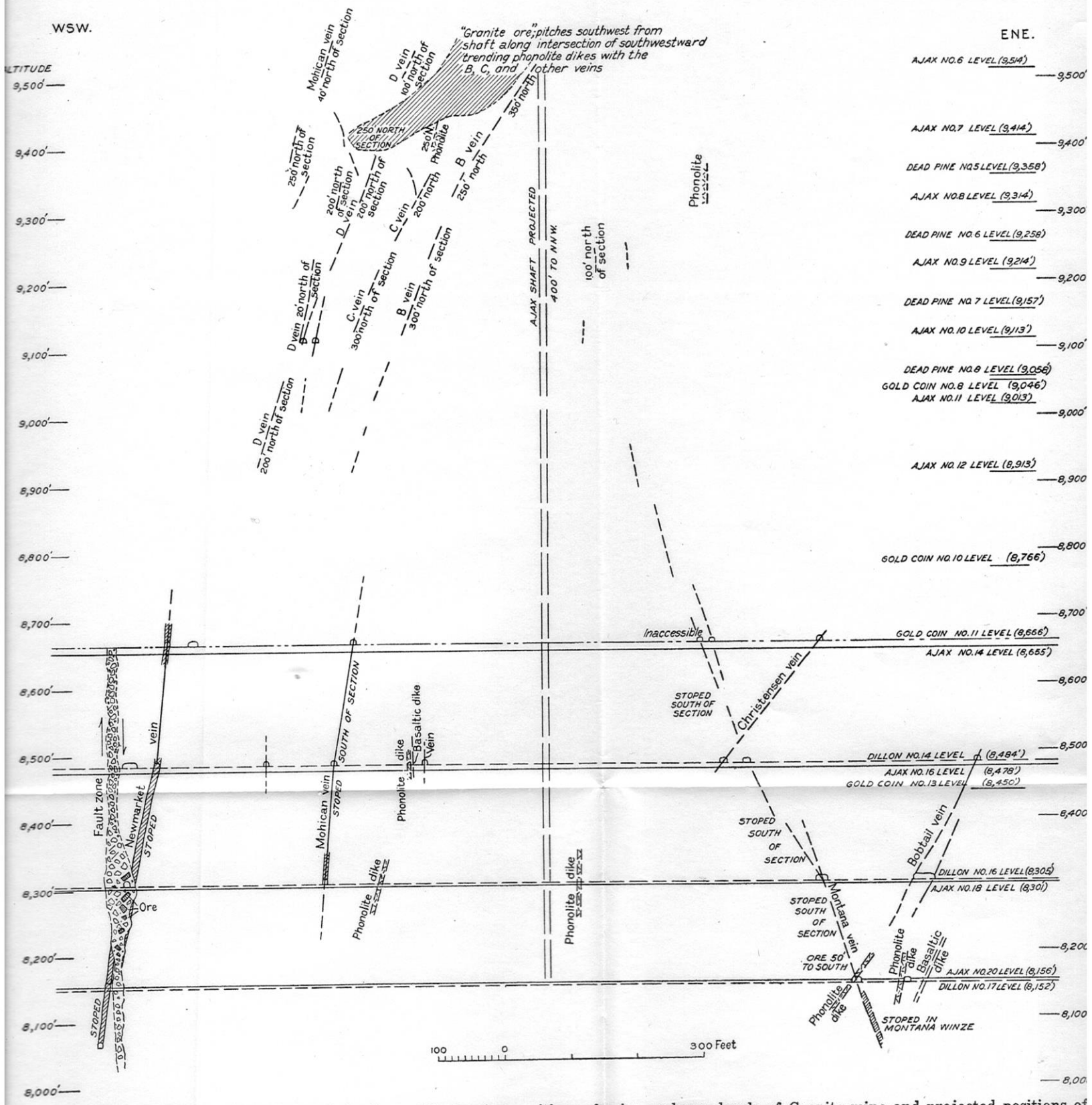

Figure 34.—Cross section along line A-A', figure 33, showing positions of veins on lower levels of Granite mine and projected positions of veins and irregular ore shoots at higher levels north-northwest of the line of the section.

(Ajax), a vertical distance of more than 800 feet. Its maximum stope length (fig. 35), about 1,050 feet, is on level 16, and the aggregate length on level 20 is about 700 feet. Production by lessees between the sublevel and ground 100 feet above level 20 during the period 1927-32 amounted to 15,145 tons of ore (68 percent of the total muck hoisted), with an average gold content of 0.93 ounce to the ton. Samples of ore from faces below level 20 at the time of flooding and at the southern faces on higher levels had similar gold contents. The ore shoot as a whole pitches northward as far as level 20, but developments on and below that level suggest a vertical or southerly pitch. It is interrupted on level 20 by a barren interval, which may mark the beginning of a downward division into short branches similar to those that mark the lower end of the Independence ore body (fig. 28). It does not extend far north of the Hamlin dike. On level 20 it ends southward where the vein passes into a network of small veins, but these farther south gave fair promise of leading to another ore shoot.

North of the Hamlin dike the ore shoot becomes poorly defined, and the Newmarket vein, together with the B or Mo-

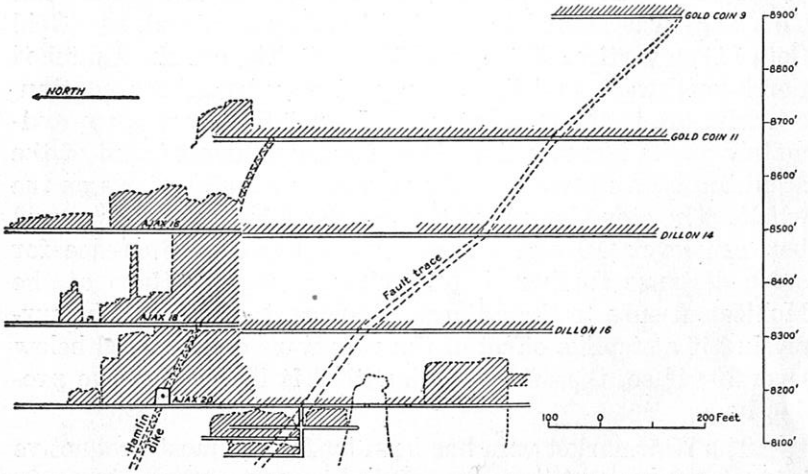

Figure 35.—Profile of Newmarket ore shoot, showing its intersection by the vertical postmineral Ajax fault.

hican vein (fig. 33), passes into a network of short veins in which a little ore has been stoped. This network resembles those above the east vein on levels 17 and 21 of the Portland mine (p. 336) and suggests that if deeper development is undertaken, either after pumping or by drainage through a deep tunnel, a downward steplike continuation of the Newmarket vein to the northwest may be found productive.

The Newmarket fissure is very narrow and does not follow any phonolite or basaltic dikes but cuts squarely across the Hamlin dike; furthermore, the fact that it is filled or lined with quartz, minute to microscopic telluride crystals, and little or no fluorspar distinguishes it from many other veins of the district and strongly suggests that it was not formed until after the first stage of mineralization. It certainly was not accessible before the second stage, and its opening is attributed to tension during the north-northeastward shearing movement. As this tension in the deeper part of the mine locally diminished north of the Hamlin dike, the outlook for a deeper ore shoot, suggested in the preceding paragraph, is open to doubt, but the size and prevailingly north-northwest pitch of the Newmarket ore shoot, as well as the presence of the small ore shoots north of the Hamlin dike, suggests that the ore-forming solutions rose from that direction, perhaps where a continuation of the Newmarket fissure zone, approximately parallel to the Apex dike, intersects with cross fissures near the collapse breccia (fig. 33).

The most likely source of the solution that deposited ore in the Newmarket and adjacent veins was beneath the Queen-Ajax subcrater, and the most open channels were along fissure intersections affected by tension. During the first stage of mineralization one such intersection doubtless gave rise to the collapse breccia on level 18, but fissuring on the whole was so tight that the solutions rose to rather shallow levels before finding so favorable a place as that between levels 8 and 3, where they converted the granite into its honeycombed condition. The movement that followed the first stage opened the favorably situated fissures in the granite but kept the dominant fissures in the breccia tight except where they were

crossed by fissures of northeast trend. The ore-forming solutions, therefore, found their way for the most part into the granite and spread horizontally and upward along the Newmarket and Mohican fissures, a part working upward into the honeycombed granite, and another part continuing along the Dorothy fissure and through minor connecting fissures into the Coin vein. The course followed by solutions that formed the Apex ore shoot is not clear. It may have been northward from the honeycombed granite or southward near the Triumph shaft. In either case the solutions evidently moved a considerable distance without finding openings large enough to permit ore deposition in noteworthy amount.

There were, then, at least two local centers from which ore-forming solutions rose—one close to the junction of the Montana and Bobtail fissure zones and near the south end of the breccia embayment, and the other along a northerly continuation of the Newmarket fissure which roughly parallels the northwestward-trending boundary of the embayment. Solutions from each center doubtless coalesced along the Coin vein, and the shallow shoots in the northeastern part of the mine were also supplied in part from solutions that rose along the Portland fissure zones. (See p. 341.) Because of the deep as well as horizontal persistence of the master fissure zone along which the Granite mine is located, solutions from beneath the Queen-Ajax subcrater may have reached the shear zone in granite far below the present workings and traveled southward as far as the sheer zone was continuously developed. Plate 3 of Professional Paper 54 shows workings as far south as the Doyle shaft, 3,500 feet south of the Ajax shaft. The relations of the shear zone to the overhanging contact at the deeper levels would imply a general northerly pitch and therefore an increasingly shallow range for the veins southward. The bottom of the shear zone, however, has not been reached, and the occurrence of promising ground at the south end of level 20 in no way disagrees with this implication, even though one or more additional local centers might be found through which solutions rose into the southern part of the mine. It does, however, suggest that ore shoots on the

deeper levels may exist in undeveloped ground beyond the south limits of workings and that where ore shoots end southward it is worthwhile to look for steplike continuations.

The postmineral Ajax fault, which displaces the Newmarket vein (figs. 34 and 35), has a uniformly vertical dip and represents a vertical movement, as there is no horizontal overlap of the ends of the vein on either side nor any gap along the fault between them. There is, however, a considerable gap across the fault (fig. 36), and as the vein dips uniformly 82° W., this gap implies that the east wall has dropped relatively 120 feet. At the southwest end of level 9 (Gold Coin) the approximate position of the fault is represented by excessively fractured and slickensided granite, and it therefore appears that the fault is feathering out, changing its course, or approaching the junction with another fault. During the general uplift that followed ore deposition in the region (p. 240) some settling of ground within the master shear zone would

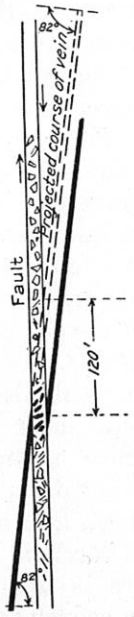

Figure 36.—Diagrammatic cross section showing offset of the Newmarket vein by the Ajax fault in the Granite (Ajax) mine.

probably occur, and it would not be surprising if other post-mineral faults of considerable displacement were found to be present.

STRONG MINE

The Strong mine, situated between the Portland-Independence ore zone and the veins of the Granite mine, invites speculation regarding the source of its ore. Its vein zone follows a zone of latite-phonolite, phonolite, and basaltic dikes, which intrude the granite, and is continuous on the upper levels with the western veins that extend southward from the Bobtail vein in Portland ground. It therefore was doubtless supplied in part through the Portland zone. The fact that the deepest ore shoots thus far worked are farther south than those at higher levels suggests a more southerly source, but there is no more direct evidence for such a source. The relation of the Strong fissure zone to the Bobtail fissure zone suggests a tendency of the west wall to move upward to the north during the prephonolite stage of deformation and to develop the steplike group of fissures partly represented in figure 37. The later premineral movement in a north-northeast direction, so far as it was locally influenced by the northerly slope of the breccia-granite contact, gave the east wall also a tendency to move upward to the north and therefore for the ore shoots individually and as a group a tendency to pitch southward, even though the fissure zone weakened in that direction. The veins, however, are not so well developed on the lowest as on the intermediate and upper levels. As distance from the breccia-granite contact increases with depth, a corresponding tendency for the fissures of the shear zone to weaken with depth would be expected. The three main shoots shown in figure 37 pinch out above level 13 (altitude 8,435 feet). Only a small shoot was found on level 14, and a cross-cut from Independence ground on level 15 (Portland 21) failed to disclose anything encouraging. There is little, therefore, to encourage deeper development, but a search for southward, steplike continuations of the veins is worthy of consideration.

The southeasterly trends of some of the dikes and fissures near the Dillon shaft, in the eastern part of the Granite mine, might suggest that solutions rising along the junction of the Montana and Bobtail veins (p. 354) could have followed these dikes into Strong ground and supplied ore to the deepest shoots near the Strong shaft; but the general rule in the vicinity is that these southeastward-trending fissures are tight on the east sides of the northward-trending fissures. Such a source for the ore, therefore, seems unlikely and would be less direct than the extremely productive Portland zone. The pitch of the ore shoots shows that the direction of southward circulation from Portland ground was locally downward. Whether

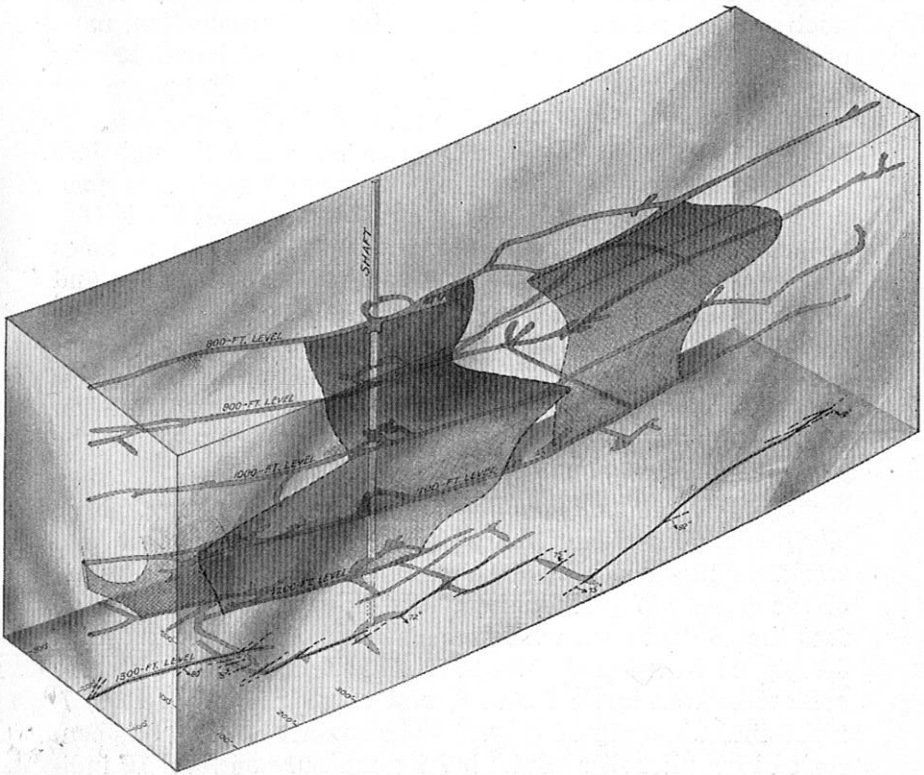

Figure 37.—Block diagram showing form and steplike arrangement of veins and ore shoots in the lower part of the Strong mine.

it found an opportunity to rise again along a well-marked group of fissures south of the shaft and to contribute to the southernmost ore shoots at higher levels or whether it became scattered and produced weak mineralization throughout a large area in the surrounding granite is a question for speculation.

QUEEN MINE

The Queen mine, owned by the Queen Gold Mining Co., includes the Eclipse, Carbonate Queen, and adjacent claims on the east slope of Eclipse Gulch, close by the highway between Cripple Creek and Victor. It has been one of the more productive small mines, but figures on its total production, most of it within 800 feet of the surface, are not at hand. Recent operations have been conducted through the Eclipse shaft (altitude of collar 9,696 feet), which is 1,000 feet deep and from which nine levels have been turned; also through two long laterals from the Roosevelt drainage tunnel. The productive ground is mainly within a relatively small block (fig. 38) near the breccia-granite contact, but there are old stopes and some promising prospects elsewhere on both upper and lower levels, and some low-grade ore has been stoped on the 1,600-foot or drainage level. The veins and geologic structure conform on the whole to those of neighboring areas but also emphasize the influence of local conditions on the limitation of ore shoots and the consequent difficulty of appraising the prospective value of unexplored ground nearby.

The breccia contact on the surface south of the Eclipse shaft (fig. 7) makes a sharp curve from north to west, and workings to a depth of 500 feet show that this curving part of the contact is overhanging; but below an altitude of 9,300 feet the contact as a whole trends north-northwest and dips steeply east-northeast (fig. 39). The Eclipse shaft cuts the contact betwen levels 5 and 6, and exposures on levels 6, 7, and 8 indicate a dip of 70°-80°. The contact on level 9 is concealed by a phonolite "flat," but its exposure on level 16 indicates an average dip of 83° below level 8.

The breccia is mostly of the fine-grained variety, but a mass of coarse, cobbly breccia is exposed at the north ends of levels 7 and 8, and the steep, northwestward-dipping contact between this mass and the fine-grained breccia may have determined the positions of local northeastward-trending fissures. Two elongate masses of granite enclosed in breccia and about parallel to the main granite contact are exposed on levels 7 and 8 (fig. 38).

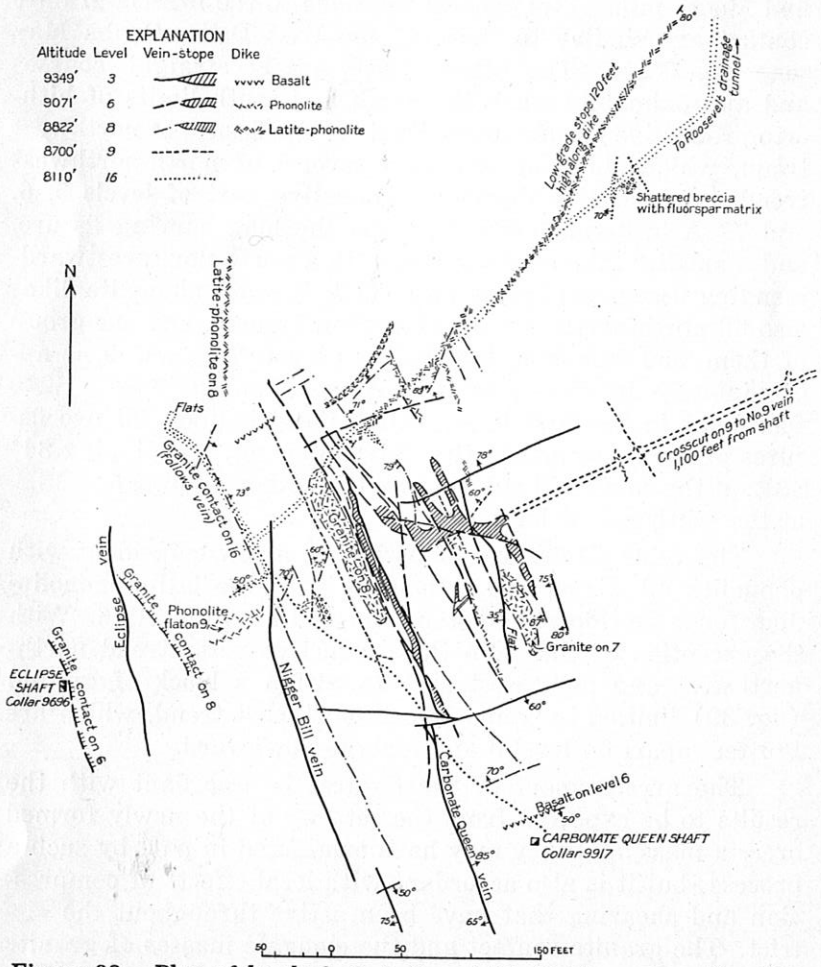

Figure 38.—Plan of levels 3, 6, 8, 9, and 16 (drainage tunnel) of the Queen mine.

The dominant set of fissures also strikes north-northwest and dips on the whole very steeply toward the granite contact, although vertical and steep easterly dips are conspicuous in places. A second set strikes east-northeast and includes both northward-dipping and southward-dipping fissures. One of them exposed for a long distance on level 16 curves gradually to the north and is essentially continuous with the fissure zone that extends northnorthwestward through the Ada Bell and Moose mines. Its general relations to the breccia-granite contact are similar to those of the Last Dollar-Orpha May zone (p. 332). The others have nearly straight courses and approximately mark the north and south limits of hitherto productive ground above level 9. One fissure of northwest trend, which obliquely crosscuts several of north-northwest trend, is present in the most productive part of levels 5, 6, and 7. A latite-phonolite dike fills the long curving fissure, and a smaller dike of similar rock in a north-northwestward-trending fissure is exposed on level 3. Several phonolite dikes also fill north-northwestward-trending fissures, and one group of them, 350 feet from the shaft on levels 7, 8, and 9, is approximately in line with the Apex dike (p. 346), 1,200 feet away in the Coriolanus claim. Basaltic dikes fill two fissures of the east-northeastward-trending set, one dipping 84° SSE. at the north end of level 9 and the other dipping 50° SSE. at the south end of level 16.

The veins fill fissures of both sets, a few coincident with phonolite dikes and one coincident with the latite-phonolite dike for a considerable distance on and above level 16. With the exception of this vein the productive veins trend north-northwest and northwest and lie within a block of ground (fig. 39) limited by veins of east-northeast trend, which are 175 feet apart on level 3 and diverge downward.

The arrangement of the fissures is accordant with the results to be expected from the settling of the newly formed breccia mass, and they may have originated in part by such a process; but it is also accordant with local effects of compression and shearing that have been active throughout the district. The granite contact and the elongate masses of granite

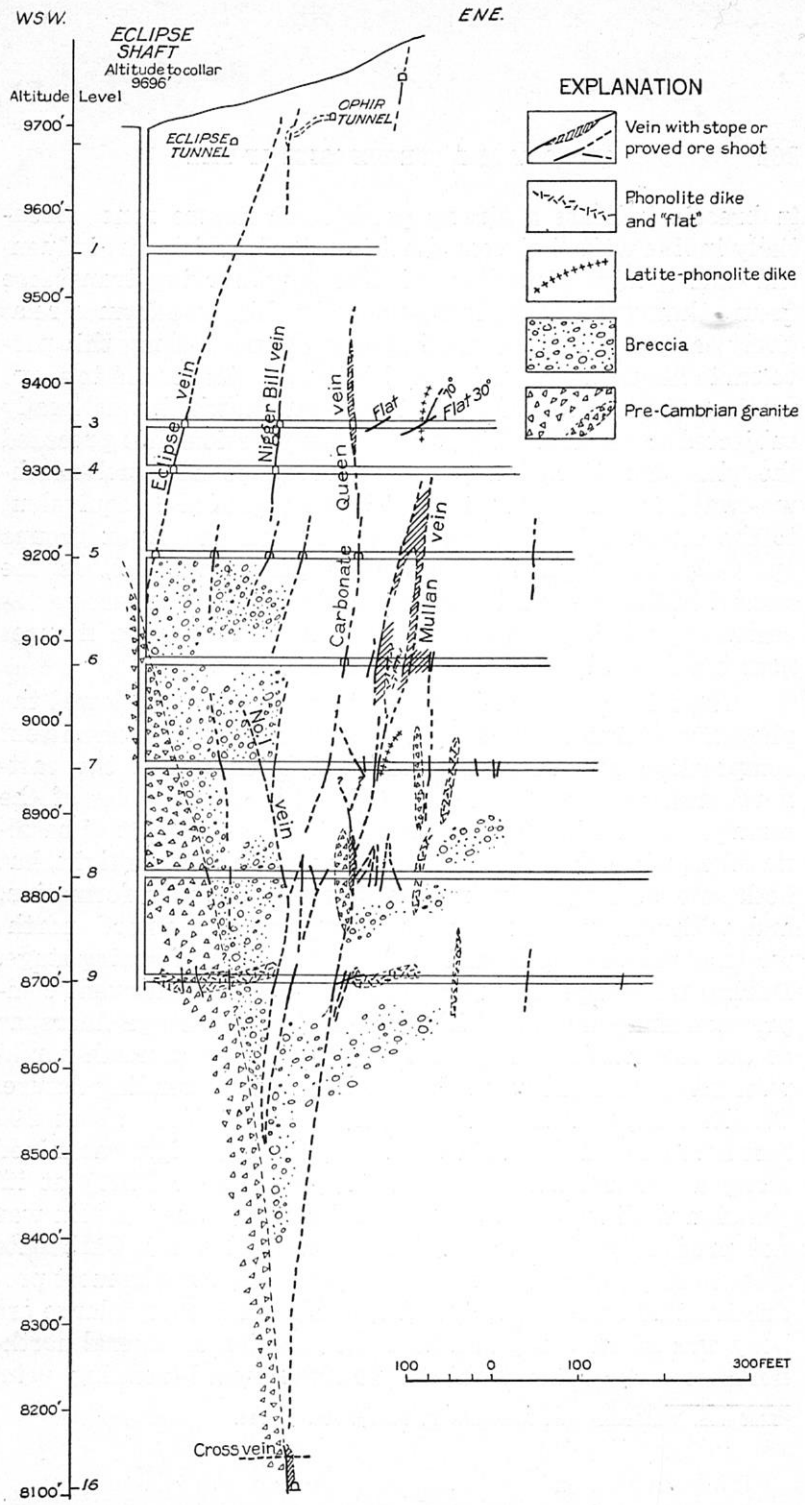

Figure 39.—Section N. 65° E. through Eclipse shaft and workings of Queen mine.

in breccia indicate a strong prevolcanic fissure zone, essentially in line with that near the Ajax shaft, which was influential during later disturbances. The long, curving transverse fissure that contains the latite-phonolite dike was formed relatively early and may be attributed to shearing along this prevolcanic fissure zone, during which the granite tended to move northward and pressed against the breccia, which was locally subjected to tension. The regional compression that preceded the phonolite intrusion produced or reopened north-northwestward-trending fissures, which are regarded as equivalent to the compression fissures of the Bobtail and Apex groups (p. 346), although they are more nearly vertical, as the contact in the Queen mine is not overhanging. The east-northeastward-trending fissures and the local transverse fissures near the Ajax shaft were formed at the same time.

The mild north-northeasterly movement that followed the phonolite intrusion was evidently modified by intermittent compression and relaxation of local blocks; thus the east-northeastward-trending fissures that bound two sides of the main productive block were open during the intrusion of basaltic dikes, while those of north-northwest trend were tight, but both sets were open during the first stage of vein formation, and, with one known exception, only parts of the north-northwesterly set were open during the second or ore-forming stage. During this stage the main productive block underwent compression and torsion, which crushed the first-stage fluorspar in the east-northeasterly veins, opened those of north-northwest trend, and produced the northwestward-trending fissure. On the Eclipse tunnel level (altitude 9,679 feet) about 200 feet northeast of the shaft an ore body 90 feet high was mined along a vertical north-south vein (the Nigger Bill?) at its junction with an east-west vein and a "flat," but the vein was not productive at lower levels.[58] On level 3 the Carbonate Queen vein, 100 feet east of the Nigger Bill, was the most productive, and on levels 5, 6, and 7, still farther east, a large ore body was mined along and near the junction of several north-northwesterly veins with the northwestward-trending vein.

[58]Lindgren, Waldemar, and Ransome, F. L., op. cit., p. 494.

In short, the productive parts of these veins have a steplike arrangement (fig. 39), but developments to the east on levels 7 and 9 have not disclosed a continuation of this arrangement, and it appears that the lower and thicker part of the block was not so well opened.

Development along the granite contact on level 16 has exposed the intersection of a north-northwesterly vein and an east-northeasterly vein 170 feet northeast of the shaft. Both veins consist of first-stage fluorspar, and the north-northwesterly vein has been shattered and recemented by minerals of the second and third stages, including an encouraging amount of telluride. A short distance south of the intersection the main vein curves southeastward and leaves the granite contact. It returned favorable assays for 70 feet from the intersection and appeared rather open as far as a point almost directly beneath the old Carbonate Queen shaft. There it crossed a basaltic dike, beyond which it was perfectly tight. Evidently the ground south of the dike moved as a unit, without yielding along any of the vein fissures that have been exposed. The ore-forming solutions evidently rose along the intersection noted above and continued upward along available openings to form the ore shoots on higher levels, as suggested in figure 39. The intervening unexplored ground, therefore, deserves attention.

There are also places in the northern parts of levels 8 and 9 and the eastern part of level 3 where encouraging assays have been reported and where search for connections with another favorably situated block is justified. Prospecting in such ground is obviously more difficult than along more continuous veins, as the trend and arrangement of productive fissures in one block may be very different from those in another. This difference is illustrated in the northeastern part of level 16, where the low-grade stope along the latite-phonolite dike on level 16 trends northeast and adjacent veins of north and north-northwest trend are crushed and tight. This part of the dike (fig. 38) trends a little more northward than the average, and it appears that during the northward compression that preceded ore deposition the southeast wall of the dike was

crowded against the dike for most of its length and tended to move northeastward, producing a relatively open fissure where the dike curved slightly to the north. The adjacent northward-trending veins represent local planes of shearing, which were most marked near the turn in the dike. Their intersections with the open fissure along the dike doubtless increased the opportunity for ore deposition. The ground above this stope and between it and the promising showings on levels 8 and 9 is obviously worthy of consideration, with due regard to the size and grade of possible ore shoots and the cost of further development.

A long east-northeast crosscut on level 9 cuts a vein called the "No. 9" about 1,150 feet from the Eclipse shaft. This vein trends north and has been followed for about 260 feet with encouraging results. It has also been opened along a lateral from the Roosevelt tunnel where low-grade ore has been found. This vein on level 9, according to John Tait Milliken, is 1,140 feet below the Comanche Plume tunnel, a winze from which has also exposed ore. Parallel veins of barren first-stage fluorspar have been cut to the northwest of the No. 9 vein on the tunnel level. They have a steplike relation to the No. 9 vein. These showings indicate a vein zone, otherwise unexplored, west of a southward continuation of the Rose Nicol zone and approximately in line with the Ada Bell and Moose veins This vein zone was rather favorably situated for opening during the north-northeasterly compression and deserves further development. Although far from any other productive workings, it seems more nearly related to the veins of the Queen mine than to any others. Downward projections of the vein zone and the breccia-granite contact would meet about 4,000 feet below the tunnel level, and the source of the ore may well be the same as that from which the Queen ore was supplied.

The fact that the principal fissure zone in the Queen mine is approximately in line with that near the Ajax shaft might lead to the conclusion that the intervening ground should be productive; but the only veins known to continue into this ground consist of low-grade to barren first-stage fluorspar,

and the descriptions of the two mines show that the reopening of such veins and the introduction of ore was very localized. There may be other ore-bearing blocks similar to the main productive block in the Queen mine, but their positions cannot be predicted. The courses followed by the solutions that deposited the Queen and Ajax ores indicate independent local trunk channels, although the channels may join at great depth beneath the Queen-Ajax subcrater.

Mines Adjacent to Cresson Mine

Although several mines, including the Dante, Trail, Blue Bird, Dexter, Rose Nicol, Moose, Bertha B., and Ada Bell, are close by the Cresson mine and their ores are attributable to the same sources, their structural settings are better understood after those of the Portland, Granite, and Queen mines have been considered. Only parts of the Dante, Dexter, Rose Nicol, Bertha B., and Moose mines were accessible to us.

The northwestward continuation of the main Portland vein zone beyond its junction with the east vein (p. 332) is marked by a few steplike veins that pass out of Portland ground and connect with a zone of general north-northeast trend that passes through the Rose Nicol, Trail, Dexter, Blue Bird, Dante, and Logan mines. The south end of the zone crosses the narrow, western part of the large syenite mass. Although the zone as a whole trends north-northeast, most of the individual ore shoots trend a little west of north and thus fill a steplike group of fissures that were opened by tension during north-northeast shearing, which roughly paralleled that along the Last Dollar-Orpha May zone (p. 332). North and west of the Dexter shaft the northward-trending veins cross or end against veins of northeast trend and southeast dip, generally parallel to those near the south edge of the Cresson blowout. These deflect the zone eastward into the Blue Bird mine, whose maps indicate veins of north-northeast trend and east dip connected by short veins of north-northwest trend.

The veins in these mines, so far as seen, present the same general features, including the reopening of first-stage fluor-

spar and the location of ore shoots either along intersections of fissures or along places where the strike and dip favored opening during shearing, and the general principles already discussed apply here. The most likely source of ore was that beneath the Dante collapse breccia, which supplied much of the Cresson ore, and ore shoots as a whole may be expected to converge downward toward this source; but single shoots may pitch away from it, and there may be long intervals in which there are no shoots of commercial size. A smaller source is indicated by the small body of collapse breccia in a short lateral extending southward from the Roosevelt tunnel in Rose Nicol ground, where the Funeral dike cuts the syenite. The Portland source may also have contributed ore, especially to the Dexter and Rose Nicol veins.

The Moose and Bertha B. workings follow a zone of latite-phonolite, phonolite, and basaltic dikes, which indicate repeated reopening of the zone as a whole, although the younger dikes cut the older ones at small angles. The latite-phonolite dikes represent the western members of the conjugate group in the Cresson mine, but one of them exposed along the Moose tunnel (level 6) curves from a south-southeast to a south-southwest course, and its southernmost part is directed toward the dike on level 16 of the Queen mine. The basaltic dikes form a typical steplike and forking group but deflect southeastward toward Ada Bell ground instead of following the latite-phonolite dike. The ore shoots on the upper levels have been found at and north of this point of deflection, and the ore recently reported in Ada Bell ground may represent the southeastward continuation of the productive zone. The ore shoots occur mainly where the veins dip steeply eastward, especially at or near intersections with veins of east-northeast trend that connect the Moose with the Cresson veins. The shoots pitch northward and for the most part step successively eastward down to level 8 (altitude about 9,695 feet). Levels 9 to 15 disclosed no ore in significant quantity, and the mine maps suggest that the vein is interrupted on the lowest levels. Recent work from level 12 of the Cresson mine found a network of veinlets in an open, angular breccia at the inter-

section of the main basalt dike and fissure zone with an east-west fissure zone. The dike or vein-fissure zone was followed northward into Bertha B. ground but was tight and barren, even where crossed by a vein of first-stage fluorspar.

The relation of the open breccia to the collapse breccia reported to occur southwest of the Cresson blowout (p. 314) is not known. It differs from the typical collapse breccia in the smaller size and sharply angular character of its fragments and in the general absence of first-stage minerals. Shattering took place at different times, as one "rib" along the north-south fissure zone consists of rounded fragments of typical fine-grained breccia in a dense, silicified groundmass and is in line with a western branch of the basalt dike, as if it represented material pushed along the fissure by the intruding dike; but this rib is broken and encroached upon by the angular open material. The ore occurs mainly in distinct veinlets that follow and spread from the main dike fissure but in part as second-stage minerals that line the openings. The vein minerals have been shattered and corroded to some extent, and fine-grained pyrite of the third stage has been deposited over them or in other openings—in fact, even in the richer picked samples pyrite is commonly the only conspicuous metallic mineral. Similar open ground, according to the mine maps, is present on level 15.

Although the rib of silicified breccia indicates pre-ore disturbance and mineral deposition, probably of the first stage, the lack of rounding of the fragments and the absence of first-stage fluorspar, which is so conspicuous in the adjacent veins of the Cresson mine, show that the principal shattering took place after the first stage. The open character of the breccia and the corrosion of vein minerals show that considerable leaching of the more finely crushed material must have taken place, perhaps in part before deposition of the second-stage minerals, but certainly to a great extent afterward. It has already been suggested (p. 306) that this late corrosion and the deposition of third-stage pyrite was accomplished by water that had descended from the surface far below the oxidized zone.

The connection of the Moose vein with those of the Cresson mine warrants the inference that its ore was derived from the local source that supplied the western part of the Cresson mine. The solutions rose southward along the main fissure zone, locally following dikes and fissure intersections. Although the ore shoots thus far found have been on the eight upper levels, the persistence of the fissure zone, the occurrence of ore streaks in open breccia on Cresson level 12, and the mining of large ore shoots along the west end of the Cresson blowout down to level 17 justify the inference that ore will be found at favorable structural places down to or below present drainage level; but the general rule for the district that ore shoots are smaller and farther apart on the deeper levels is likely to apply here as elsewhere.

VINDICATOR MINE

Development and production

The Vindicator mine is 1.4 miles northeast of Victor and nearly 4,300 feet northeast of the Portland mine. Production began in 1894 and has continued ever since, though on a relatively small scale since 1922. According to the annual report of the Vindicator Gold Mining Co. for 1914, the mine's total production from April 1, 1894, to December 31, 1914, all from the 16th and higher levels, amounted to 2,040,722 net tons of ore with a gross value of $38,274,933, from which dividends aggregating $9,817,080 were paid. Its annual production from 1915 to 1932 is shown in the following table.

The shaft was deepened in 1914 to a total depth of 1,943 feet (altitude about 8,265 feet), and developments on levels 18 and 19 were begun. A washing plant for treating low-grade ore was also put into operation. The mine at that time and for the next two years was in its most prosperous condition but the report for 1916, presumably after levels 18 and 19 had been well developed and found to be somewhat less productive than the levels above and the addition to ore reserves was disappointing, stated that a consideration of ore reserves and milling practice indicated that future success depended on the