LEAD ZINC AND COPPER DEPOSITS OF THE ORGAN DISTRICT, NEW MEXICO

(With a Supplement on Occurrence of Bismuth)

Claude C. Albritton, Jr. and Vincent E. Nelson

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ABSTRACT

The Organ mining district of Dona Ana County, New Mexico, has been intermittently active since 1849. It has produced between three-quarters of a million and a million pounds of zinc, approximately four and a half million pounds of copper, and some fourteen and a half million pounds of lead. Prior to the most recent campaign of mining and prospecting, begun in 1942, the district had been virtually idle for 22 years. During this interval the largest and formerly the most productive mines have become largely or entiraly inaccessible. In May 1943, the only active mine was the Merrimac, producing between 200 and 300 tons of 15 percent zinc ore each month.

Ore deposits occur in and around a composite monzonitic batholith of Tertiary age. The ore bodies form shoots in fissure veins and replacement bodies in limestone or monzonite. The vein deposits may produce siliceous copper ore of low grade, provided there is demand for such at nearby smelters, but no appreciable production of base metals can be expected from them. The replacement deposits have accounted for the bulk of past production and contain by far the larger percentage of reserves.

Replacement bodies in limestone are controlled by lithology and structure. In the areas unaffected by strong pre-mineralization faulting the ore bodies are localized along basal or upper parts of limestone and dolomite formations near their contacts with shale or sandstone. Within the favorable zones ore shoots are most commonly localized along the crests of minor anticlines superimposed on larger folds or on homoclinal structures.

In areas of strong pre-mineralization faulting the replacement bodies are controlled primarily by the shear zones and secondarily by position of favorable beds abutting against the faults.

Inaccessibility of many of the mines and lack of sufficient exploratory work in the accessible places make it impossible to define or evaluate the ore bodies known to exist. Indicated reserves include between 2600 and 3000 tons of 15 percent zinc ore at the Merrimac mine, 17,000 tons of material containing between 1 and 3 percent copper at the Torpedo mine, and between 6,000 and 7,000 tons of 2 percent copper ore (siliceous) at the Sunrise. An additional 1,000 tons of ore containing between 10 and 15 percent zinc is inferred to exist at the Merrimac.

The survey ofthe district indicated that previous explorations have not tested a number of areas where structural controls of ore bodies seem evident. It is believed that the present small production of a few hundred tons of ore per month is a fraction of the potential production, but for lack of a systematic exploratory program the production is not likely to increase within the near future.

INTRODUCTION

The Organ mining district covers an area of approximately 55 square miles in the east-central part of Dona Ana County, New Mexico. (fig. 1) It includes the extreme southern end of the San Andreas Mountains and the northern part of the Organ range. The small town of Organ is situated near the western boundary of the area.

Most mines and prospects in the district are easily accessible by road. A paved highway (U.S.70) crosses the center of the area and connects Organ with Las Cruces, fifteen miles to the west. Las Cruces is served by a branch of the Santa Fe railway which has a terminal 60 miles south in the smelting district of El Paso, Texas.

Mining dates back to 1849, when the Stevenson mine was opened. Construction of the railway through the county in 1881 stimulated mining and prospecting to the extent that the larger ore bodies were discovered by 1900. The interval 1900-1909 has been the most productive in the history of the district. A second period of activity began with the first world war. At the end of the war production virtually ceased, and the district has been essentially idle until 1942 when the present campaign of prospecting and development began.

Between 1884 and 1933 Dona Ana County produced 779,781 ounces of silver, 4,527,763 pounds of copper, 14,437,862 pounds of lead, and 277,531 pounds of zinc. 1/ Nearly all this production was from the Organ district. In June1942, the Merrimac mine was reopened, and its production to May 1943 has been 2400 tons of 15 percent zinc ore. 2/ This increases the total productionof zinc for the district to between three-quarters of a million and one million pounds.

The most recent and comprehensive publication on the district is that of K. C. Dunham 3/, whose excellent and detailed account summarizes all previous contributions to the geology and contributes much new material. The mines and prospects are described in detail commensurate with their size and productivity. Petrologic and petrographic data on igneous rocks are included, and theproblems relating to ore deposition are treated at length.

Field work on which the present report is based was completed between January 1 and May 25, 1943. The accessible parts of all known mines and prospects in the district were examined. The more important workings were surveyed, except where Dunham's earlier work rendered mapping a useless duplication of effort. Surface geology of the district was mapped on enlargements of aerial photographs.

The writers are indebted to all the operators and prospectors in the district for providing full access to their properties. Mr. L. B. Bentley of Organ was generous in supplying maps, assay data, and general information on the mines. Messrs. C. H. Johnson and W. R. Storms of the Federal Bureau of Mines cooperated throughout the course of the project and made possible an examination of some of the shafts. Mr. Storms joined the writers in mapping the Memphis mine.

GEOLOGY

The district centers around a composite batholith of probable Tertiary age, consisting of three types of monzonite. The intrusive cuts pre-Cambrian granite and sedimentary rocks ranging in age from Cambrian to Carboniferous. The general areal geology is shown on Plate 1.

Sedimentary Rocks

Sedimentary rocks within the area mapped belong to the Paleozoic and Cenozoic. The Paleozoic sequence aggregates more than 3800 feet and consists mostly of limestone and dolomite, with lesser amounts of shale and sandstone. Cenozoic rocks include alluvial bodies of several ages and types, including terrace deposits, fan deposits, and pediment gravels. The various kinds of alluvium are not differentiated on the geologic map and are not further treated in this report.

Bliss Formation (Cambrian)

The Bliss formation consists of brown-weathering sandstone, quartzite, and hard sandy shale bedded in thin units and aggregating approximately 140 feet in thickness. Many of the sandy beds are perforated by worm borings, which appear to be the only fossils that have been preserved. The formation rests on pre-Cambrian granite and grades upward into calcareous beds of the El Paso formation.

Ordovician and Silurian Limestone and Dolomite

Overlying the Bliss formation is a sequence of limestone and dolomite totaling 1250 feet in thickness and including the El Paso, Montoya, and Fusselman formations, in order from oldest to youngest. The El Paso is 800 feet thick and consists of thin limestone layers that weather gray. A disconformity, locally marked by fine sandy and conglomeratic layers, separates the El Paso from the overlying Montoya formation. The Montoya and Fusselman together form an apparently conformable sequence of gray-weathering to white-weathering dolomitic limestones containing chert nodules at many horizons. Throughout the entire section fossils are rare, and where present are generally too poorly preserved for identification. No attempt was made to differentiate between the three Ordovician and Silurian formations in the course of areal mapping.

Percha Formation (Devonian)

The Percha formation consists of dark fissile shale that locally encloses small limy concretions. Thin limestone layers occur near the top. The basal layers rest disconformably on the Fusselman, filling small channels that may be as much as 20 feet across and five feet deep. Within the area mapped, the shale averages approximately 100 feet in thickness.

Lake Valley Formation (Carboniferous)

The Lake Valley formation includes approximately 300 feet of limestone and shale. Limestone is the predominant rock; it is white or light gray and is bedded in units ranging in thickness from a few inches to three feet. Many of the layers are coarsely crystalline, and some of them abound with crinoid stems and coral fragments. Chert forms nodules and thin layers at many horizons. The shale is calcareous, occurring in minor quantities as partings between limestone beds.

The Lake-Valley-Percha contact is one of apparent conformity.

Magdalena Series (Carboniferous)

The Magdalena series consists of alternating thin layers of impure limestone, shale, and calcareous sandstone. The total thickness has not been determined, but it must be in excess of 2,000 feet. At the base is a bed of dark gray or brown shale that locally contains plant remains. This bed is similar to others higher in the section so that in areas where bedrock is poorly exposed it is often difficult to locate the Lake Valley-Magdalena contact. In general, however, the two formations may be distinguished from a distance by their contrasting shades of weathering; the Lake Valley weathers white or light gray whereas the Magdalena weathers to shades of darker gray or of brown.

Igneous Rocks

The principal types of intrusive rock are granite and monzonite. The granite is pre-Cambrian; the monzonitic rocks together form a composite batholith of probable Tertiary age. The oldest phase of the batholith, a dark monzonite, is cut by quartz monzonite, which in turn is cut by a stock of quartz-bearing monzonite. Related in origin to the batholith are dikes, sills and small laccoliths of quartz-monzonite porphyry and of rhyolite.

Extrusive rocks cover large parts of the southern Organ mountains, but are limited within the area mapped to a faulted outlier of andesite.

An extended treatment of the igneous geology is to be found in Dunham's bulletin. 4/

Pre-Cambrian Granite

The granite is a medium to coarse-grained rock in which orthoclase is the predominant mineral and quartz and biotite are easily visible without the aid of a lens. The orthoclase crystals may be as long as 20 mm.; they commonly show parallel orientation. Fresh rock is gray but on weathering a reddish color develops.

Enclosed by the granite are small zenoliths of schist and quartzite, and cutting it are pegmatite and aplite dikes that generally do not exceed a few feet in thickness. Cutting the pegmatite and aplite in turn are dark gray or black diabase dikes, now altered to epidiorite.

Tertiary Monzonitic Rocks

Monzonite.- The earliest phase of the Tertiary batholith is a dark medium-grained monzonite containing oligoclase, perthite, enstatite, augite, hornblende, biotite, and accessories. The rock is not exposed within the area mapped, but crops out around the Sunrise copper mine in Texas Canyon. Here it is invaded by quartz monzonite constituting the second and most widely distributed phase of the batholith.

Quartz monzonite.- This rock is composed largely of feldspar--perthite and ologoclase having been identified in thin section by Dunham, who gives the average length of feldspar crystals as 7 mm. The plagioclase is zoned, typical crystals showing pinkish centers and margins of lighter color. On weathering, the inner zones decompose more rapidly than the outer, causing exposed surfaces to have the pitted appearance that provides a helpful criterion for field identification. Quartz is present, though it cannot generally be seen in the hand specimen. Biotite and hornblende occur locally in small amounts.

Quartz-bearing monzonite.- The third and youngest phase of the batholith is coarse-grained quartz-bearing monzonite that is gray on fresh exposure and brown on weathered surfaces. The rock is predominantly oligoclase and perthite. Feldspar crystals average about 10 mm. in length although exceptional individuals may be as long as 25 mm. Hornblende and biotite may also be recognized in the hand specimen, but careful examination with a lens is required to detect the small amounts of quartz that are present. The rock contains abundant xenoliths of dark color believed by Dunham to represent altered masses of monzonite from the earliest phase of the batholith. These xenoliths have rounded outlines and generally do not exceed two feet in longest dimension.

The quartz-bearing monzonite is cut by numerous thin sheets of aplite and it encloses large, irregular bodies of pegmatite.

In the field the three phases of the batholith may generally be distinguished by differences in color and texture -- the monzonite by its dark color, the quartz monzonite by its medium texture and zoned feldspars, the quartz-bearing monzonite by its light color and coarse texture. From the pre-Cambrian granite the monzonitic rocks may be recognized by the fact that the quartz is not present in sufficient amounts to show conspicuously on weathered surfaces.

Quartz-monzonite porphyry.- This rock forms dikes cutting the youngest phase of the batholith, and sills intruded into the Paleozoic sedimentary rocks around the batholith. The sills are generally so highly altered that little can be judged regarding their original composition. Quartz and feldspar occur as phenocrysts, but the feldspar is mostly replaced by sericite. The rock is white on fresh exposure but turns brown on weathering.

The dikes are less altered than the sills, and Dunham has identified the common phenocrysts of certain examples as oligoclase and perthite. The fine groundmass is of quartz and feldspar.

Rhyolite

The granite, the Paleozoic sedimentary rocks, and the Tertiary monzonitic rocks are cut by numerous rhyolite dikes. The rhyolite is a dense white to grayish rock which locally contains small phenocrysts of quartz and feldspar but which generally shows no mineral constituents that can be recognized in hand specimen. The dikes range in width from a foot to 30 feet; they have vertical or nearly vertical sides and commonly show closely spaced joints parallel to the walls. The greater number are arranged en echelon. Long dikes, as those around San Augustin Peak, show abrupt bends along their outcrops. Easterly northeasterly, and northwesterly systems may be recognized on the geologic map.

North of the Big Three mine is a small rhyolite laccolith in the Lake Valley formation. This evidently was fed by the long dike that terminates on the west near the Excelsior mine.

Andesite

The andesite is a gray, brown-weathering porphyritic rock with phenocrysts of feldspar and hornblende. The phenocrysts are commonly several millimeters long, and they are so closely spaced as to equal or exceed the volume of the groundmass. On the hill west of Copper Buckle prospect the bedding of the lava is obscure. Tentatively Dunham 5/ has correlated these croppings with the Orejon andesite of the southern Organ mountains.

Metamorphic Rocks

Along the margins of the Tertiary batholith Paleozoic rocks show metamorphic effects that vary with their original composition and with their proximity to the intrusive.

The pre-Cambrian granite and the Percha shale, even where directly in contact with the batholith at its northern end, show no metamorphic changes that serve to obscure their identity. On the other hand the Paleozoic limestones and dolomites have been recrystallized, replaced with silica, or converted to garnetite.

Replacement of limestone by silica is most widespread in the lower (El Paso) beds of the Ordovician-Silurian sequence, which show silicified zones at many horizons to the northern limit of mapping. The dolomitic fraction of the same sequence has been less susceptible to such replacement, and generally the silicified zones that do occur lie within a few hundred feet of the batholith.

The dolomites are recrystallized along the northern part of the area to the limit of mapping. Likewise the Lake Valley formation along its outcrop between the Little Buck and Excelsior mines, is for the greater part changed to coarse-textured marble. Limestones of the Magdalena group show similar alteration in the Memphis mine area.

Garnetized layers are common in the basal El Paso beds, especially within the lower 40 feet. Dense garnet beds are also common in the Lake Valley formation, particularly in the lower part around the Merrimac mine, as well as in the middle and upper parts around the Excelsior mine and along the contact with the rhyolite laccolith to the east. In the Memphis area limestones of the Magdalena series have been altered to coarse garnetite that carries considerable specularite. This alteration is most pronounced in two zones, the more westerly of which is 200 feet away from the contact with the monzonite.

Small bodies of massive green serpentine are found throughout the dolomitic parts of the Ordovician-Silurian sequence. Veinlets of asbestos are commonly associated with the serpentine.

Structural Geology

Stresses operating during emplacement of the Tertiary batholith resulted in arching and folding of the Paleozoic sediments at the northern end of the area. An anticline trending northwest and plunging in the same direction developed along a line between the Silver Coinage and Merrimac workings. Strata along the western flank were irregularly and discordantly invaded by the quartz-bearing monzonite and were cut by dikes and sills of quartz monzonite. North of the area affected by this fold the strikes in the Paleozoic rocks turn more northerly and the regional dip is westward at angles averaging between 30 and 40 degrees.

Superimposed on the nose and northeast flank of the anticline are minor flexures which trend between north-northwest and northwest and which plunge northwest with the axis of the major fold. These small structures are best developed around the Merrimac mine and the Rickardite mine, but similar flexures were also mapped at the Hilltop mine. They are inconspicuous and can hardly be defined without the aid of detailed mapping; yet their economic significance is considerable, as lead-zinc replacement bodies are commonly localized along their crests.

Along the western side of the district the Paleozoic rocks have a prevailing westerly dip, but the structure here is complicated and dominated by a system of north-trending normal faults which make up what Dunham has named the Torpedo-Bennett fault zone. This zone extends beyond the limits of mapping, both to the north and the souther; it is only a few feet wide at the Copper Buckle prospect on the north, but it widens southward and is nearly a quarter of a mile in width at the Stevenson-Bennett mine. Most faults along this zone dip at high angles toward the east, although westward-dipping and vertical fractures are also present. Traces of the major faults are commonly marked by silicified breccia which weathers in relief to form miniature hogbacks.

As the faults of the Torpedo-Bennett zone displace the youngest phase of the Tertiary batholith, it follows that fracturing occurred after the magma was largely consolidated; yet the faults must have formed before the stage of Tertiary mineralization was completed. That they have exerted a major control on ore deposition is indicated by the fact that the largest mines in the district are located along the fracture zone.

A second system of normal faults has a general easterly trend. Faults of this system displace those of the Torpedo-Bennett zone and evidently were formed after mineralization was completed. Such faults are especially numerous in the area of the Hilltop mine where their complexly branching pattern divides the Paleozoic terrain into a series of small blocks.

ORE DEPOSITS

Mineralizing solutions responsible for the ore deposits were active during and for some time following emplacement of the Tertiary batholith. Within the intrusive itself, sulphides were segregated inside bodies of pegmatites or else were precipitated along fissures to form veins.

Solutions moving out of the batholith were guided by fractures and further influenced in their courses by the structural attitude of impervious strata that resisted infiltration. The type of deposit formed depended largely on the solubility and reactivity of the country rock. Where solutions traveled along fissures in the relatively unreactive pre-Cambrian granite they deposited minerals as narrow vein-fillings. Where the fissures lead through limestone or dolomite, the easily soluble and highly reactive rock was locally replaced by sulphides. Along the Stevenson-Bennett fault zone the mineralizing agents locally permeated ramifying cracks in the batholithic rock itself and there formed bodies of low-grade ore.

A simple scheme of classification divides the ore bodies into three groups: (1) segregations in pegmatites, (2) veins in igneous rocks, and (3) replacement bodies in limestone, dolomite, and monzonite. This classification has the advantage of dividing the deposits into categories of differing economic importance insofar as the base metals are concerned. The pegmatite deposits have no possibilities for producing lead, zinc, and copper except in negligible amounts as by-products of precious metals. The veins in igneous rocks are marginal in their possibilities for producing base metals; most of them are valuable only for their content of gold and silver, but some may produce small amounts of lead and zinc as well as high-silica copper ore. It is from the replacement bodies that by far the greater amounts of base metals have been produced and from which any future production is likely to come.

Attention is thus confined in this report to the vein and replacement deposits. Examination of the pegmatites at the Ben Nevis, Gray Eagle, and Quickstrike mines added nothing to the account that Dunham has already given.6/

Vein Deposits

In the Tertiary Batholith

The Tertiary batholith is cut by numerous quartz veins, some of which carry high percentages of metallic minerals. The veins are generally nearly vertical and their prevailing trend is easterly. Only a few exceed a foot in width, although exceptional examples may locally be as much as ten feet across. Individual veins cannot ordinarily be traced for more than a hundred feet, although vein systems related to a single set of fractures may persist for several thousand feet along the strike.

The veins were formed by the filling of fissures. Generally the sulphides are concentrated toward the central portions. The common sulphides are sphalerite, galena, and pyrite. Tetrahedrite, argentite, and tetradymite — $Bi_2(Te,S)_3$ — are locally present, and cerargyrite has been mined from some of the oxidized croppings. The silver for which the veins are generally prospected is associated with galena, argentite, and tetrahedrite, especially tetrahedrite which may carry around 10 percent silver according to Dunham's estimate. 7/

Many such veins have been mined and prospected in the northern part of the batholith, as at the Big Three mine, the Rainbow prospect (formerly the Crested Butte), the Navy King, the Hornspoon (formerly the Hawkeye) group, the Amy prospect, the Silver King prospect, the Silver Coinage mine, and the Corpus Christi prospect. South of the highway are the Galloway, Poor Man's Friend, and Sunrise (formerly the Texas Canyon) mines.

Sulphides within the veins may form almost solid lenticular bodies or may be distributed throughout the quartz gangue as discrete crystals. In the first type the ore minerals form shoots a few inches across and generally not more than a few score feet in longest dimension. Assays of such bodies of course give high percentages for lead and zinc. The volume of the vein deposits is so small, however, that they cannot be profitably mined except where there are good values in silver.

Where the sulphides occur as scattered crystals, as at the Sunrise mine, assays show that copper, lead, and zinc do not individually exceed a few percent. Such deposits could be mined for base metals only if there is demand for high-silica ores for use as enriching fluxes.

In the Pre-Cambrian Granite

The majority of veins in the pre-Cambrian follow along the sides of epidiorite dikes, but there are also fissure veins similar in trend and structure to those of the Tertiary batholith.

The veins are important only for their content of precious metals, chiefly gold, and less commonly for their fluorspar. Examination of a large number of mines and prospects showed conclusively that no production of copper, lead, or zinc may be expected from these deposits. The workings investigated included accessible parts of the Rainbow prospect, Black Hawk prospect, Buck Deer prospect, Dona Dora prospect, Dummy B prospect, Eureka prospect, Green Girl prospect, Maggie G mine, Mormon mine, Pagoda prospect, Rock of Ages prospect, Sally mine, Santa Cruz prospect, Sunol mine, and Tennessee mine. All except the first and last named have been described by Dunham. 6

Replacement Deposits of the Hilltop-Merrimac Area

In the northern part of the district, between the Hilltop mine on the east and the Merrimac mine on the west, replacements are localized above or below contacts between calcareous formations and formations of shale or sandstone. Three mineralized zones may be recognized. The lowest is related to the Bliss-El Paso contact and includes the basal 40 feet of El Paso limestone. The medial and upper zones occur respectively below and above the Percha shale. The medial zone includes the upper 10 feet of Fusselman dolomite and the upper lies within the basal 40 feet of the Lake Valley limestone. Only these last two zones have to date been productive of lead, zinc and copper.

Related to the Bliss-El Paso contact.- Along the plunging anticline directly north of the batholith the basal 40 feet of the El Paso contains numerous garnetized zones. These are lenticular in form with their long dimensions parallel to the bedding. The largest garnet body observed was 10 feet thick and could be traced for 50 feet along the strike. Limy beds adjacent to garnet zones are locally replaced with sulphides, of which pyrite, chalcopyrite, and sphalerite are the most common. Galena is a minor constituent. The sulphides are found in narrow shoots a few feet across, not more than six feet thick, and elongated with the direction of dip in the beds they replace. Within the shoots, sulphides occur as closely-spaced lentils that rarely exceed an inch in thickness.

The numerous short drifts, shallow shafts and trenches that explore the favorable zone do not reveal any sulphide bodies that could be classed as ore. The only prospect that offers some promise for production is the Lodge. Here the sulphide zone is four feet thick; lateral dimensions and form have not been determined. The material in the face would probably average not more ghan five percent zinc and a percent each for lead and copper.

Related to the Fusselman-Percha contact.- Beds in the upper 10 feet of the Fusselman are locally replaced by sulphides and tellurides. Ore bodies of this zone have been worked at the Hilltop, Rickardite, and Little Buck mines, and have been prospected at the Mullins workings.

The ore bodies may occur directly below the Percha shale, as in parts of the Hilltop mine, or their upper levels may lie as much as five feet below the contact as in portions of the Rickardite. The maximum thickness of the sulphide bodies now exposed is about four feet, but stopes in some of the old workings suggest that in places the mineralized zones were as much as six feet thick. In form the ore shoots are flat-lenticular, paralleling with the bedding of the Fusselman. They are irregular in plan, and most are elongated with the general line of dip in the country rock. The greatest lateral dimension of individual ore bodies probably would not exceed a few score feet.

In the Hilltop and Rickardite areas the ore bodies are localized along the crests of minor anticlinal folds which trend between west-northwest and north-northwest and plunge with the dip of the country rock. As mineralized shears are associated with these folds it would seem that the structural control is ultimately due to fissuring of the anticlinal crests at the time the folds were produced. Ascending solutions followed these fissures to the basal Percha, were checked by the impervious shale, and deposited their mineral content in the subjacent dolomite.

The ore minerals are sphalerite and galena. Altaite (PbTe) and rickardite (Cu_4Te_3) are occasionally found, and native tellurium is locally present in the Hilltop workings. Gold and silver have been produced at the Little Buck, but the mineralogy of these deposits is not recorded, and the deposits themselves are exhausted.

The lead-zinc ratio varies progressively along the strike of the Percha-Fusselman contact between the Little Buck and Hilltop mines. In the Little Buck area zinc predominates and the ratio is roughly 1:2. The lead is still subordinate but is relatively more abundant at the Rickardite, where the ratio is about 1: 1.7. At the Hilltop, lead predominates over zinc, the ratio being around 1.35: 1.

Two types of mineralization may be recognized. The sulphides may be scattered through the dolomite as discrete crystals or they may form solid masses of interlocking crystals. Deposits of the first type remain in some of the Little Buck workings. They are too low in grade for profitable mining and do not constitute ore reserves under present conditions. Deposits of the second type are seen in the Little Buck No. 4, the Rickardite, in the Mullins, and at the Hilltop. At the Hilltop the richest ore of this type carries around 38 percent lead and 28 percent zinc. At the Rickardite No. 1 the heavy sulphide bodies average 18 percent lead and approximately 30 percent zinc. These sulphide bodies, while rich, are never more than a few feet thick. The thickest mass of sulphides exposed is in the face of the Rickardite No. 1, where the ore body is four feet from top to bottom. At the Hilltop the richest sulphide body is only eight inches thick.

The value of ore bodies in the upper Fusselman dolomite is problematical. Richness of ore will hardly compensate for the thinness and relatively small volume of the bodies unless mining is done with care and economy. Present explorations do not indicate the order of magnitude of reserges. A campaign of core-drilling is needed to determine the potentialities of the medial zone.

Related to the Percha-Lake Valley contact.- So far as is now known these are limited to the area around the Merrimac mine. Here a salient of quartz-bearing monzonite extends northward to within a few feet of the contact.(Plate 2) North of the salient the shale and limestone are thrown into a series of small anticlines and synclines. These minor folds trend northwest; the longest fold axis that was mapped extends through the Foy workings and can be traced for 400 feet on the surface. The basal Lake Valley beds are garnetized. Near the top of the main garnet zone, and with its base approximately 35 feet above the top of the Percha, is the replacement deposit followed by the Merrimac workings. The ore zone varies in thickness between 1.5 and four feet. Mineralization appears to be structurally controlled here, as at the Hilltop and Rickardite, by the minor folds along the crests of which the ore shoots are localized.

The chief ore minerals are sphalerite and chalcopyrite. Galena is a minor constituent that carries a small amount of silver. Pyrite is abundant, especially along the margins of the shoots where it locally occurs virtually to the exclusion of other sulphides. The gangue is of milky quartz, calcite, and garnet. Within the mineralized zone the sulphides are intergrown to form lentils that may be as much as a foot thick and three feet in longest dimension. Taken as a whole the mineralized zone will average between 8 and 10 percent zinc and between a half and one percent copper. The silver is highly variable, but has not yet exceeded one and a half ounces per ton in the sorted ore that has gone to the smelter.

The value of the deposit remains to be determined, as there has been no effort to block out reserves prior to extraction. It is probable that there are three more or less distinct shoots -- one exposed in the Foy workings and two others in the main workings. The Foy shoot, which has an average thickness of nearly two feet, is about 40 feet across. No exploratory work has been done with the view of determining the downward extent of this body toward the northwest. The two shoots that apparently exist in the main workings average four feet in thickness and vary in width between 20 and 40 feet. There is no reliable information to indicate limits of their downward extensions toward the northwest.

Around the Excelsior Rhyolite Laccolith.

In the vicinity of the rhyolite laccolith north of the Big Three workings the limestone beds in the upper Lake Valley and lower Magdalena formations are garnetized at many horizons. Some of the altered beds have been replaced with copper and zinc sulphides.

Beds of the Lake Valley directly below the laccolith are commonly stained with copper carbonates, and a number of these leads have been prospected by short inclined drifts. The situation at the Tish prospect is typical. Here the copper is contained as films and lentils of malachite associated with limonite and hematite in a zone of thin-bedded limestone a foot thick. Mineralization is sporadic, and the entire deposit would not average one percent of copper. The workings do not extend below the oxidized zone. Here as elsewhere along the rhyolite-limestone contact the deposit is too small and of grade too low to be counted as ore.

West of the laccolith, along or near the contact between the Lake Valley and the Magdalena, are replacement deposits explored by the Excelsior and Cowpuncher mines. The Excelsior, which has produced copper, is entirely inaccessible, and there is no direct information regarding the size and nature of the ore body. Judging by materials on the dump the deposit was a replacement of chalcopyrite and other sulphides in recrystallized Lake Valley limestone that also carries considerable garnet. The conditions were perhaps similar to those observed on a smaller scale in the nearby Cowpuncher mine. Here the replacements in limy beds occur both in the lower Magdalena and the upper Lake Valley. Deposits at the higher stratigraphic level have been for the greater part removed; evidently they consisted of oxidized copper ore with malachite the principal mineral. Smelter returns indicate eight percent copper in the one small shipment from the oxidized zone. Judging by the form of the stope the deposit was a lens eight feet in maximum thickness abutting on the south side against a fault and tapering to an edge a few feet away to the north. Below the level of oxidation there are lentils of sphalerite replacing favorable beds in the Lake Valley. None of these are of sufficient size to justify further developments.

Until the Excelsior mine is made accessible for examination and the controls of mineralization there are determined, the possibilities for further production of copper and zinc from this area cannot be known.

Along the Torpedo-Bennett Fault Zone

<u>Copper Buckle</u>.- Near the northern end of the fault zone at the Copper Buckle prospect, limestone beds of the Magdalena have been replaced with sulphides along the east side of a fault that brings Tertiary andesite in contact with Carboniferous sediments. Prospecting has revealed a zone of almost solid pyrite 15 feet across, but the lateral extent and limits of downward continuation are not known. The pyritized material contains a few hundredths of a percent copper, suggesting chalcopyrite as an accessory. The deposit as now exposed has no value, but in view of its size it would seem to deserve exploration down along the fault.

Memphis.- The Memphis workings explore the ground directly west of a fault separating quartz-bearing monzonite on the east from limestone and shale of the Magdalena on the west. Some limy beds of the Magdalena have been altered to massive garnetite. Peripheral to and between the garnetized layers calcitic beds were locally replaced by sulphide bodies which trend north with the regional strike and dip west at angles between 40 and 65 degrees. Four favorable zones, the most westerly of which lies 300 feet from the monzonite, have been mined. The general inaccessibility of the workings, together with conflicting reports on the composition of the ore, renders impossible any adequate notion regarding the value of the ground.

Examination of the main workings that lead from the South shaft indicated that the ore shoots were aligned along a north-south belt and that they formed tabular bodies of elliptical plan with long axes trending north in some examples and east in others. Most of the bodies did not exceed 30 feet in maximum linear dimension, but a large stope south of the shaft indicates the former presence of a body that must have extended at least 100 feet both laterally and down the dip. The thickness of the ore bodies evidently varied between three and six feet. Judging by material remaining along the sides of the stopes the primary ore consisted of chalcopyrite and sphalerite with some galena, all set in a gangue of milky quartz, calcite and pyrite. Oxidation has produced variable amounts of azurite, malachite, chrysocolla, and calamine. Tetradymite is reported to have been a common constituent in places, but the stope from which high-bismuth ores were reputedly taken was found to have been backfilled to the level of the main drift.

Dunham's compilation of average assays for sulphide ores taken from the main workings shows 10.8 ounces of silver, 6.6 percent copper, 15.4 percent zinc, and 7.1 percent lead. 9/

Torpedo.- The Torpedo ore body occurs in altered quartz-bearing monzonite between two faults of northerly trend. The western fault separates altered monzonite on the east from Magdalena limestone and shale on the west. The eastern fault cuts the igneous rock and roughly defines the eastern limit of the cupriferous zone. Both faults are inclined toward the east at angles averaging between 70 and 80 degrees. Near the surface they are between a hundred and a hundred and fifty feet apart. As the fault surfaces are curved and not strictly parallel, the thickness of the mineralized zone ranges between 30 and 200 feet, as measured approximately normal to the planes of the bounding faults.

Primary ore consists of chalcopyrite, which, with pyrite and quartz, fills numerous closely spaced veinlets in the shattered monzonite between the two faults. This material contains between 1 and 3 percent copper. The richer ores that have been mined in the past had formed by oxidation of this protore. Chrysocolla has been the chief ore mineral, although malachite, azurite and native copper have been mined. These oxidized bodies have been found to extend to the limit of exploration 300 feet below the surface. The stopes to this depth attain maximum widths of about 40 feet. These are now inaccessible, and no sampling could be done. According to L.B.Bentley the ore that was mined averaged not less than 5 percent copper.

Value of deposits that may remain above the 300 level in the oxidized zone cannot be determined until the mine is reconditioned. The only ore body that can now be observed is one of low grade crossed by the 200 level from No. 4 shaft. The workings prove that this body has a length of 275 feet and a width of 75 feet. 10/ Indicated ore at this level amounts to 17,000 tons of material containing between 1 and 3 percent copper. At present nothing can be inferred regarding the limits of this body above or below the 200 level.

Stevenson-Bennett.- Ore bodies in the accessible parts of the Stevenson-Bennett mine have been depleted; accordingly the lengthy description of this mine given by Dunham 11/ will not be duplicated here.

Dunham's mapping showed that the three ore bodies which have accounted for the past production of lead and silver are tabular replacements of dolomite. Mineralization is related to faults and fissure zones and to contacts between dolomite and intrusive sheets of quartz monzonite porphyry. The largest, or Bennett, ore body follows a fracture zone trending north and dipping 70° west. As determined by explorations from the No. 1, No. 2, and No. 3 levels, and at the level of the drainage tunnel, the body was 500 feet long, 20 or more feet thick in the richer portions, and extended downward along the dip for a known distance of 600 feet. Pyrite, galena and sphalerite are the common primary sulphides in the mineralized zone; these are set in a quartz gangue. The upper oxidized portions contain limonite, cerussite, and wulfenite, with lesser amounts of anglesite and smithsonite. Assays preserved by L. B. Bentley indicate that the sulphide body carried between 10 and 15 percent each of lead and zinc, and between 2 and 11 ounces in silver.

The Stevenson ore body lay 350 feet east of the Bennett across the strike. At the surface it follows eastward dipping shear planes, but the mineralization continues downward only about 50 feet along the fault; thence the ore body extended west following along the lower side of a quartz monzonite sill. It has been mined from the No. 6 and No. 7 workings and in open cuts to the south.(Plate 1). The body was of the order of 300 feet in length along the strike. As it cropped out along the surface and extended only a few tens of feet below, it was mostly of oxidized material, with residual pods of galena and sphalerite set in masses of cerussite and smithsonite.

Between the Stevenson and Bennett ore bodies is a smaller replacement called the Paige. This appears at the surface south of the No. 4 workings and has been mined in the No. 1, No. 3, and No. 4 workings. The ore is generally similar in its oxidized portions to that of the Stevenson body and in its unoxidized portions to that of the Bennett.

The three ore bodies have been mined to the point of depletion. Nothing of any value remains above the level at which water stands in the main shaft, 250 feet below the collar. If reserves exist they must lie below this level, but there is no direct information at hand to indicate the possibilities of ore remaining in the flooded parts of the mine.

RESERVES

In the past there has been little effort to block reserves prior to extraction of ore, and such exploratory work as is in progress is not so far advanced as to define the ore bodies that are indicated to exist. Consequently the reserves must be classed as "indicated" or "inferred" rather than "measured".

Between 2600 and 3000 tons of 15 percent zinc ore are indicated in the downward continuations of the ore shoots in the main workings of the Merrimac mine. About 1,000 tons of ore are inferred to exist in the downward continuation of the nearby Foy orebody. If production continues at the same rate as during the past few months, between 200 and 300 tons should be shipped each month.

Indicated at the 200 level from Number 4 shaft of the Torpedo mine are 17,000 tons of material containing between 1 and 3 percent copper. Unless a much larger body of this low-grade ore is established by future exploration, it is doubtful that mining can be done profitably. At present there is no basis for inferring the existence of such a large body of ore.

Indicated reserves at the Sunrise mine amount to between 6000 and 7000 tons of material averaging two percent copper and carrying values in gold. Whether this can be mined under present conditions may depend entirely on the market for siliceous copper ore. If premium prices are to be paid for high-silica ores, the Sunrise is likely to become a producer. However, financial considerations stand in the way of immediate production, and an access road must be constructed if shipments are to be made.

Because of inaccessibility nothing can be said regarding reserves that may exist in the flooded parts of the Stevenson-Bennett, or in the main workings of the Torpedo, Philadelphia, Homestake, and Excelsior, as well as in parts of the Memphis.

Further exploratory work is required to establish values for the promising but unproved ground on the Lodge, Hilltop, Rickardite, and Little Buck claims. Structural controls of mineralization seem to be well defined on parts of these claims, but little consideration has been given them in the course of past developments. No production can reasonably be expected from any of these claims within the next three months.

MINES AND PROSPECTS

Vein Deposits in Igneous Rocks

Corpus Christi Prospect

The Corpus Christi property consists of an unpatented claim registered by W. P. Houser of Organ, New Mexico, and W. L. Hemmer of Corpus Christi, Texas. The prospect is connected with High 70 by a dirt road a third of a mile long. Work was begun on the Corpus Christi in the fall of 1941 and continued until February 1943. No shipments have been made.

The geology of the prospect area and the plan of the underground workings are shown on Plates 3 and 4. A vertical shaft has been sunk 87 feet along a quartz fissure-vein, which has a maximum observed thickness of eight inches. Drifts have been driven at levels 42 and 87 feet below the surface. The upper level follows the vein 48 feet to the northeast. The lower level explores the vein 73 feet to the southwest and eight feet to the northeast. Throughout the prospect the vein is highly variable in thickness. At the end of the upper drift it splits into a stockwork of veinlets where it crosses a diabasic dike. Along the lower drift it consists of a number of curved en echelon units to the point where it disappears upon intersection with a rhyolite dike.

Small crystals of purite and chalcopurite are set in the quartz gangue that forms most of the vein. Two samples collected by the writers were assayed by L. B. Bentley. The first, chosen as representative of the material richest in chalcopyrite, yielded 4.2 percent. The second sample, picked as average vein material, carried only 0.5 percent copper.

The vein is too thin to be mined profitably for the copper it contains, and no reserve of copper ore can be inferred to exist in the Corpus Christi area.

Sunrise Mine

The Sunrise mine is located in Texas Canyon on the east side of the Organ Mountains approximately six miles south of U. S. Highway 70. From Organ the mine is reached by traveling 2.7 miles east on Highway 70 and then turning south on a gravel road which leads to the mouth of the Canyon. Formerly a road led up the canyon the remaining two miles to the mine, but this stretch is now impassable.

The Sunrise group consists of six unpatented claims in Sections 34 and 35 of T. 22 S., R. 4 E. They are registered in the names of Fred C. Schneider and George Hohenberger. The vein that has been mined on this property was discovered between 1890 and 1900. The earliest owners of which there is record were John Dodd and his brother. In 1910 the Texas Canyon Mining and Milling Company acquired the property. Very little development work was done by this company, which abandoned its holdings in 1927. The present owners staked their claims in 1932.

Mineralization occurs along a vein developed in a shear zone striking

N. 76° E. and dipping 80° to the north. The entire length of the mineralized vein along the shear zone is more than 4000 feet.

The mine workings (Plate 5) consist of four drifts driven into the shear zone, one 22-foot winze directly inside the portal of the Number 1 workings, and one inclined shaft communicating with the rear portion of the Number 4 workings.

Exposed at the portal of the Number 1 drift is a six foot quartz vein which widens at the winze to 10 feet. This vein shows heavy chalcanthite and melanterite bloom. Twenty feet from the portal it branches into veinlets that diverge toward the west to form a coarse textured stockwork 25 feet wide. This is explored by drifts at the west end of the workings. The quartz veinlets carry pyrite, chalcopyrite and small amounts of barite.

The Number 2 drift has been driven in the shear zone at a level 50 feet above the Number 1 workings. The south side of the drift follows the footwall of the shear zone. The face exposes several small quartz veins, the largest being one foot wide. Small amounts of pyrite and chalcopyrite can be seen in these veins along with barite and considerable limonite.

The Number 3 drift follows the shear zone at a level approximately 50 feet above the Number 2 workings. Vein material is inconspicuous from the portal to about 25 feet inside the drift, but gradually widens to 2-1/2 feet at a point 45 feet from the portal. From this point the vein can be traced to the face where it again narrows to 3 to 6 inches. The crosscut 60 feet from the portal has been driven through the shear zone to solid dark monzonite on the footwall side. The shear zone is interlaced by small quartz veins, all of which are oxidized and mostly leached but which show thick chalcanthite coatings.

The north wall of the uppermost or Number 4 drift follows the hanging wall of the shear zone, which dips from 67° to 74° to the north. Vein material is present along this entire exposure of the hanging wall. From the portal to the inclined shaft it is narrow, leached and unpromising, but at the shaft it is 8 inches wide and in the face has widened to 2.7 feet. Named in order of decreasing abundance, the vein carries quartz, pyrite, and chalcopyrite with small amounts of barite. As in the Number 3 drift, a crosscut has been driven into the shear zone toward the footwall. The face of this crosscut shows gouge indicating that the shear zone was not crossed in the 20 feet. Near the face two quartz veins are cut, the one 1.3 feet and the other 2 feet wide. These carry sulphides with pyrite predominant.

Vein material from the uppermost workings carries tetradymite. The mineral was not observed in the drift, but specimens gathered on the dump showed prismatic crystals up to 2½ mm. in length. Tetradymite is certainly not abundant, as careful search of the dump resulted in finding but a few specimens.

No large shipments of ore have been made by the present owners. Mr. Schneider has given the writers one ore settlement sheet for 12.7 tons of ore sent to the American Smelting and Refining Company at El Paso, Texas, on August 5, 1939. It should be noted that this ore came from the Number 4 workings east of the inclined shaft where material is considerably oxidized and leached of copper. Analytical data [12] on the settlement sheet shows the following:

silver	10.8 oz.	lime	0.1%
gold	0.298 oz.	zinc	0.1%
copper	0.64 %	sulphur	1.5%
insoluble	83.2 %	alumina	3.0%
silica	80.0 %	bismuth	0.1%
iron	6.7 %		

Dunham [13] gives the following as an average of assays for ore from the lower workings and the shaft: gold 0.194 oz. per ton; silver 13.87 oz. per ton; copper 1.57%.

A sample of material coming from near the present face of the upper workings and picked as representatives of the vein as seen at the end of the drift was assayed by L. B. Bentley of Organ, New Mexico, for the writers. It yielded the following results:

gold	0.24 oz.	lime (CaO)	0.078%
silver	3.84 oz.	silica	72.0 %
copper	2.30 %	alumina	0.012%
iron	8.28 %	magnesium oxide	.0 %
manganese	0.0 %		

Reasonable assumptions as to grade of ore, size of the body, etc., indicate that there are between 6,000 and 7,000 tons of ore that may be classed as indicated reserves, carrying 2% copper, 0.24 oz. per ton gold, 3 oz. per ton silver, 70% silica, 10% (CaO - FeO) and a trace of alimina. Assay data are insufficient to class this ore with measured reserves.

Should there be a market for siliceous copper ore of this type not too distant from the Organ district, the Sunrise Mine appears to be worthy of development.

Hornspoon Group

The Hornspoon group includes workings in La Cruz Canyon on the northwest side of San Augustin Peak. The mine area is two miles northeast of Organ, and is joined with Highway 70 by a dirt road that can be traveled by truck to within a few hundred yards of the point of operations. Three unpatented claims registered by F. C. Hoffer and F. B. Seale of Las Cruces are leased by H. A. Hershfield of Albuquerque.

Fissure veins cutting quartz-bearing monzonite are said to have been discovered on this ground during the middle of the 19th century by a priest. A number of shafts and prospect pits, now filled or otherwise inaccessible, are attributed to the discoverer, who supposedly mined cerargyrite-rich croppings. Early in 1941 Mr. Hoffer shipped approximately six tons of ore to the El Paso Smelting Works, El Paso, Texas. This trial shipment was settled at $8.84 per ton. Payment was for lead and silver; there was no payment for zinc, gold, and copper indicated in the smelter assay. No further shipments have been made to date.

Present explorations are along a quartz vein which has a maximum thickness of 1 foot and which may be traced along the strike for more than 1000 feet. Its trend is between 75° and 80° east of south and it has an average dip of 80° south. The vein has been explored underground for an aggregate distance of approximately 195 feet by two drifts, here designated as the Number 1 and Number 2 workings (Plate 1).

The Number 1 workings are situated near the most westerly exposure of the vein. A trench and horizontal drift have been driven 128 feet. Maximum thickness of the vein along this drift is 6 inches. The vein consists of vuggy, milky quartz enclosing sphalerite, galena, pyrite and chalcopyrite. A sample collected by the writers and assayed by L. B. Bentley showed 19.53 percent zinc and 4.9 percent lead.

The portal of the Number 2 workings is 225 feet east of the Number 1 portal and 97 feet higher up the slope toward the crest of the San Andreas Mountains. Here the vein is exposed in a drift 27 feet long. In the face the vein has a maximum width of 4 inches. As exposed in a vertical section for 9 feet, it proves to be irregular in width and variable in degree of mineralization. Toward the top, where it branches to enclose a foot of barren monzonite, sulphides are concentrated in small amounts along the sidewalls of the veinlets. Toward the bottom of the face the veinlets converge to form a single body three to four inches across, consisting mostly of sulphides. The most abundant mineral is coarsely crystalline, argentiferous galena. Sphalerite, pyrite and chalcopyrite are present in smaller amounts. The minerals locally show regular zontation. Sidewalls are commonly of dense quartz bordered on the inside by layers of pyrite. The central parts contain intergrown crystals of galena, sphalerite and chalcopyrite. Growing toward the center of the vein and anchored to the sides are elongate quartz crystals, whose attitude indicates that the vein matter filled fissures that were open during the time of mineralization.

A sample of average vein material from the Number 2 workings was assayed by Mr. Bentley, with the following results:

lead	36.35%
zinc	13.39%
copper	1.40%
silver	8.15 oz.
bismuth	trace

The trace of bismuth probably indicates the presence of tetradymite, although this mineral was not recognized in hand specimens.

The ore shipped to the El Paso smelter was from the Number 2 workings. Analytical data on the settlement sheet are given below:

gold	0.02 oz.	silica	70.40%
silver	14.80 oz.	lime	0.20%
lead	7.70%	sulphur	3.60%
copper	0.43%	alumina	4.20%
zinc	2.30%	arsenic	0.27%
iron	4.40%	antimony	0.32%

The occurrence of antimony is taken to indicate small amounts of tetrahedrite, which is fairly common in the eastward continuation of the vein, but which was not observed in specimens taken from the Number 2 workings.

Since the material which is being removed from the workings at the present time cannot be extracted at a profit there is nothing that can be classed as ore. However, blocked out by the projected level of the lower drift and by the downward projection of the face of the upper drift are between 450 and 500 tons of material that should average about 20% lead, 15% zinc, and 1% copper. Silver should run consistently over 8 oz. per ton.

Even if prospecting fails to expose a body of ore, production of a small amount of lead and zinc can be expected incidental to the exploratory work.

Other Mines and Prospects

The following mines and prospects exploring veins in igneous rocks were examined during the course of the Survey project: Big Three mine, Rainbow (formerly Crested Butte) prospect, Amy prospect, Davy King mine, Galloway mine, Singleton prospect, Poor Man's Friend mine, Silver Coinage mine, Silver King mine, Sunshine prospect, Black Hawk prospect, Buck Deer prospect, Dona Dora mine, Dummy B. prospect, Eureka prospect, Green Girl prospect, Maggie G mine, Mormon mine, Pagoda prospect, Sally mine, Santa Cruz prospect, and the Sunol mine. Most of these have been described in Dunham's bulletin.14/ Further description in this report is not warranted as none of the mines and prospects named above can produce lead, zinc, or copper. All were inactive in May 1943.

Replacement Deposits in Limestone and Monzonite

R. C. and R. J. Lodge Prospect

This prospect is the most promising of a series along the Bliss-El Paso contact as exposed in the plunging anticline north of the Tertiary batholith. The ground is leased by R. R. Redington from R. C. and R. J. Lewis, the locators. One small shipment of zinc ore made early in 1943 by the Messrs. Lewis did not compensate for hauling and smelting charges. The ground lay idle until prospecting was resumed in May of the same year by Mr. Redington and his associates.

The prospect is at the end of a tractor road which descends a steep grade westward for half a mile to join a dirt road passable to trucks and leading to U. S. Highway 70 at Organ.

The ore body is a sulphide replacement in El Paso limestone. It is four feet thick with its base approximately 15 feet above the Bliss sandstone. The inclination is 25 degrees northwest with the dip of the country rock. Within the mineralized zone sulphides form subparallel lentils separated by barren or sparsely mineralized layers of limestone and silicified limestone. Pyrite is the most abundant mineral, dark sphalerite the next most abundant. Galena, chalcopyrite, and pyrolusite are minor constituents. Above the sulphide zone is a garnetite bed five feet thick that forms a conspicuous outcrop on the hillslope above the prospect.

Developments consist of a drift that connects with an elliptical stope 20 feet north of the portal. The stope has a long axis of 15 feet that follows down the dip of the ore bed to the northwest (Fig.2). Pyrite occurs practically to the exclusion of other sulphides along the northeast and southwest sides of the stope, whereas sphalerite attains its maximum concentration between the pyritic zones along the northwest face. Relationships suggest that the zinc-bearing zone forms a northwesterly trending shoot approximately six feet wide, four feet thick, and inclined 26° northwest. The shoot does not continue up dip to the southeast.

Eighteen pounds of ore collected from the northwest end of the stope by Mr. Redington are reported by him to have assayed 1.2 percent lead, 2.6 percent copper, and 19 percent zinc. These figures may approximate the grade of such hand sorted ore as may be shipped, but crude ore would not average more than 5 percent zinc and 1 percent copper.

As the concentration of sulphides appears to increase down dip, the prospecting in progress is justified. However, the value of the deposit cannot be predicted from what is now exposed. No reserves in zinc and copper can safely be assumed to exist unless further exploration proves the downward continuation of the shoot.

Hilltop Mine

The Hilltop is on the crest of the ridge west of Black Prince Canyon, 3-1/8 miles northeast of Organ. A pack trail approximately one mile long connects the west portal with the old Merrimac road, and a foot trail leads up the steep side of Black Prince Canyon to the east portal.

The ground was staked in 1881 as the Eureka claim, and was developed in 1904 and 1905 by a Mr. John Thompson15/ . He is reported to have shipped argentiferous galena and auriferous quartz, but production figures are lacking. Subsequently the claim was acquired by Jose Buergo, who leased to the Hilltop Mining Company in August 1929; two years later the company acquired title. Extensive explorations were conducted from the west portal and the workings on opposite sides of the mountain were connected. Certain controls and limits of lead-zinc mineralization were thereby established, and although a few tons of high-grade ore were extracted none was shipped. On March 8, 1943, the company reorganized as the Bethesda Mining Co.,Inc. In May of the same year the mine was idle, but plans were to extract lead-zinc ore pending approval of a loan from the Reconstruction Finance Corporation. The mine is amply equipped for work and is in good condition.

Paleozoic strata cut by the Hilltop workings strike north-northwest and dip west at angles averaging around 35°. Superimposed on this general homoclinal structure are two minor anticlinal swells separated by a shallow suncline. These folds trend west-northwest and plunge in that same direction, with the regional dip. Two systems of joints and minor shears may be recognized; one set trends northwest and the other northeast.

The plan of the mine is shown on Plate 6. From the west portal a cross-cut, begun in the Lake Valley beds, has been driven through the Percha shal shale to the Fusselman dolomite. A long drift to the south and a shorter one to the north together explore the Fusselman-Percha contact for 260 feet along the strike. East of this drift the cross-cut continues at tunnel level, winding obliquely across the strike of the Fusselman and ending in the Montoya. The two short drifts branching from it follow narrow veins in the Fusselman. From the south arm of the long drift connecting with the cross-cut, a raise has been driven up along the Fusselman-Percha contact to join the irregular upper workings. These include the older and also the only productive parts of the mine. With the exception of the adit opening at the east portal, the upper workings follow the Percha-Fusselman contact.

Sulphide mineralization is concentrated along the Fusselman-Percha contact and in narrow fissure veins cutting the beds below. The zone from which past production has come and from which any future production may be expected includes the upper six feet of Fusselman dolomite. Rarely the sulphides extend upward as veinlets and lentils in the basal few inches of Percha shale. The fissure veins are with few exceptions confined to fractures of the northeasterly set. Most do not exceed an inch in thickness and nowhere are they of sufficient body to justify mining.

The primary ore minerals are sphalerite and argentiferous galena, with which quartz and pyrite are generally found. Tellurium is a widespread minor associate; it occurs most commonly as altaite ($PbTe_2$), more rarely as rickardite ($CuTe2$), and exceptionally (as near the upper end of the inclined raise) as the native element.

The ore bodies are tabular or lenticular masses of almost solid galena and sphalerite forming coarse-textured aggregates of interlocking crystals. Shoots are localized along the crests and upper flanks of the two anticlinal arches. Judging by the stopes in the discovery workings and to the southwest, the bodies must have locally attained thicknesses as great as six feet; the thickest body of massive sulphides now exposed is eight inches. The shoots are further confined to the up-dip parts of the anticlinal arches. The Percha-Fusselman contact is barren along the main drift in the lower workings, as well as along the lower 200 feet of the inclined raise. Exploratory work has not disclosed any general plan or average size for Hilltop ore bodies.

In the suncline between the anticlinal arches the favorable zone in the upper Fusselman is sporadically mineralized. Crystals of galena, sphalerite and pyrite are scattered through the dolomite, but no solid masses of sulphides are to be seen, and the grade of such material is prevailingly too low for mining.

The massive sulphide shoots contain exceptionally high percentages of lead and zinc. Five analyses of heavy ore exposed along the most southerly drift in the upper workings were made by the Colorado Assaying Company and average 8.06 ounces silver per ton, 38.5 percent lead, and 27.9 percent zinc. These were kindly furnished by A.C. Meneray, Superintendent;

There is no ore blocked out in the Hilltop mine, and the sulphide bodies exposed in section along the drifts are too thin to be mined profitably. The most promising showing is that in the southmost drift of the upper workings. Here the massive sphalerite-galena zone is eight inches thick in the face. Its richness is indicated in the above assays. This drift should be continued south, and an inclined raise should be driven northwest along the favorable zone from a point near the present face in order to test the central part of the anticlinal arch that lies in that direction. Asecond area of untested ground meriting exploration lies along the favorable zone down the axis of the anticlinal arch that passes through the discovery workings.

Rickardite Mine.

The Rickardite workings explore the Fusselman-Percha contact zone between the Hilltop claim on the east and the Little Buck on the west. Access is provided by a foot-trail that continues a quarter of a mile east from a dirt road ending at the Little Buck mine.

The ground is covered by one unpatented claim, the Rickardite, owned by B. F. Horton and leased by Cooperative Mines, Inc., of La Madera, New Mexico. Formerly known as the Jim Fisk, the claim was held by L. B. Bentley until the first world war, when Horton acquired the ground. It was reported that in 1915 he shipped oxidized zinc ore worth $2,000. When Cooperative Mines leased the property in July 1941, the main workings had largely filled with wash. Company activities to date have consisted of reconditioning one of the old mines and in reworking the dumps. Thirtyfour tons of zinc ore from the dump of Number 2 workings have been profitably shipped to the Ozark Smelting and Refining Company at Coffeyville, Kansas. In November, 1942, a government loan of $5,000.00 was obtained, and subsequently it was largely consumed in the work of reconditioning. There has been some mining by hand, but no shipments have been made.

The workings are aligned along the south side of a ridge trending east and exposing the Fusselman, Percha and Lake Valley formations in sequence from bottom to top. The regional strike is northeasterly; dip ranges between 23 and 36 degrees northwest. The mine area is singularly free of faults, although inconspicuous folds that plunge northwest down the dip are superimposed on the general homoclinal structure. The favorable zone at the top of the Fusselman has been tested in a number of inclined drifts, pits and trenches. Only the three most promising of these, located by numbers on the geologic map, are described.

The main (Number 1) workings explore the contact zone from its outcrop to a point 230 feet down the dip. The only ore showing is in the hook-shaped end of the inclined drift(Plate 7). Here an ore bed with a maximum thickness of four feet may be seen in the face and traced along the sides for 40 feet. The body replaces beds in the Fusselman dolomite; its top is roughly five feet below the base of the Percha. Primary ore consists of heavily crystalline aggregates of intergrown sphalerite, galena and pyrite. The sulphides form parallel pods and lenses elongated with the bedding and as much as three feet long by six inches thick. Peripheral parts of these masses are altered to carbonates stained with limonite. Both the sulphide and carbonate materials contain high percentages of zinc, but lead seems to be a minor constituent in the oxidized material. This is shown by the following assays of samples collected by the writers as representative of the two types of ore.

	Lead	Zinc	Silver	Bismuth
Sulphide ore	19.89%	31.24%	1.22 oz.	Trace
Oxidized ore	Trace	44.64%	No assay	0.00

(Analyst: L. B. Bentley)

Three large composite samples from the sulphide bodies, taken by Mr. A. C. Bohrnstedt 16/ from walls near the ends of the workings, assayed as follows: 17/

Sample No.	Gold (oz.per ton)	Silver (oz.per ton)	Copper (Percent)	Lead (Percent)	Zinc (Percent)
1	Trace	0.50	0.05	16.4	33.8
2	Trace	0.40	--	14.5	25.9
3	--	--	trace	24.0	27.8
Average				18.3	29.2

The averages are believed to give a fair indication of grade.

The ore at Number 1 is apparently localized along the crest of the anticlinal fold crossed by the lower workings. The arch of the controlling structure should be tested both down the plunge toward the northwest and upward in the opposite direction.

Mineralization similar to that described above is seen along the lower end of the irregular Number 2 workings (Plate 7). Here the ore zone is three feet thick. Structural and stratigraphic controls are not known; the lower workings are entirely in Fusselman beds whose structural attitude could not be determined. A composite sample collected by the writers and assayed by L. B. Bentley showed 1.79% lead, 39.73% zinc, 2.48 oz. silver, and 0.00% bismuth.

In the number 3 workings a northwesterly drift exposes the favorable zone for 60 feet along the strike, and a side drift to the north follows the same zone down-dip 20 feet. Small amounts of sphalerite and galena associated with abundant pyrite replace the upper 1.5 feet of Fusselman at the end of the northeast drift. At the same general horizon along the east wall of the northerly drift is a bedding vein of almost solid galena 2.5 inches thick. According to assay data by Mr. Bentley the galena carries 5 ounces of silver. Around the face of the north drift, theupper one foot of Fusselman contains scattered grains and lentils of sulphides with sphalerite prrdominant.

The attitude of the beds in Number 3 workings suggests that the northeasterly drift crosses a slight synclinal warp and approaches the flank of an adjoining anticline. In view of the control on mineralization commonly exerted by anticlinal arches in this area, further exploration toward the northeast is warranted.

There has been no effort to block reserves on the Rickardite claim, and no effort to follow such structural controls as can be recognized. Exploration by diamond drilling would doubtless be the most economical method of defining such reserves as may exist. It is doubtful, however, that ore could be profitably extracted from the present highly irregular workings. Also the problem of access remains to be solved if mining is to be profitable.

Little Buck Mine

The Little Buck group is situated approximately 2¾ miles northeast of Organ. A dirt road suitable for light hauling connects the mine area with Highway 70. The ground is covered by a patented claim said to be owned by Mrs. Sophie Graham of Los Angeles, California, and held under bonded lease by E. R. Wooley of the same city. Local estimates place the past productionaround $50,000 in gold and silver. Most of these values were extracted prior to 1905; there has been little activity since, and at present the ground is idle.

Numerous small workings explore the upper Fusselman and lower Percha beds. The strata have a general strike of east-northeast and dip north at angles averaging around 35°. They are broken by joints and minor shears that appear to have no prevailing trend, and are locally warped into low folds that plunge down the dip. Sulphide mineralization is localized in veins filling fissures and as replacement deposits concentrated along the upper few feet of the Fusselman.

As the ore bodies formerly mined for gold and silver have been depleted, nothing could be determined regarding their mineralogy. The ore minerals that remain are sphalerite, galena and chalcopyrite, named in order of relative abundance. With these pyrite is almost invariably associated.

Of the accessible workings on the Little Buck, those figured on Plate 8 and Fig. 3 include the largest and formerly the most productive. Workings No. 1 and No. 3 are in the Percha shale, which shows no mineralization at either locality. Little Buck No. 2 explores the Percha-Fusselman contact by a drift to the southwest, and also the Fusselman beds below the contact by a cross-cut to the south. At the end of the drift the upper few inches of Fusselman contain scattered sulphide grains, pyrite predominating. These showings evidently prompted the beginning of a raise up the dip and along the contact. The workings cross shears that contain limonite, galena, and pyrite as narrow fissure veins, and at the end of the cross-cut there is a fracture zone south of which the Fusselman contains ramifying sulphide veinlets.

At the end of the arcuate drift in No. 4 workings a winze leads down 13 feet into a small stope. A fault trending along the south face of the stope has brought the Percha shale on the north down against the Fusselman dolomite on the south. A vein 1.5 feet thick and consisting mostly of sphalerite and pyrite follows the shear zone to the limits of observation. Along the roof of the stope a swarm of thin fissure veins containing sphalerite cut the Percha shale.

At No. 5 workings a short cross-cut in crystalline Fusselman dolomite communicates with small stopes from which pod-shaped and lenticular bodies not more than 20 feet long and a few feet in thickness have been cleanly removed. The only sulphide body remaining is a lens of almost solid sphalerite four feet long and one foot in maximum thickness exposed in section at the western limit of the workings.

The irregular workings of No. 6 follow the Fusselman-Percha contact at two levels and elsewhere explore mineralized shears of northeasterly trend. Near the northeastern end an elongate stope trending northwest records the former presence of an ore shoot in the uppermost Fusselman dolomite that must have been some sixty feet long, ten feet wide and one to three feet thick. This body has been exhausted. Throughout the workings the upper few feet of Fusselman generally show sporadic sulphide mineralization with crystals of galena and sphalerite scattered through the dolomite. The grade of such material is too low for mining.

Similar lean mineralization is seen along the short drift that constitutes the greater part of No. 7 workings.

At Little Buck No. 8 the upper five feet of Fusselman shows heavy sulphide replacements along the crest and flanks of an anticline trending north-northwest. A hook-shaped inclined drift follows down the favorable zone and communicates at its lower end with a stope 15 feet wide and aligned with the anticlinal axis. The stope is filled with wash, obscuring all but the upper part of the sidewalls. Here the Fusselman beds contain scattered grains and small lentils of sphalerite with minor amounts of galena. Samples of representative materials assayed by Mr. Bentley showed 8.7 percent zinc. Along the sides of the inclined drift is a thick pyrite zone that apparently carries no values in zinc or lead.

No reserves of lead, zinc, or copper are apparent in the Little Buck group. There are, however, two showings that deserve exploration. The first is that in the No. 4 stope. The sphalerite vein here should be tested down the dip along the shear zone and thence down the dip of the favorable zone in the upper Fusselman. The second is at the No. 8 workings, where the materials filling the stope should be removed to allow for examination of the sidewalls. Zinc ore that evidently came from this stope is to be found in some quantity on the dump, and it is possible that mining was discontinued here because the materials contained no values in precious metals.

Mullins Prospect

The Mullins prospect, south of the Merrimac mine, was developed by R. C. and R. J. Lewis of Las Cruces, but the ownership is at present a matter of dispute. Workings disclose a massive vein of intergrown sphalerite and galena that has a maximum thickness of six inches (Fig.4). The vein is in the upper Fusselman dolomite; it dips to the west and southwest with the inclination of the beds. It has been explored by a shaft for 30 feet down the dip. An arcuate drift, leading southward from the bottom of the shaft, follows the vein for 35 feet. Cross-cuts both north and south of the shaft were not so driven as to intersect the favorable zone along the strike. However, as the vein thins to a fraction of an inch at the face of the drift, and as it does not seem to persist northward beyond a few feet from the shaft, its outcrop limits appear to be confined to a broad arc, the chord of which is 50 feet. In spite of the richness of material the body of the sulphide is too small for mining.

Black Prince Mine

The Black Prince mine 1/2 mile northeast of the Hilltop has been described by Dunham.[18] The workings are accessible and were examined by the writers. As the ore shoots beneath the Percha have been depleted, the mine was not mapped and the geologic map was not extended north to include the mine area.

Merrimac Mine

The Merrimac is 2.6 miles northeast of Organ, and is connected with Highway 70 by an excellent dirt road suitable for heavy hauling. The ground is covered by a patented claim acquired from E. R. Wooley in May 1943, by the American Smelting and Refining Co. Between June 1942, and May of the following year the mine was operated by Mr. Wooley and 2400 tons of 15 percent zinc ore were shipped. The early history of mining on the Merrimac claim is not known, and there are no available records of past production.

The character and localization of the ore have already been described (pp. 21-22). Although the main values are in zinc, there have been payments also for copper, lead, and silver. Smelter assays provided by Mr. Wooley indicate that the sorted material that has been shipped carries up to 1.38 ounces of silver, up to 1.75 percent copper and generally 1/2 percent or less of lead. One shipment was penalized for bismuth.

The plan of the mine as developed March 31, 1943, is shown on Plate 9. From the west portal of the main workings a drift follows minor sinuosities in strike of the Lake Valley beds along the favorable zone, and communicates with overhead and underhand stopes. This drift struck ore at 40 feet northeast of the portal, and the ore bed has been followed down dip toward the north by an underhand stope. An inclined raise driven opposite the stope and up the dip to the surface did not disclose additional ore. Between the underhand stope and the main stope at the east side of the workings is an essentially barren zone of limestone and garnetite. This seems to divide two roughly parallel shoots, the long axes of which trend northwest down the dip. Most of the mining in the large eastern stope had been done prior to 1942,[19] and that which has since been done closely defines the lateral limits of the shoot above tunnel level. The limits of the shoot down the dip have not been established. From the bottom of a crooked shaft at the lower end of the main stope, an inclined drift continues in the ore zone for at least 40 feet down the dip to the level at which water stands.

The shoot followed by the large east stope has been explored down dip for a known distance of 170 feet and has a breadth between 15 and 40 feet. The shoot nearest the west portal had been followed 25 feet down the dip at the time of examination, when it showed a proved width of 40 feet. In both shoots the ore zone has an average thickness of four feet.

There has been no effort to block reserves in the process of mining, and any estimation of the ore that remains must be grounded on certain assumptions regarding localization and downward continuation of shoots that may prove invalid on further development. Bearing on the down dip continuation of the bodies are log data from a churn drill hole contracted by Mr. Wooley. The well is 200 feet north of the west portal. Approximately 25 feet above the Percha-Lake Valley contact the drill struck a mineralized zone containing sphalerite and other sulphides. The grade and thickness of the zone cannot be deduced from the logg and assay data that have been recorded, but it is reasonable to suppose that the zone itself is a continuation of that mined in the main workings.

Thus Thus, granting that the ore zone explored in the main workings is localized along two shoots that persist northwestward to a line of strike passing through the well, the indicated ore for each shoot would amount to between 1300 and 1500 tons that should yield around 15 percent zinc. This calculation allows for an average width of 40 feet for each supposed shoot, and for a productive zone uniformly two feet thick.

Ore slightly lower in grade but similar in character to that in the main workings has been mined in the Foy workings (Pl. 9a) some 80 feet to the northeast. Developments consist of a short drift communicating with a stope that extends both up and down the dip. The upward limits of the ore body to the southwest are approximated in the face of the overhead part of the stope. The northeastern extent of the ore body is defined by the surface of the hillside along which the favorable beds crop out a few feet east of the portal. At the southwestern end of the drift the mineralized zone is lean and unpromising. Only along the northwest face of the underhand stope is there ore in sight. Here the mineralized zone averages 1.5 feet thick.

The anticlinal flexure along the crest of which the Foy ore body appears to be localized may be traced at the surface for some 250 feet to the north-northwest. Assuming that the ore body extends to the vertical underground projection of this distance while maintaining its present thickness and grade, approximately 1000 tons of 10 to 15 percent zinc ore may be inferred.

Owing to the apparent control of ore bodies in the Merrimac area by anticlinal folds, it is unwise to infer that ore reserves exist in the synclinal area between the Foy and the main workings. No additional likely structures similar to those that have been productive were discovered in the survey of the Merrimac area.

Tish Prospect

The Tish Copper prospect is two miles northeast of Organ. It is located a few hundred feet south of a good dirt road which joins with U.S. Highway 70 at Organ.

The Tish claim is unpatented ground registered in the name of R.R. Redington. The existing workings (see Fig. 5) consist of a crooked inclined drift which follows down the dip of beds in the Lake Valley formation. These workings were completed some years ago and there is no record of their history.

Mineralization at the Tish has already been discussed in connection with the section dealing with ore bodies (p. 12). Due to low grade and small volume, no material is present which can be classed as ore. The showing does not encourage further prospecting for copper or other metals. Due to low grade and small volume, no material is present which can be classed as ore. The showing does not encourage further prospecting for copper or other metals.

Excelsior Mine

The Excelsior Mine is located 1½ miles north of Organ and may be reached by a good dirt road that is passable throughout the year. The property consists of five patented claims and belongs to J. I. Pierce of 201 North Wells Street, Chicago, Illinois. Production is said to have totaled $60,000.00 with values chiefly in copper. The mine was developed from a shaft trending northwest, inclined 60°, and 175 feet deep. The shaft is said to communicate directly with large stopes. The mine workings are completely inaccessible, so that it is impossible to get any first-hand information regarding reserves. Local sources report that sulphide ore, consisting partly of enriched copper ore and partly ofprimary zinc ore, remains in the mine.

Cowpuncher Mine

The Cowpuncher Mine is on an unpatented claim adjoining the Excelsior claim on the east. Its position in relation to the Excelsior may be seen by reference to Plate 10.

The claim was located by R. E. Beasley and deeded to E. D. Shipe and W. L. Hammer. Work was started on the mine in July 1941 and the last mining on the property was in January 1943. During the campaign of prospecting only 1 1/3 tons of ore was shipped from the mine, the shipment being made in January of 1943. The material carried 8.77 percent copper.

The mine workings (Fig. 6) consist of a vertical shaft 78 feet deep communicating at the bottom with a short drift to the southeast and a winze of moderate inclination (42° to 52°) that extends in the opposite direction and ends with a 30-foot horizontal extension. There are two other levels, one at 43 feet and the other 70 feet below the collar of the shaft. The lower of these consists of a cross-cut to the southwest (now largely filled), from which branch out some short drifts. On the same level a small irregular stope has been developed from the northwest and northeast sides of the shaft. The 43-foot level is a short, crooked drift trending northwest.

The 43-foot level drift follows the shear zone indicated on the surface map (Plate 10). Magdalena limestone and shale are broken by numerous small faults, only the larger of which were mapped. Along these fractures there is local development of limonite with some copper stain.

No ore exists in the northeastern stope at the 70-foot level. The accessible part of the cross-cut at this level follows a zone of shearing which seems to be devoid of mineralization except near the face of the drift that branches northwest. Here chrysocolla and hematite are associated in fractures.

The workings from the bottom of the shaft follow along a line of major dislocation in the shear zone. Lake Valley limestone forms the northwest wall and the opposite side is gouge and brecciated rock. In the short drift southeast of the bottom of the shaft the fractured limestone is impregnated with seams of hematite and limonite carrying minor quantities of malachite and chrysocolla. The east side of the northwest drift exposes a replacement body rich in sphalerite and containing some chalcopyrite. This body follows the inclined bedding and may be traced for about 8 feet before intersecting the drift floor and disappearing upward by thinning. Its maximum thickness is one foot.

The Cowpuncher Mine has no ore reserves nor are there any showings of sufficient size to justify further development.

Copper Buckle Prospect

The prospect is 2.75 miles north of Organ. At the Excelsior mine a dirt road branches from the new Merrimac road, leads past the Cowpuncher shaft, and ends at a point three-quarters of a mile south of the Copper Buckle. The intervening distance is across the almost level surface of a pediment along which a road could be constructed at small cost. The ground is covered by two un-patented claims registered in the names of C.T. Seale, F. B. Seale and F. C. Hoffer, all of Las Cruces, New Mexico.

Areal geology and configuration of the area are shown on Plate 11. The Orejon andesite is faulted against westward-dipping beds of the Magdalena series along a fracture zone that trends north and apparently dips steeply to the west. Along a narrow zone east of the fault the Magdalena limestones have been silicified and locally replaced by pyrite.

The pyritized zone is best exposed in the main prospect, an L-shaped pit near the crest of the hill. At the west end of the pit a shaft has been started; it is now filled to a level 16 feet below the surface, though, judging by the volume of materials on the dump, it was never more than a few feet deeper. Along the west side of the shaft is silicified Magdalena limestone. The sulphide body extends from this wall 15 feet to the east where it gives way to crystalline limestone crossed by veinlets of pyrite. Within the sulphide zone the limestone has been almost entirely replaced by sulphides.

Prospecting north and south of this pit has established neither areal pattern nor downward extent of the sulphide body. An eight-foot rectangular pit 65 feet to the south reveals garnetized and silicified limestone cut by thin stringers of pyrite, now largely altered to limonite. Two trenches have been dug north of the main prospect pit. The massive pyrite shows at the south end along the west wall in Trench 1. The zone does not show at all in Trench 2. The proved linear extent of the mineralized zone is thus 40 feet-the distance between the main prospect and the head of Trench 1. The maximum proved thickness is 15 feet, and the maximum downward extent below the surface is 16 feet.

A composite sample from the pyrite zone exposed in the main prospect was collected by the writers and assayed by L. B. Bentley. It contained 0.08 percent copper. Whereas the deposit as presently known is of no value, it nevertheless deserves further exploration. This is the most conspicuous sulphide body exposed at the surface in the Organ district. Elsewhere, as at the Merrimac and Little Buck No. 8 mines similar heavy pyrite has been found marginal to commercial deposits of zinc and copper.

Memphis Mine

The mine area is a third of a mile northeast of Organ. Highway 70 passes through the southeastern corner of the Memphis patented claim, and dirt roads in poor condition branch east from the Merrimac road and lead to the larger of the old workings. The property is owned by the Torpedo Mining Co.

The ground is credited with a production between $200,000.00 and $400,000.00 in copper, zinc and silver. Extraction of ore is said to have begun in 1882, and in 1884 the ore was being smelted at the mine. Little has been recorded regarding subsequent history; the last systematic work seems to have been done between 1927 and 1929 when the Memphis Corporation completed work at the Roos shaft.

Location of the workings is shown on the geologic map(Plate 1); none of the more extensive of these are entirely accessible and most of the shafts are entirely inaccessible. Examination was limited to the upper parts of the zinc stope, and to the 160-foot level of the south shaft which had to be reached by use of a windlass.

The zinc stope follows down a mineralized zone four feet thick, a replacement of Magdalena limestone. Like the unmineralized beds above and below it, this tabular ore body dips west approximately 55°. Its outcrop makes a broad arc convex toward the west and about 200 feet from end to end. Open stopes now partly caved and too dangerous to be thoroughly explored follow the ore bed for as much as 75 feet down the dip, while near the northern end an inclined drift leads 200 feet down the dip from the surface. No ore remains in the accessible parts of the stopes or in the upper part of the inclined drift. The material that was mined here was oxidized; malachite, azurite and calamine were the chief minerals. It is reported that primary sulphide ore was struck at the bottom of the inclined drift and that massive sphalerite remains in the face, but this could not be verified by an examination.

What could be learned regarding the ore bodies that were mined from the south shaft at the 160-foot level has already been noted in the foreoing section of this report. The plan of the workings is shown on Plate 12. A short cross-cut at the bottom of the shaft leads west to the main drift which extends 516 feet to the north and for an accessible distance of 300 feet to the south. The drift follows the strike of Magdalena limestone which dips west at angles of about 65°. All the stopes connect with the main drift; five lie along the workings north of the shaft and three,- including the main stope - lie to the south. Cross-cuts were driven at intervals.

The longest lie near the north end of the drift and explore the terrain 150 feet to the east and for the same distance west. No ore was cut in any of the lateral workings.

The workings from the Roos shaft are inaccessible. According to records of the Memphis Corporation the shaft is 200 feet deep with levels at 27, 55, 65, 100 and 200 feet. It is evident that most of the mining was done between the 27-foot and 65-foot levels, and according to local reports the material extracted was chalcocite. It is further reported that the ore body has been exhausted.

No evaluation of the Memphis ground can be given here since little of the old workings could be seen. The parts examined contain no reserves. It would be worth while to recondition parts of the zinc stope and also the Roos and other shafts for examination. It is very likely that such investigations would lead to recommendations regarding further exploratory work around the zinc stope and east of a line joining the Roos and South shafts.

Torpedo Mine

The Torpedo Mining property is located immediately south of U. S. Highway 70 approximately a quarter of a mile east of Organ in the NW 1/4 and SW 1/4, Sec. 1, T. 22 S., R. 3 E. It consists of two patented claims, the Torpedo and Little Ben Scott, and one unpatented claim, the Papoose.

The Torpedo deposit was discovered in 1899 by William Foy and acquired in the same year by an unknown company which mined $100,000.00 worth of copper ore before June 1900. In 1904 the mine passed into the hands of the Torpedo Mining Company and subsequently has been leased numerous times. The last work to be done on theproperty was in 1941-42 when the International Smelting and Refining Company held a lease on it and carried out a short diamond drilling campaign. At the present time it is idle and held by the Torpedo Mining Company.

Total production figures from the mine are not available but local estimates place them as high as $300,000.00. Almost all of this production was prior to 1921.

Geological relationships in the vicinity of the mine may be seen on the geologic map of the Organ District (Plate 1), and a description of the ore body has already been given on p.p.26-27 of this report.

The mine workings include four shafts designated by numbers as the No. 1, No. 2, No. 3 and No. 4. They are 165, 300, 500 and 165 feet deep respectively. The stopes and drifts on the 200-foot level between the No. 1 and No.2 shafts have caved. The No. 3 shaft is in such condition that it also is inaccessible. Thus it was impossible to gather any first hand information on the greater part of the underground workings. Plates 13 and 14 show the plans of the 200 and 300-foot levels, and Plate 15 shows the regional relations of the workings.

It was possible to examine a part of the 200-foot leve from the No. 4 shaft by use of a portable hand windlass. Figure 7 shows the plan of these workings and accessible portions are indicated on the map. Within the accessible workings a part of the low grade primary ore body may be seen. However, reliable sampling of the ore was not possible for the walls of the drift have acquired a post-mining bloom of chalcanthite which would produce too high a figure for copper content in rock at the surface and in turn result in too low a figure for copper content immediately beneath the surface. Blasting would be necessary if sampling is to be done with any degree of accuracy.

The diamond drilling completed by International Smelting and Refining Company in 1941-42 yields some important data on the Torpedo ore body. Four holes were put down. Their horizontal projections are plotted on the surface map of the mining area (Plate 15).

The No. 1 drill hole was started at the surface 515 feet east of the No. 3 shaft and about 350 feet east of the ore body. Figure 7-A shows its relatiônship to the ore body and also gives pertinent assay data where the hole intersects the ore zone. The No. 2 hole (Fig.8) was started at the same position on the surface but was extended in a southwesterly rather than northwesterly direction. Upon striking the supposed ore horizon difficulty was encountered because of caving. The hole had to be abandoned before reaching the limestone-monzonite contact and no samples could be obtained from the supposed ore horizon for assaying.

The surface location of the third drill hole is 427 feet in a S.71° E. direction from the No. 1 hole. Figure 9 portrays adequately its relation to the ore body and gives assay data of samples taken from the ore zone. The fourth diamond drill hole (Fig. 10) was started at a point 100 feet S. 45° W. of hole No. 3. It is interesting to note that this test never reached the mineralized zone, indicating that the two faults which control it, after having an eastward dip from the surface downward for several hundred feet, apparently assume a westward dip.

Although the drilling campaign was unsatisfactory, some inferences may be made from it. Even though the recovery of samples in the ore zone was poor, there is no indication of a rich, continuous secondary sulphide zone immediately below the explored oxidized zone. The record also indicates that the two faults defining the ore body are converging with depth, causing the ore zone to narrow downward. The tests which cut the lime-monzonite contact showed no mineralization in the limestone. It seems strange that some replacement bodies are not present within the limestone near the contact. This suggests that the faulting in the region may have taken place in two stages. Faulting could have occurred prior to mineralization, these faults serving to guide the solutions; then renewed movement may have dropped the mineralized block down against the unmineralized Magdalena limestone. The second period of movement is also suggested by the relationships of oxidized to unoxidized ore. At the eastern end of the area the oxidized ore goes down at least 300 feet below the surface, while at the No. 4 shaft primary ore is encountered 165 feet below the surface. The renewal of movement could have opened parts of the shear zone sufficiently to allow easy access to surface waters with the resulting deep oxidation.

The question of reserves at the Torpedo property has been discussed in the section dealing with ore bodies, p. 14. Some exploratory work might be justified along the zone of faulting south of the No. 4 shaft, for here lies considerable ground which has not been prospected adequately.

Stevenson-Bennett Mine

The Stevenson-Bennett mine is located $1\frac{1}{2}$ miles south of Organ along the western slopes of the Organ Mountains (SE 1/4, Sec. 11 and NE 1/4, Sec. 14, T. 22 S., R. 3 E.). The property can be reached by car over a dirt road branching south from U. S. Highway 70. It consists of three patented claims and one unpatented claim, owned by the Torpedo Mining Company.

The Stevenson ore body was discovered in 1847. Between that time and 1882 the ore was mined for its silver content and production amounted to about $150,000.00. In 1887 the Bennett ore body was discovered and proved to be much larger than the Stevenson. At this time the mine became an important producer of lead. Several lessors have had the mine since that time, including the Phelps-Dodge and the American Smelting and Refining Companies.

Only a very small amount of work has been done at the mine since the American Smelting and Refining Company relinquished its lease in 1920. In 1941 the International Smelting and Refining Company sank one diamond drill hole on the property. The hole was put down 420 feet S. 81° W. of the main shaft in a S. $74\frac{1}{2}$° E. direction and at an angle of dip of 45°. The drill hole is reported to have been 411 feet deep and intended primarily for assessment work. No assay data were obtained from core samples.

Production from the Stevenson-Bennett mine probably totals more than $1,200,000.00. The mine was idle in May 1943.

The local surface geology is shown on the areal geologic map of the Organ District. Dunham 20/ has given an excellent and detailed account of the mine. His map of the underground workings shows all that are accessible. The writers spent four days in March 1943 examining the mine. There are no reserves in the accessible parts and in view of Dunham's work nothing could be gained by remapping.

Philadelphia Group

The group includes shafts and inclined drifts which explore the limestones and shales of the Magdalena group. The ground is covered by three patented claims belonging to Emmett Isaacks of Organ. It is reported that oxidized lead-silver ore has been produced and that in 1934 the dumps were re-worked. No ore is apparent in the shallow pits, whereas the main workings are inaccessible. It is thus impossible to establish controls for such mineralization as may be present or to evaluate the ground for future production.

As the main workings are aligned northwest along the apparent continuation of a shear zone exposed in the arroyo to the north, it is possible that mineralization is controlled by fissures of this trend.

Homestake Mine

The Homestake is 3/4 mile north of Organ, and is connected with Highway 70 by a dirt road in fair condition and passable throughout the year. The ground is claimed by E. D. Shipe of Las Cruces. Production of lead-silver ore from this property was estimated to have totaled $25,000 as of 1927. In 1937 two shipments, amounting to approximately eight tons each, were sent to the smelter at El Paso. There is no record of more recent shipments; evidently the mine has been idle for the past six years.

The ore body is a replacement of Magdalena limestone beneath a porphyry sill that dips northward between 35° and 40°. 21/ The primary ore consists chiefly of pyrite and argentiferous galena; oxidized ore contained limonite, cerussite and argentojarosite ($Ag_2O \cdot 3 Fe_2O_3 \cdot 4SO_3 \cdot 6H_2O$), according to Dunham. The workings are now completely inaccessible, and it is doubtful if they can be profitably reopened.

Smelter assays for the last ore shipped indicate between 7 and 9 ounces in silver, .01 ounce gold, between 2.6 and 8.6 percent lead, between 0.1 and 6.3 percent zinc, and between 0.07 and 0.40 percent copper. Bismuth was reported in amounts between 0.04 and 0.08 percent.

Inaccessibility of the workings make any evaluation of the ground impossible.

SUPPLEMENTARY REPORT ON BISMUTH INVESTIGATIONS,

ORGAN MINING DISTRICT.

During the course of investigations on lead, zinc, and copper resources in the Organ District a request was made for a similar investigation on bismuth.

In the past bismuth has been reported as having been found associated with the ores from several of the mines in the district. The element appears to be most abundant in mine workings along the western slopes of the San Andreas Mountains in an arcuate belt 2½ miles long and 1/2 mile wide, beginning around the Merrimac mine, extending west and south so as to include the Excelsior, Cowpuncher, Homestake and Memphis mines, and ending near U. S. Highway 70.

Investigations

Memphis Mine

Past history reveals that ores from the Memphis mine have carried the largest amounts of bismuth. Dunham 22/ reports that oxidized ore taken from an open cut on the property carried 13.65 percent of the element. The writers collected a sample from this open cut and had an assay run which yielded negative results. According to Mr. L.B. Bentley, local assayer, bismuth ore was taken from an underhand stope developed from the 165-foot level at the Number 4 shaft. Examination of the workings from this shaft revealed that the stope had been back filled to drift level, making sampling impossible.

Merrimac Mine

A shipment of ore from the Merrimac mine in January 1943, was penalized rather severely for bismuth at the smelter. Shortly after this samples were gathered from the stope yielding the ore. Six chip samples were taken around the stope, each sample including material from the top to the bottom of the ore horizon. Assay data on these samples failed to reveal any bismuth, indicating that bismuth is probably concentrated as pods of tetradymite which are not common in the ore body. Later shipments from the mine have not carried any important quantities of the element.

Cowpuncher Mine

One shipment of approximately 7 tons of ore has been made from the Cowpuncher mine. Smelter returns revealed that this ore carried 0.53 percent bismuth. However, there are no ore reserves at this mine, so no bismuth production can be expected.

Homestake Mine

The last ore taken from the Homestake Mine was in January 1937, when two shipments of approximately 8 tons each were made. The one shipment carried .04 percent bismuth and the other .08 percent. The mine workings are inaccessible at the present so it is impossible to evaluate this ore body.

Rickardite Mine

Samples were collected from the Numbers 1, 2, and 3 workings of the Rickardite mine. These were assayed for bismuth as well as for their lead and zinc content. Only one of the samples showed a trace of bismuth, the others yielding negative results.

Hilltop Mine

A. G. Meneray, superintendent at the Hilltop mine, stated that complete analyses have been made of numerous samples of ore from that mine and none of these have shown bismuth.

Texan Canyon Mine

The one shipment of ore that has been made by the present owners of the Texas Canyon mine carried .10 percent bismuth. This shipment of 12½ tons came from the uppermost tunnel. Samples collected on the dump showed crystals of tetradymite up to 2½ mm. long. The mineral is not abundant, however, as a careful seafch was required to find very few specimens. The mineral does not seem to be present in the part of the vein exposed by the other workings.

Summary

The only mine in the district which seems to have uncovered large enough quantities of bismuth to be a potential producer of this element is the Memphis. The condition of the mine at present makes it impossible to evaluate any reserves of bismuth which might exist. Pulps from samples collected in the Merrimac, together with a sample from the upper end of the filled stope in the Memphis, are on hand and will be forwarded on request.

FOOTNOTES

1. Dunham, K. C., The Geology of the Organ Mountains: New Mexico School of Mines, Bull. 11, 1935. (Table opposite page 191)

2. E. R. Wooley, personal communication, May 18, 1943.

3. Dunham, K. C., op. cit., 272 pp. withmaps.

4. Op. cit., pp. 51-88.

5. Op. cit., p. 54.

6. Op. cit., pp. 198-199.

7. Op. cit., p. 118.

8. Op. cit., p. 205-214.

9. Op. cit., p. 233.

10. Op. cit., p. 219.

11. Op. cit., p. 220-228.

12. Supplied by F. C. Schneider.

13. Op. cit., p. 204.

14. Op. cit., pp. 205-214.

15. Information on history from A. O. Meneray, Superintendent.

16. President, Cooperative Mines, Inc.

17. First two samples assayed by Colorado Assaying Company of Denver, the third by Ozark Smelting and Refining Company, Coffeyville, Kansas.

18. Op. cit., p. 240.

19. Compare Plate 9 with Figure 18 of Dunham, op. cit., p. 235.

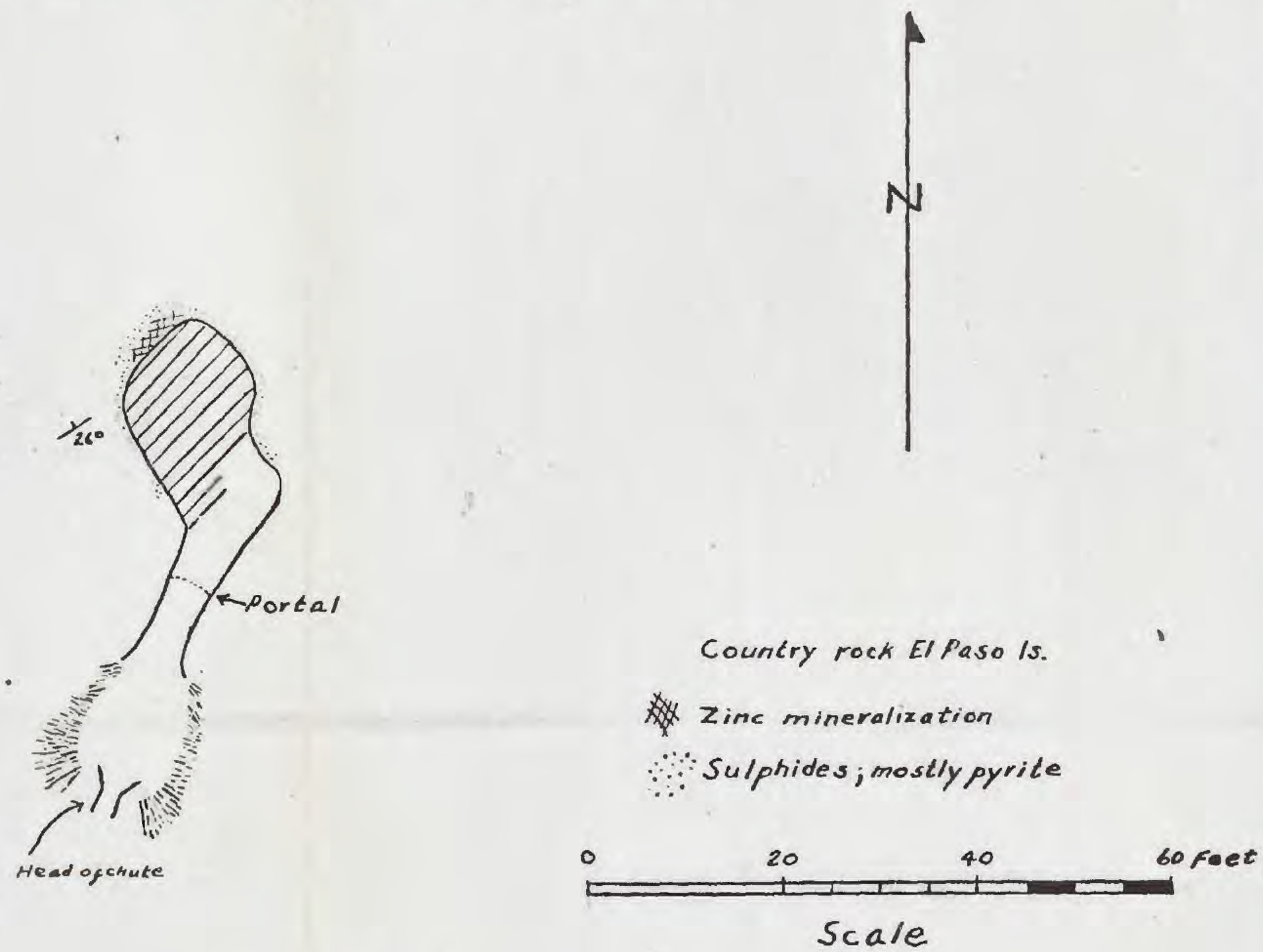
20. Op. cit., pp. 220-228, Plate 12, Figures 16, 17.

21. Dunham, op. cit., pp. 240-241.

22. Op. cit., p. 233.

43-18

R.C. and R.J. Lodge Prospect



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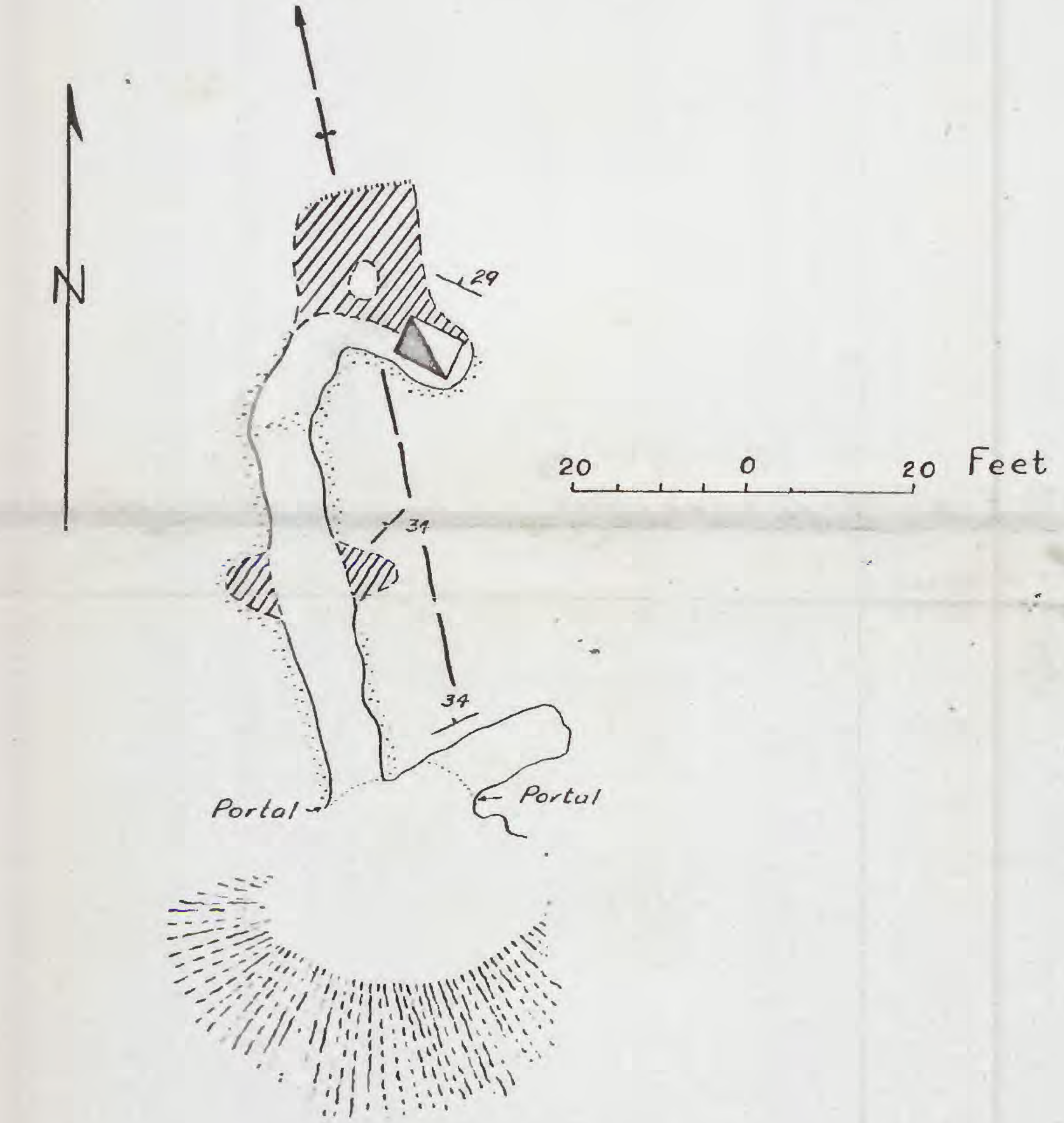
March 1943

Fig. 2

Fig 3 43-18

LITTLE BUCK No. 8



Sulphide mineralization

Axial trace of fold

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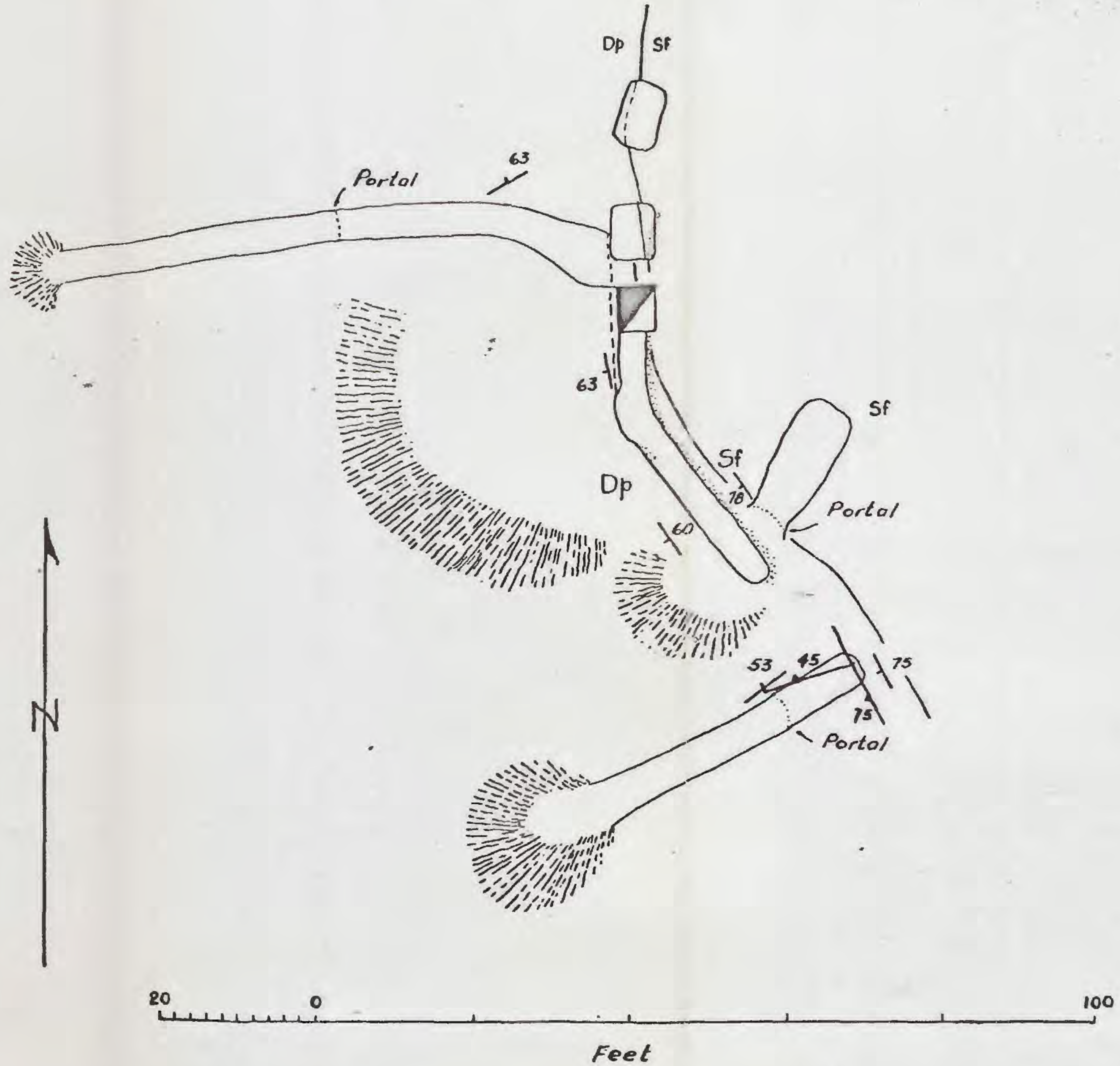
V. E. Nelson
U. S. Geological Survey

11 x 14

Figure 4 43-18

MULLINS WORKINGS



EXPLANATION

Dp - Percha formation (Devonian)

Sf - Fusselman formation (Silurian)

Formational contact - underground

Formational contact - surface

Sulphide mineralization

70 Shear, showing dip

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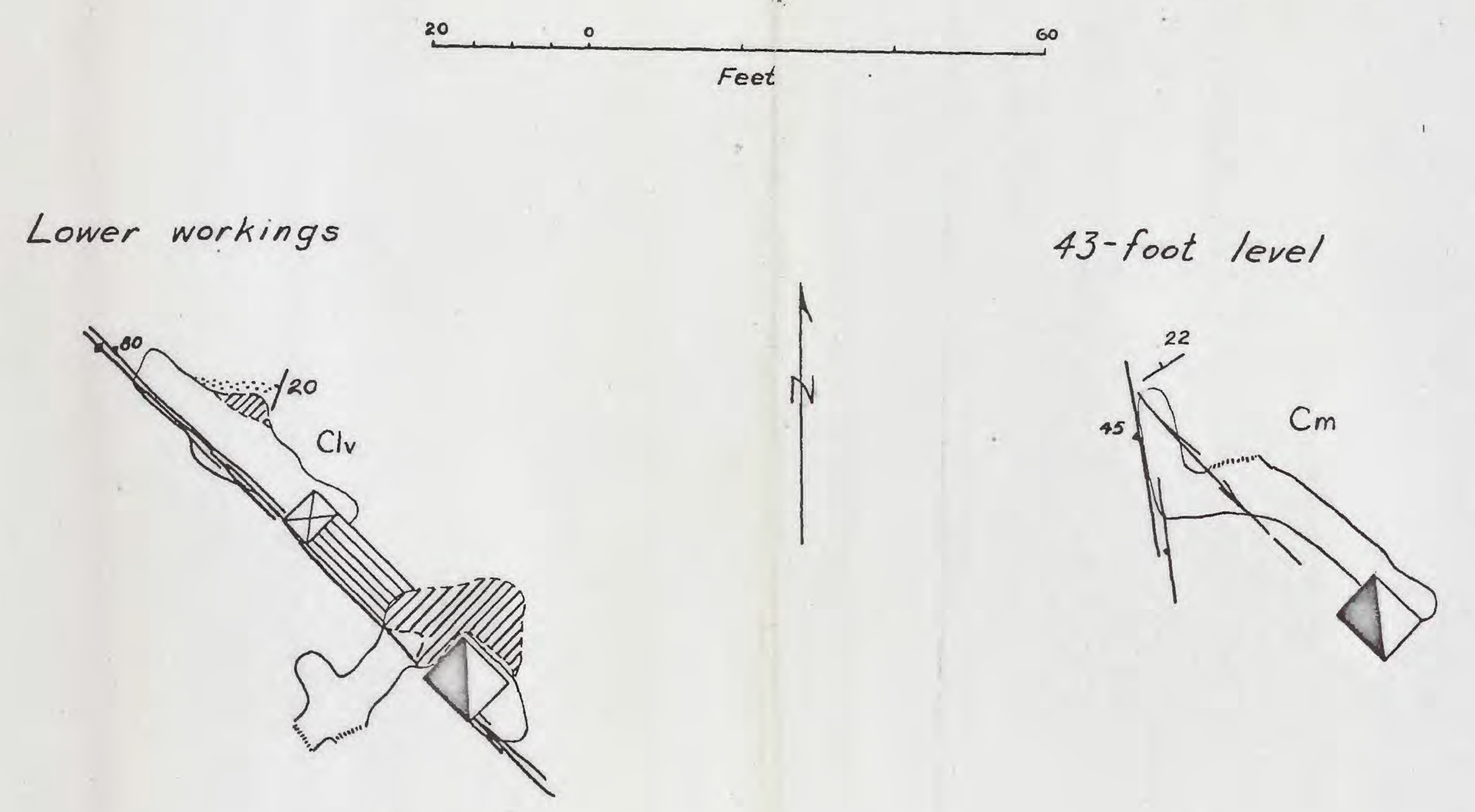
U. S. Geological Survey

April, 1943

11 x 19

43-18
Figure 6

COWPUNCHER MINE



EXPLANATION

Carboniferous { Cm- *Magdalena group (limestone and shale)*
Clv- *Lake Valley formation (limestone)*

Sulphide mineralization

Shear showing dip

Vertical shear

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V. E. Nelson
U. S. Geological Survey

13 x 15

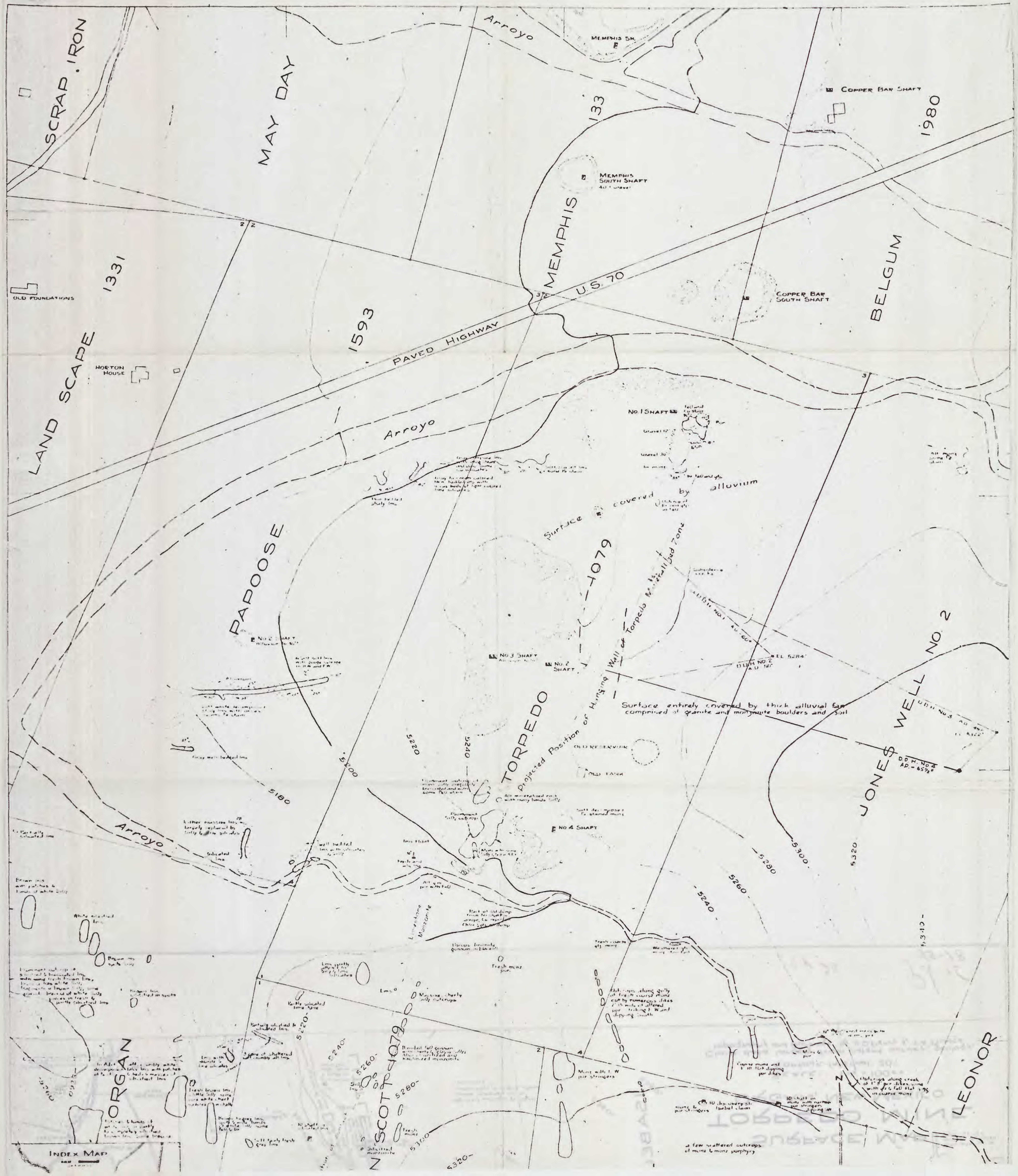
Plate 14

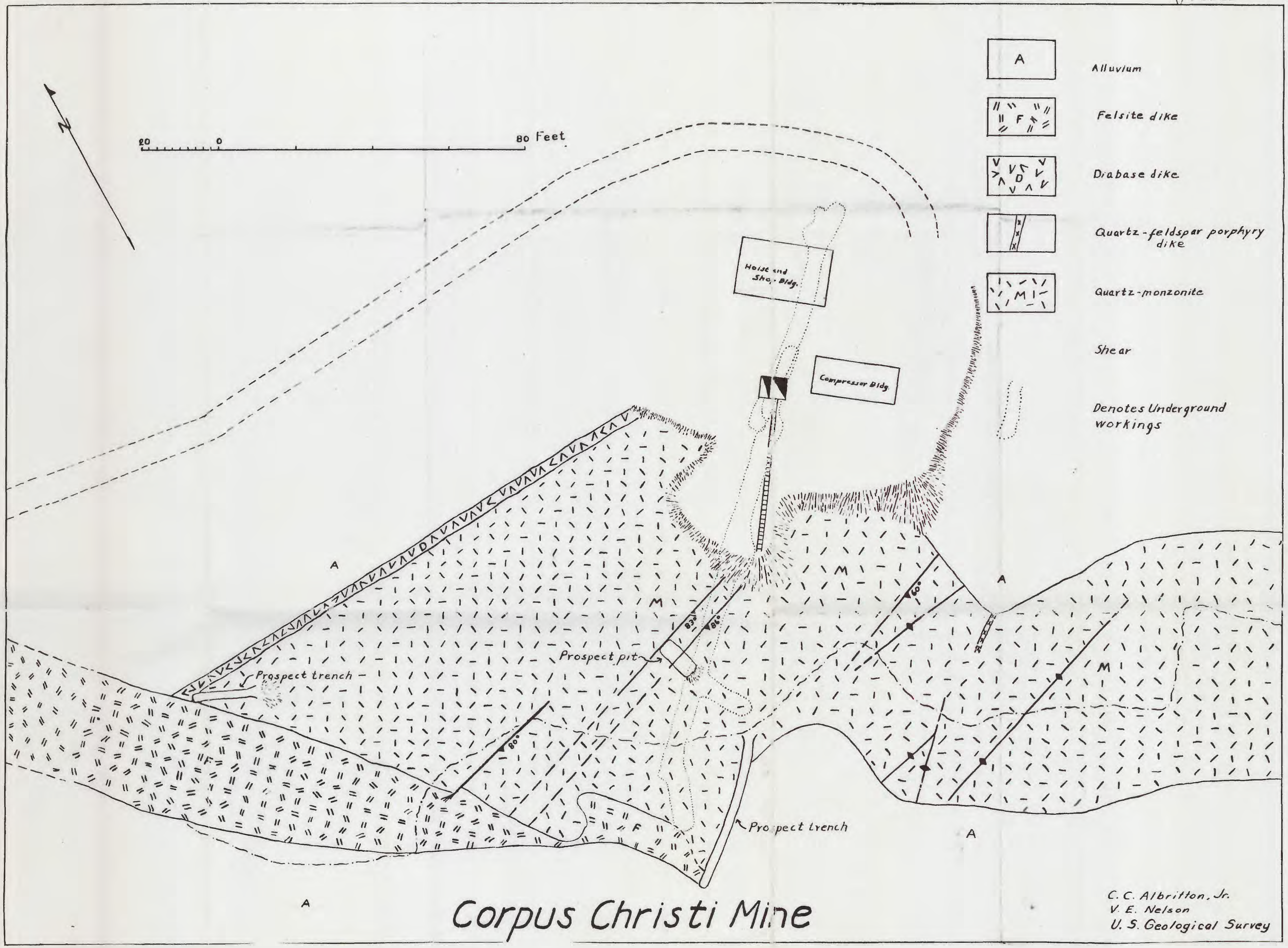
300 Level
TORPEDO MINE
Organ, New Mexico
Scale: 1 in. = 100 ft.
Data from old maps

43-18

43-18

PLATE 15




20
0
80 Feet
N
A
Alluvium
F
Felsite dike
D
Diabase dike
Quartz-feldspar porphyry dike
M
Quartz-monzonite
Shear
Denotes Underground workings
Hoist and Sho. Bldg.
Compressor Bldg.
A
M
83°
86°
60°
80°
Prospect pit
Prospect trench
Prospect trench
F
A
A
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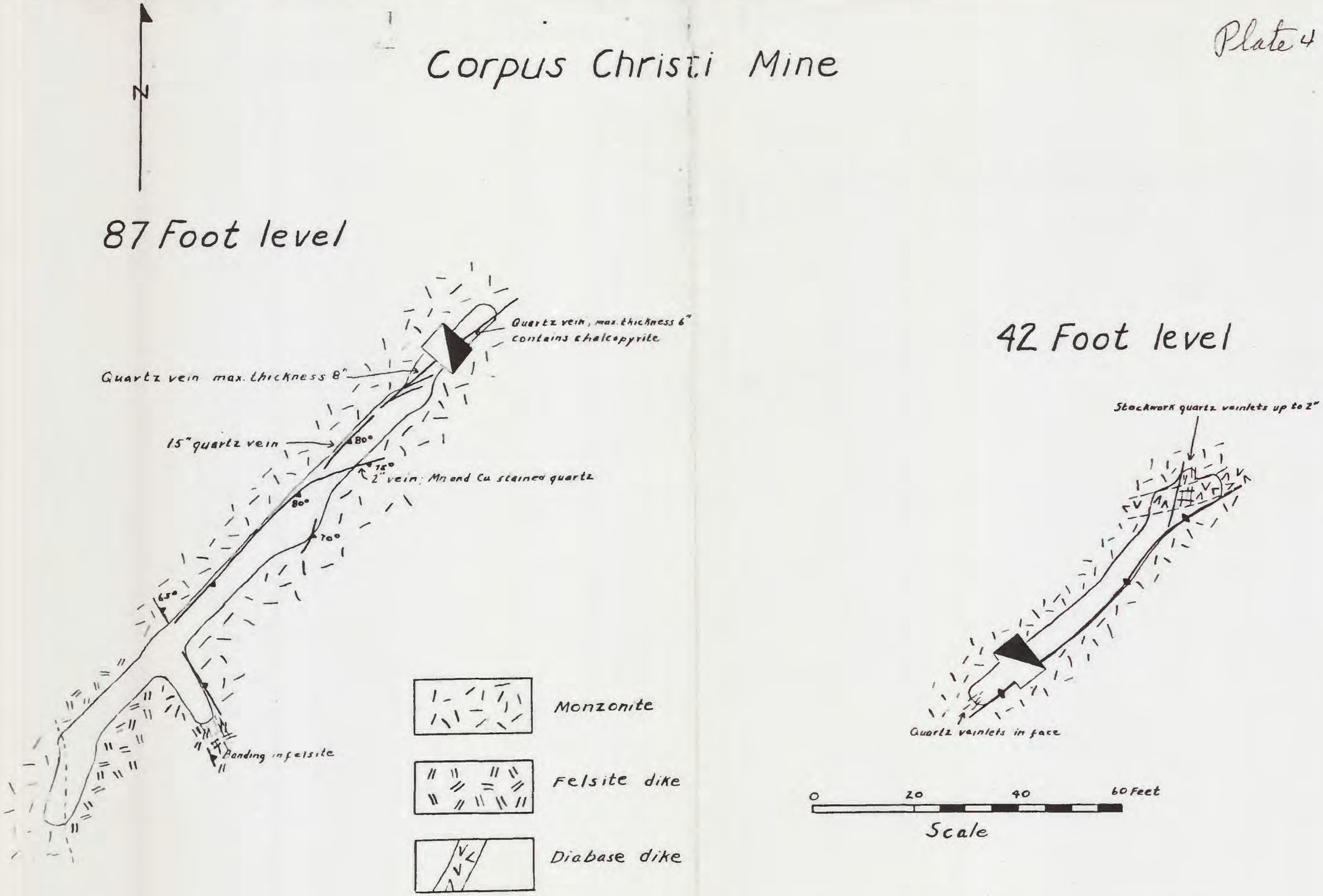
Corpus Christi Mine

Plate 4

43-18

Corpus Christi Mine



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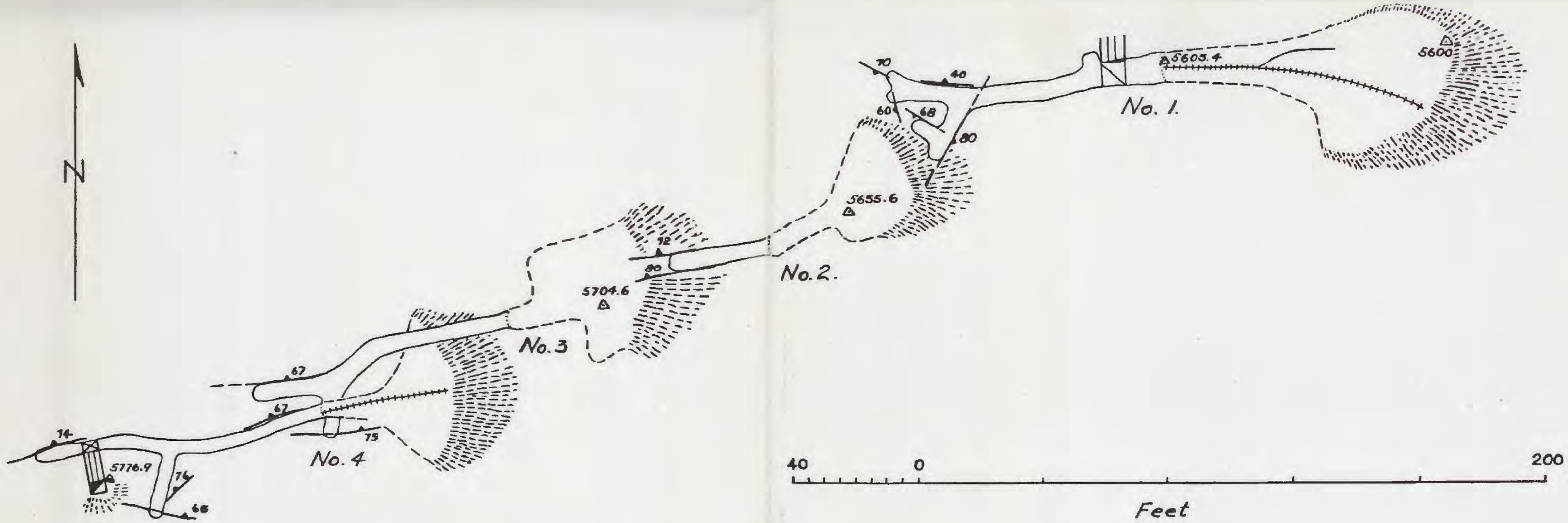
March 1943

43-18

Pl 5

SUNRISE GROUP, TEXAS CANYON



EXPLANATION

80 Shear, showing dip

Country rock is monzonite (monzonite and quartz-bearing monzonite undifferentiated)

Elevations approximate — assumed datum 5600 feet at edge No. 1 dump

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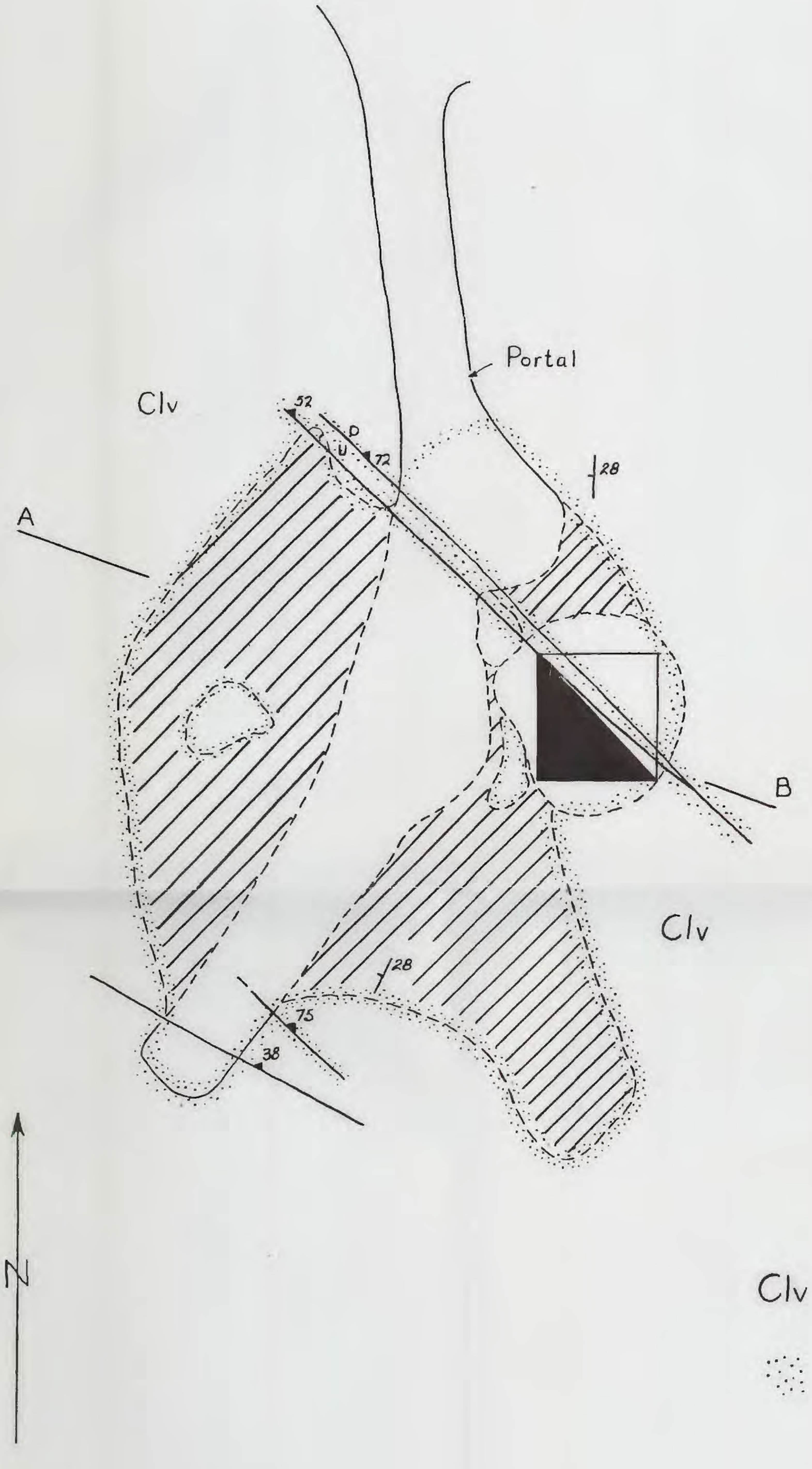
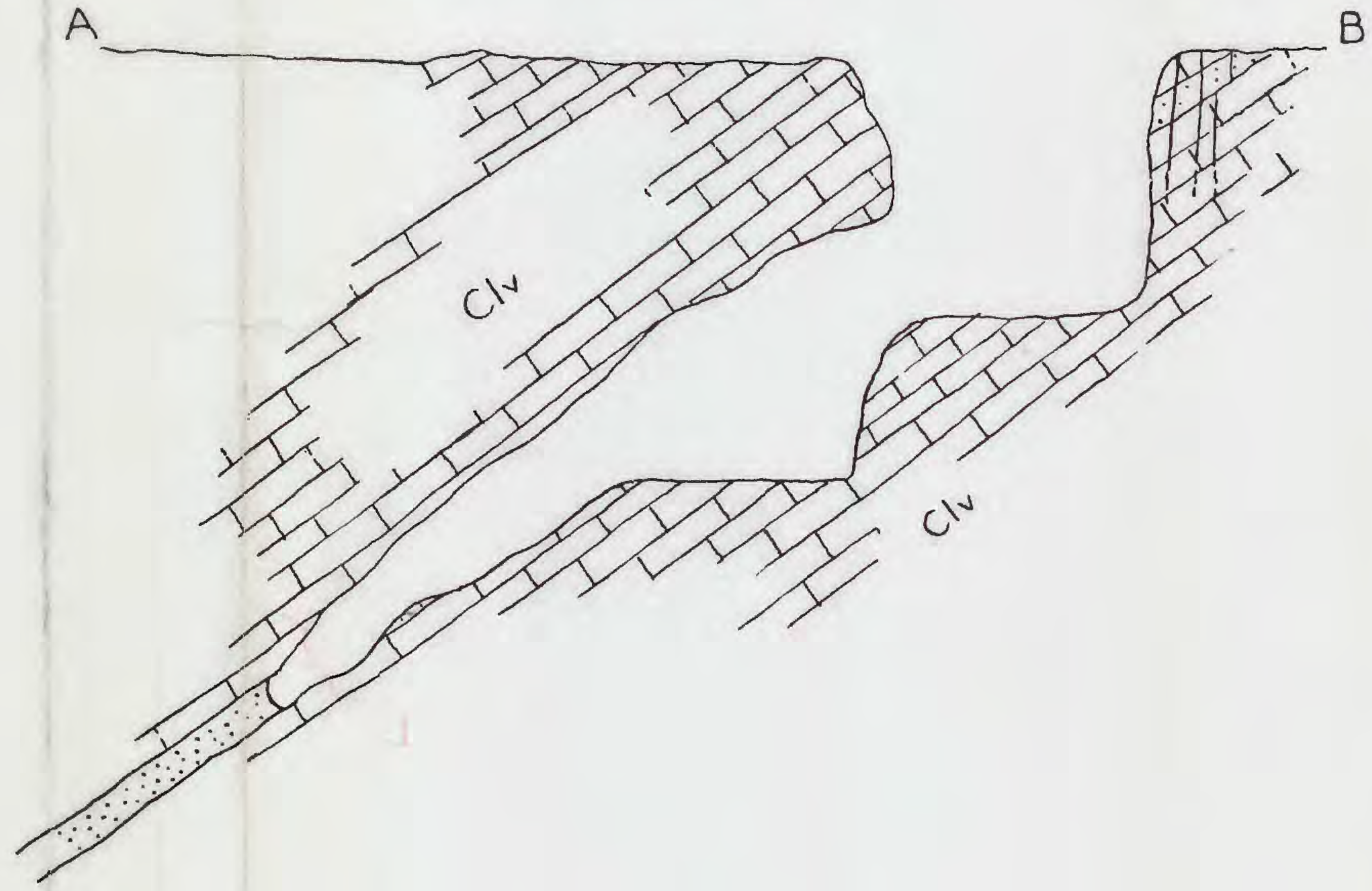
Plate 5

4-3-18
Plate 9-A



Section along Line AB



MERRIMAC GROUP

FOY WORKINGS

10 0 50 Feet

Explanation

Clv - Lake Valley formation

Sulphide mineralization

28 Strike and dip of sedimentary rocks

75 Fault or joint, showing dip

PLATE 9-A

11V 16