MME Form 52
June, 1961

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF MINERALS EXPLORATION

FOR GOVERNMENT USE ONLY
Operator
Docket No. OME –
Contract No. 14-23-090 –
Contract Date

LIEN OR SUBORDINATION AGREEMENT 1/

To the United States of America:

That certain land in the County of Inyo, State of California, described as follows: 2/ known generally as the "Lee Mine and more particularly as the "Silver Reid" Mining Claims, consisting of 9 Lode Claims located near the Saline Valley Road on "Lee" Flat, Recorded in Vol. '24-'30, Pages 310, 311, 312 & Vol. '33-'40, Page 180.

hereinafter called the "land", is the subject of a proposed exploration contract, hereinafter called the "Contract", between the United States of America, hereinafter called the "Government" and

Walter M. Hoover 3/

hereinafter called the "Operator". In consideration for and as an inducement to the Government executing the Contract, the undersigned:

1. (a) Being the owner of an interest in the land, hereby grants to the Government a lien upon all of his right, title, and interest in the land and upon any production of minerals therefrom to secure the payment to the Government of the royalty on production provided for by the Contract, and agrees if the Operator's interest should be surrendered or terminated at any time prior to the expiration of the rights of the United States under said Contract to pay royalty to the Government according to the terms of said Contract; or

(b) Being the holder of a claim, lien, or encumbrance against the land, hereby subordinates his claim, lien, or encumbrance in or against the land and in any production therefrom to the rights of the Government under the Contract with respect to royalty on production and liens to secure same. 4/

2. Undertakes and agrees that property in which the Government may acquire an interest or equity under the Contract may be dismantled, severed from the land, and removed as may be provided in the Contract; and the Government's interest and equity in such property shall be prior and superior to any adverse right or claim of the undersigned.

3. Represents and undertakes that there is no claim, lien, or encumbrance upon the undersigned's right, title, claim, or interest in or against the land other than the following: (If "none" insert the word "none". Do not leave blank.)

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4/ Subparagraph 1(a) does not apply to the holder of a claim, lien, or encumbrance.

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5. Consents to all amendments (including an agreement of termination) and assignments of the Contract without notice thereof, and undertakes and agrees that this agreement shall extend and apply thereto.

6. Added provisions NONE (State "None" or "See Annex No.____".)

Dated this 29 day of Jan, 1962.

Agnes Reid (Seal)	P. O. Box 362 (Street)	
AGNES REID	Newport Ore (City & State)	
(Seal)	(Street)	
	(City & State)	
(Seal)	(Street)	
	(City & State)	
(Seal)	(Street)	
	(City & State)	
(Seal)	(Street)	
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INT.-DUP. SEC., WASH., D.C.
95181

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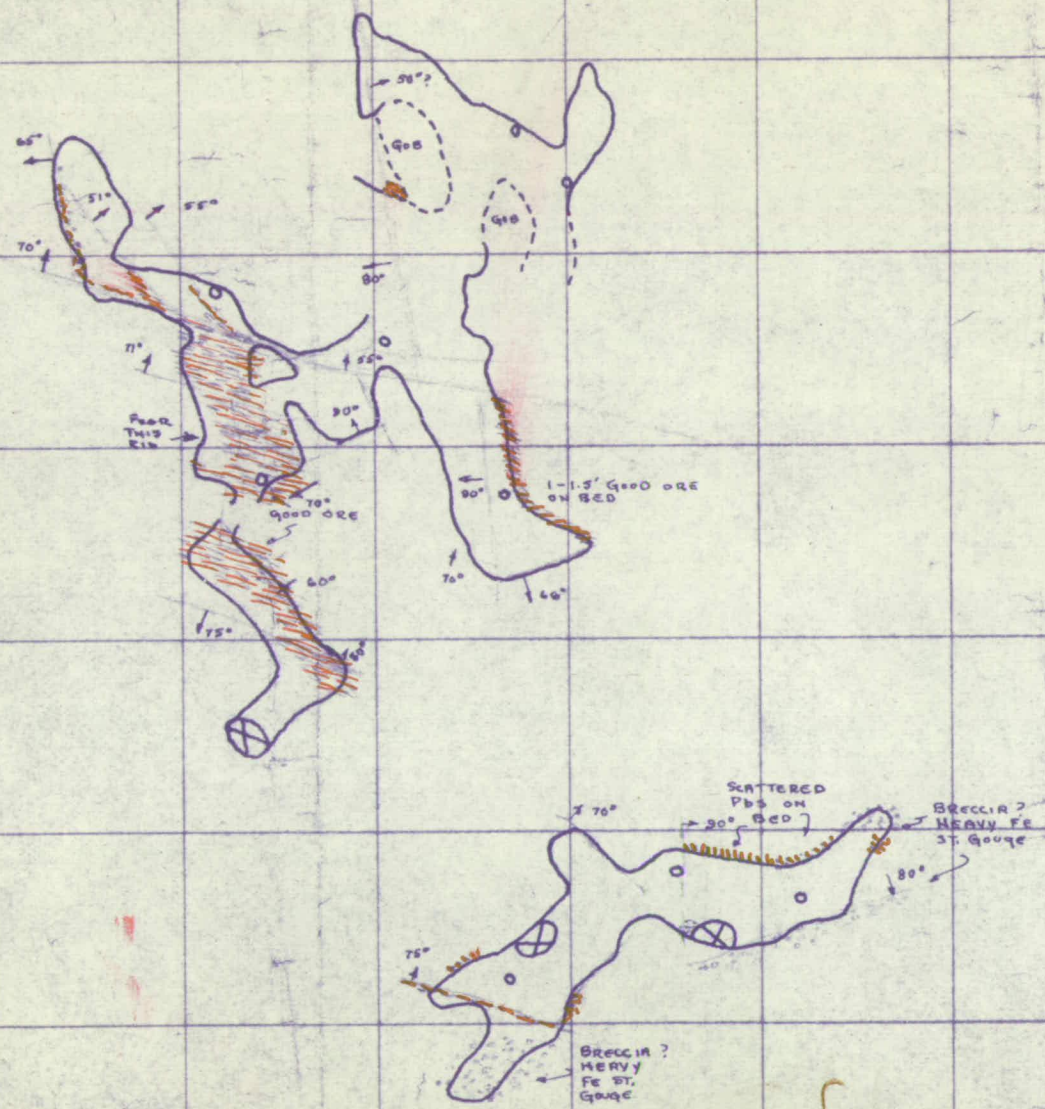
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DATE	INITIALS	NOTE

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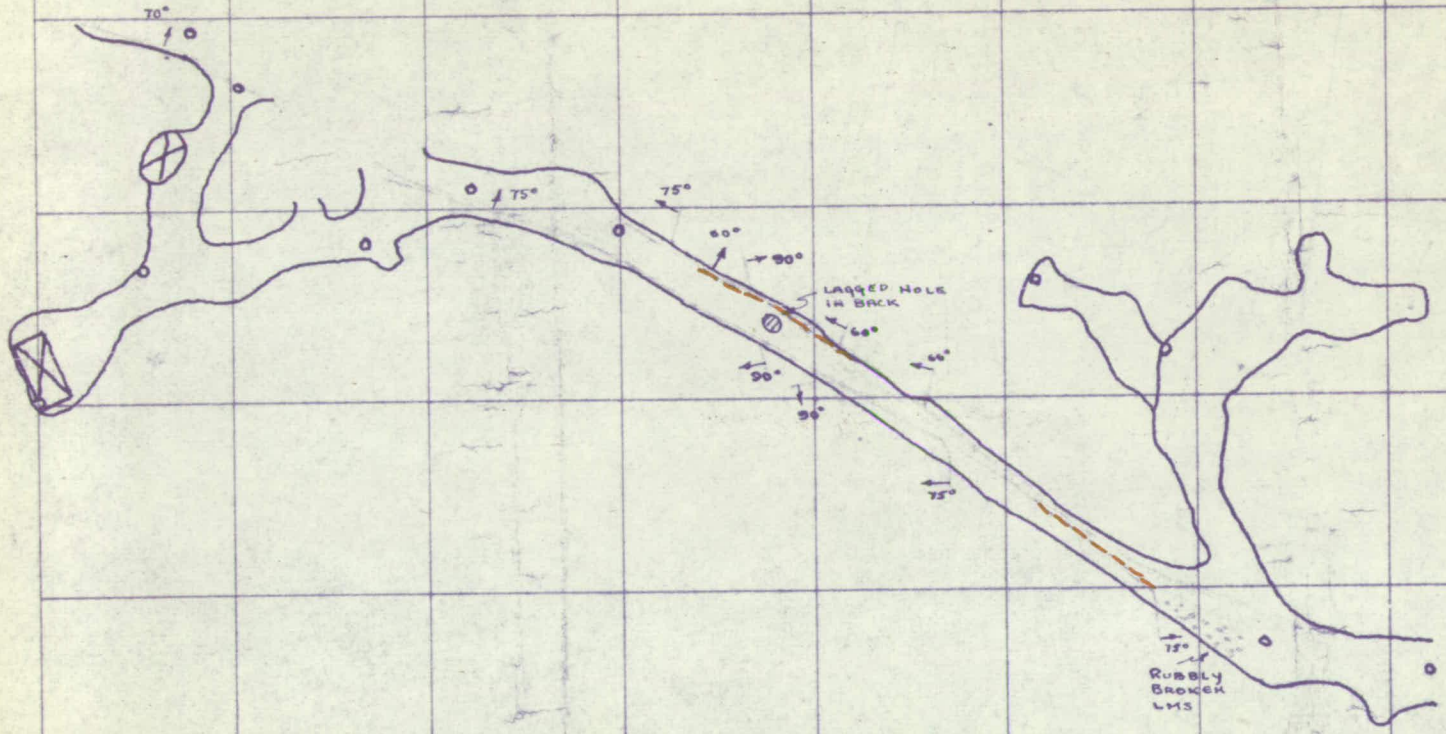
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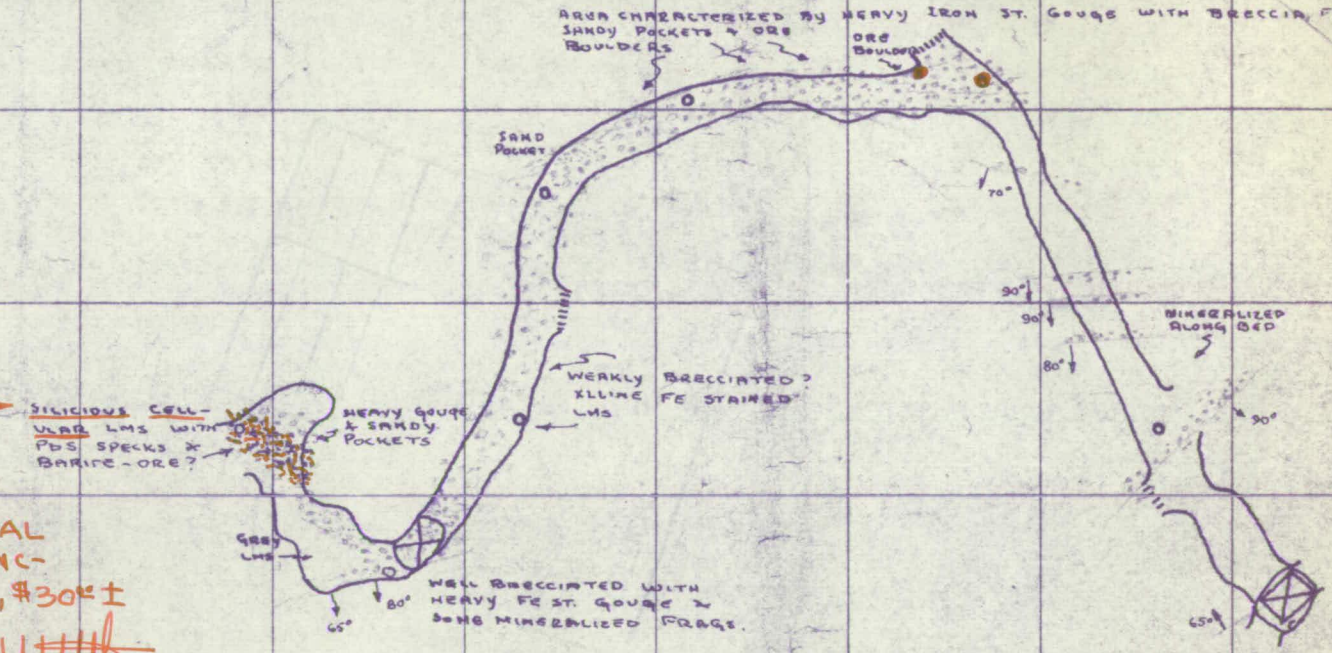

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1.2.8 K. FORM 169

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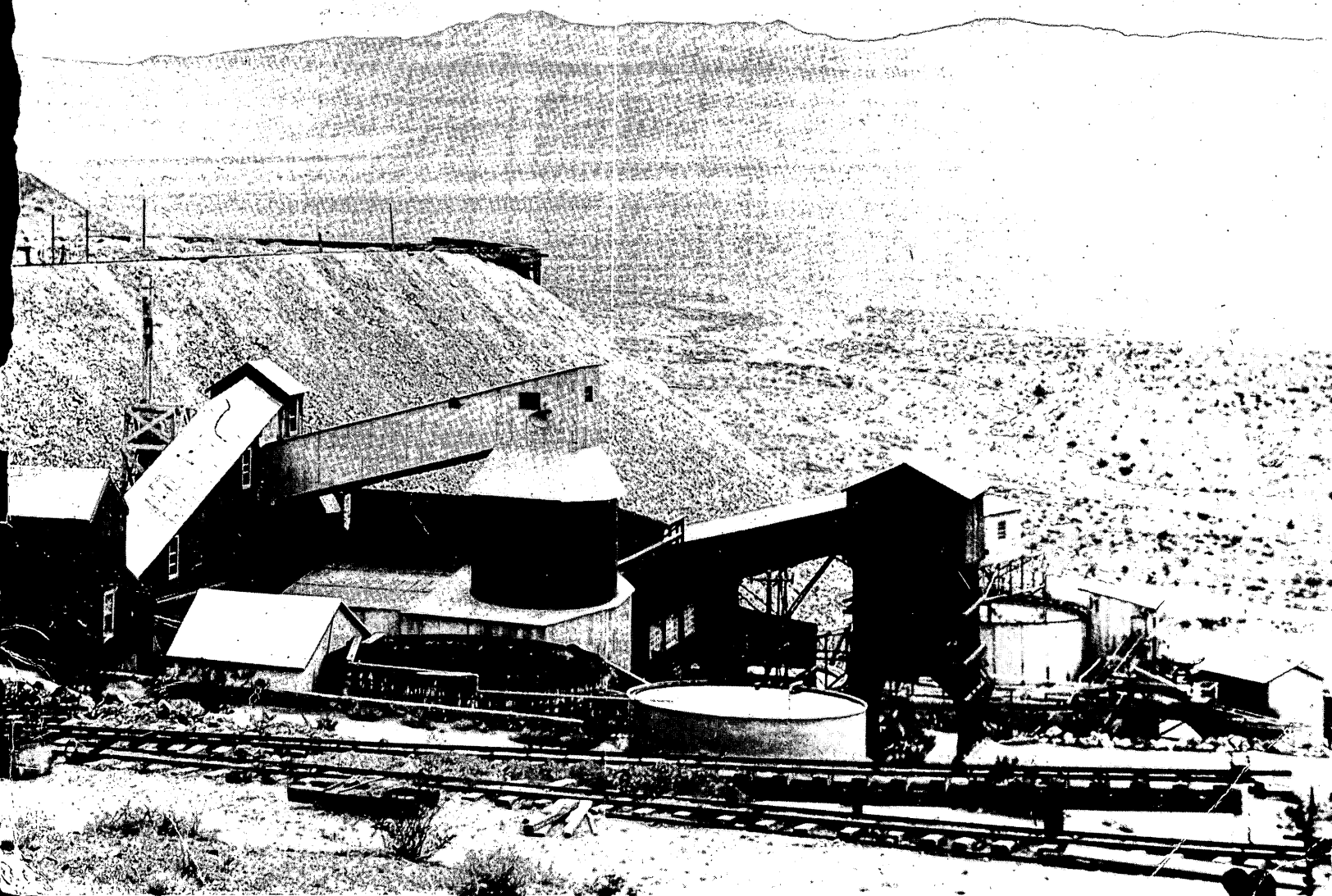
Economic Geology of the
Darwin Quadrangle
Inyo County, California

APR 9 1962
O.M.E.

W. M. HOOVER
764 Loraine
Grosse Pointe 30, Mich.

California Division of Mines
Special Report 51



COVER—Darwin surface plant, Darwin Mines. Maturango Peak, highest in the Argus Range, is in the background.
Photo by Mary R. Hill, 1957.

STATE OF CALIFORNIA
GOODWIN J. KNIGHT, Governor
DEPARTMENT OF NATURAL RESOURCES
DeWITT NELSON, Director

DIVISION OF MINES
FERRY BUILDING, SAN FRANCISCO 11
GORDON B. OAKESHOTT, Chief

W. M. HOOVER
764 Loraine
Grosse Pointe 30, Mich.

SAN FRANCISCO | SPECIAL REPORT 51 | OCTOBER 1958

ECONOMIC GEOLOGY OF THE DARWIN QUADRANGLE INYO COUNTY, CALIFORNIA

By WAYNE E. HALL and E. M. MACKEVETT

With a Section on the
DARWIN SILVER-LEAD DISTRICT
By W. E. Hall, E. M. Mackevett, and D. L. Davis

and on the
TUNGSTEN DEPOSITS
By W. E. Hall, E. M. Mackevett, and D. M. Lemmon

Prepared in Cooperation with the
CALIFORNIA STATE DIVISION OF MINES

Missing Plate I

Price $2.50

ECONOMIC GEOLOGY OF THE DARWIN QUADRANGLE, INYO COUNTY, CALIFORNIA †

By Wayne E. Hall * and E. M. Mackevett *

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† Publication authorized by the Director, U. S. Geological Survey.
* Geologist, U. S. Geological Survey.

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ABSTRACT

The Darwin quadrangle comprises 225 square miles in the west-central part of Inyo County and includes parts of the Inyo Mountains, Coso Range, Argus Range, and Darwin Hills. The dollar value of the mine production through 1951 is estimated at $37,500,000. The principal commodities are lead, silver, zinc, steatite-talc, tungsten, and small amounts of antimony and gold.

The Paleozic rocks range in age from Early Ordovician to Permian in an essentially conformable sequence more than 14,000 feet thick. Silurian and Ordovician rocks are predominantly dolomite; Devonian rocks are limestone, dolomite, shale, and quartzite; and Mississipian and younger Paleozic rocks are mainly limestone. The Paleozoic strata are intruded by the batholith of the Coso Range in the southwestern part of the quadrangle, the batholith of Hunter Mountain in the northeastern part, and by many small plutons. Most of the northern half of the quadrangle is covered by olivine basalt flows and andesite of late Cenozoic age.

Structurally the area is on the west limb of a major anticlinorium where the Paleozoic strata strike predominantly north to N. 30° W. and dip gently to the west. Within 2 or 3 miles of major intrusive bodies the structure is much more complex; the beds are tightly folded and faulted, and much of the bedding is overturned. Inverted anticlines and synclines are common.

The mineral deposits are concentrated around the margin of the batholith in the Coso Range. The Darwin silver-lead district is in the Darwin Hills on the east side of the Coso batholith. Lead-silver-zinc deposits are mainly on the western side of the Darwin Hills and tungsten deposits are on the eastern side. Talc deposits are in the Talc City Hills at the north end of the batholith.

Limestone—altered to calc-hornfels and tactite—is the host rock for most of the lead-silver-zinc deposits and the tungsten deposits; dolomite and to a lesser extent quartzite are the host rocks for the talc deposits. Fractures have controlled the deposition of most ore bodies.

INTRODUCTION

Purpose and Scope

The present investigation of the Darwin quadrangle is part of a long-range program by the U. S. Geological Survey, in cooperation with the California Division of Mines, to study the geologic factors relating to the lead-silver-zinc deposits in a belt extending from the Inyo Mountains southeastward to the Resting Spring district in the Tecopa quadrangle, a distance of about 120 miles. The Cerro Gordo, Ubehebe, Darwin, Modoc, Panamint, Resting Springs, and several smaller districts lie within this belt. As part of the program C. W. Merriam and Ward C. Smith of the U. S. Geological Survey previously mapped the New York Butte quadrangle, which includes the Cerro Gordo district and a report of their investigation is under preparation, and J. F. McAllister (1955, 1956) mapped the Ubehebe Peak quadrangle.

The Darwin quadrangle, which lies southeast of the New York Butte quadrangle and south of the Ubehebe Peak quadrangle, was mapped during 1952 and 1953, and the mineral deposits were studied during 1954. The quadrangle contains some of the most important lead-silver-zinc mines in the State, the largest steatite-talc-producing area in the State, and significant tungsten deposits.

The report is divided into two parts. The first part briefly describes the rocks and structure of the Darwin quadrangle. The second part is a description of the mineral resources, including the deposits in the Darwin lead-silver district, the Zinc Hill district, the Lee district, and the Talc City Hills. Emphasis is given to descriptions of the lead-silver-zinc deposits. The talc deposits are described only briefly, as detailed mine descriptions have been published recently by Page (1951). The tung-

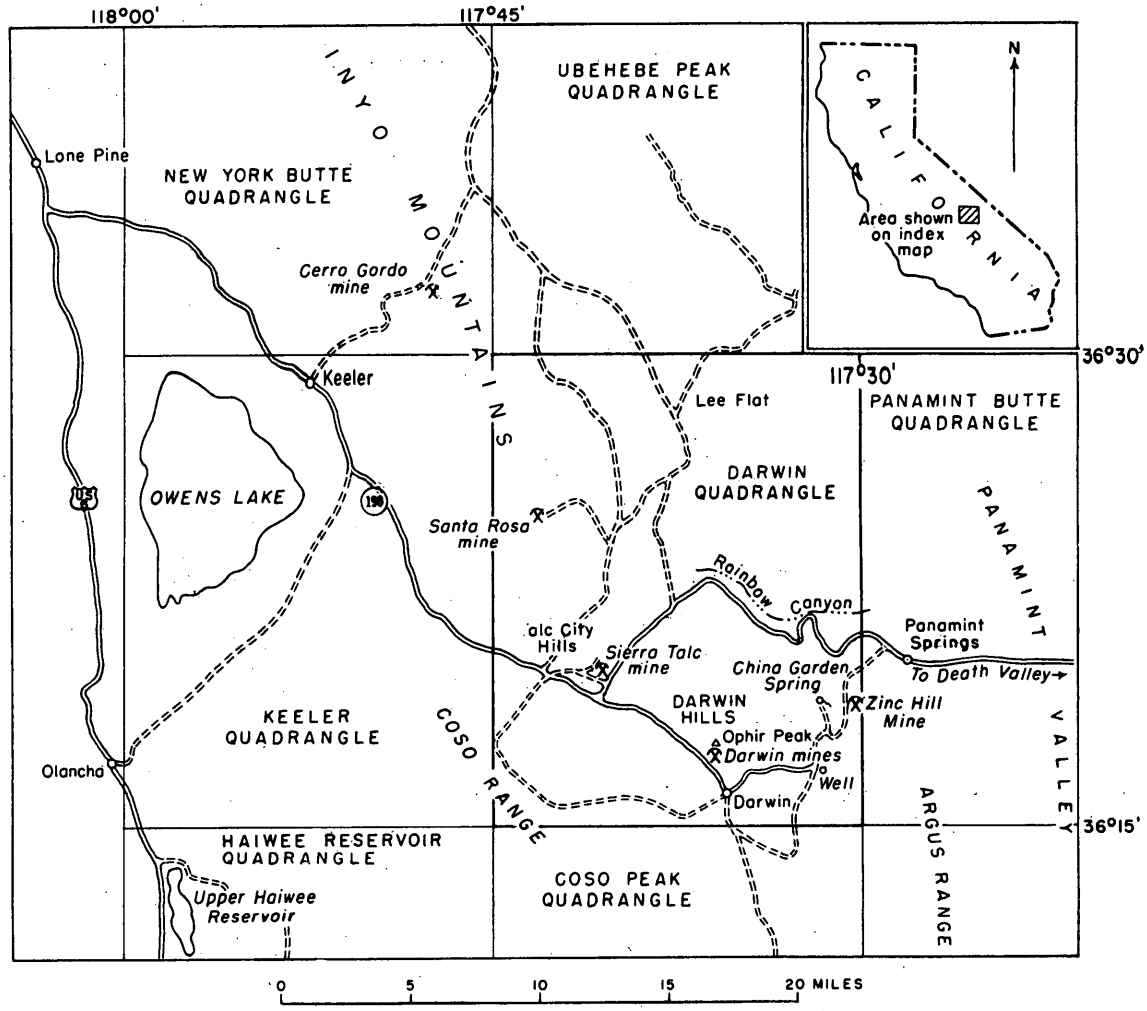

FIGURE 1. Index map of the Darwin quadrangle showing location of principal geographic features.

sten deposits were mapped in 1941 and 1942 by a U. S. Geological Survey party under D. M. Lemmon, and their maps are published herein.

Location and Accessibility

The Darwin quadrangle is in central Inyo County in the southeastern part of California 35 miles southeast of Mt. Whitney and 40 miles west of Death Valley between meridians 117°30′ and 117°45′ W. and parallels 36°15′ and 36°30′ N. (Fig. 1). The southern end of the Inyo Mountains, the northeastern flank of the Coso Range, and the northwestern flank of the Argus Range lie within the quadrangle. Darwin, a small mining town of several hundred inhabitants, is the only town within the quadrangle. The Anaconda Company maintains a large mining camp about a mile northwest of Darwin, and a few residences are at some of the mines and springs.

State Highway 190, which connects U. S. Highway 6 and Lone Pine with Death Valley, traverses easterly across the central part of the quadrangle. Abundant subsidiary roads branch off from the State Highway and provide good access. The nearest railroad is 13 miles by road northwest of the Darwin quadrangle at Keeler, the southern terminus of Southern Pacific's narrow-gauge railroad from Keeler to Laws, Calif. Lone Pine, the principal supply center, is 26 miles by paved highway northwest of the Darwin quadrangle.

Climate and Vegetation

The climate is characterized by scant rainfall, a prevalence of wind, and by a considerable diurnal and annual range in temperature. The closest weather station is 14 miles southwest of the Darwin quadrangle at Haiwee at an altitude of 3,830 feet. The U. S. Weather Bureau's publication *Climatological Data* for 1948 lists the normal annual rainfall at Haiwee as 6.06 inches. The average January temperature is 40.4° F, and the average July temperature is 81.7° F. The extremes in recorded temperature for 1948 are a high of 102° F and a low of 14° F. Except at the lower altitudes near Panamint Valley where the summer temperatures are uncomfortably hot, the figures listed above are probably typical of most of the area in the Darwin quadrangle.

Vegetation is sparse, consisting of scattered creosote bush and some cacti and Joshua trees. An impressive stand of Joshua trees is growing at Lee Flat. Piñon pines and junipers grow in some places at altitudes above 6,000 feet, except where the bedrock is basalt.

Topography and Water Supply

The Darwin quadrangle is in the western part of the Basin and Range physiographic province, in which parallel mountain ranges trending N. 10°-20° W. rise above intermontane plains. Narrow, deeply incised, easterly

trending canyons are prominent topographic features in the eastern part of the quadrangle. Altitudes range from 1,960 feet in an unnamed canyon 2 miles north of Rainbow Canyon to 7,731 feet in the Inyo Mountains.

Drainage is into two enclosed basins, the Panamint Valley to the east and Owens Lake to the west. About four-fifths of the quadrangle drains into Panamint Valley, principally through Darwin Wash, Santa Rosa Flat, and Lee Flat. The remaining area in the southwestern part of the quadrangle drains through Lower Centennial Flat into Owens Lake.

Darwin Wash and Darwin Canyon provide the principal water supply in the quadrangle. The drainage from an area of 165 square miles, which includes the Darwin Hills, the west flank of the Argus Range, and the northeast flank of the Coso Range in the Darwin quadrangle and the northern half of the Coso Peak quadrangle, is funneled into Darwin Canyon. Wells and springs in the canyon provide the water supply for the Darwin Mines, the Miller-Warnken tungsten mill in Darwin Canyon, a mill and residence at China Garden Springs, and the motel at Panamint Springs. The town of Darwin receives its water supply through a pipe line from a spring in the Coso Range 8 miles to the southwest. Water is hauled from Darwin or Lone Pine to the Santa Rosa mine and the mines in the Talc City Hills and Santa Rosa Hills

Previous Work and Acknowledgments

Early mining activity near Darwin is described by Raymond (1877, p. 25-30), Burchard (1884, p. 163-164), and in reports of the State Mineralogist (Goodyear, 1888; Aubury, 1902 and 1908). Knopf (1914) wrote on the geology and ore deposits of the Darwin lead-silver district, and Kelley (1937; 1938) mapped the Darwin Hills and made large scale maps of some of the mines. Hopper (1947) mapped about 90 square miles in the southern part of the Darwin quadrangle in his reconnaissance study of a strip from the Sierra Nevada to Death Valley.

Commodity studies carried on by the U. S. Geological Survey during World War II covered some of the mineral deposits. Preliminary reports were made available to the writers on the lead-silver-zinc deposits by C. W. Merriam and L. C. Craig and on the tungsten deposits by D. M. Lemmon and others. B. M. Page (1951) and L. A. Wright studied the talc deposits during World War II and T. E. Gay, Jr. and L. A. Wright (1954) mapped the geology of the Talc City area.

L. K. Wilson (1943), resident geologist for the Pacific Tungsten Company, described the tungsten deposits on the east side of the Darwin Hills. D. L. Davis and E. C. Peterson (1948) of The Anaconda Company described the geology and ore deposits of the Darwin Mines. A report on the Santa Rosa mine is a product of the present investigation (MacKevett, 1953).

The writers wish to express their gratitude to the mining people in the area for their wholehearted cooperation. The Anaconda Company furnished maps of many of the mines owned by them in the Darwin district and extended many other courtesies to the writers. Especial thanks are due D. L. Davis, John Eastlick, M. B. Kildale, and F. E. Tong. E. H. Snyder of Combined Metals Reduction Company furnished production data and a map of the upper workings of the Zinc Hill mine. Many other individuals supplied production data, and are credited under individual mine descriptions.

J. F. McAllister and C. W. Merriam of the U. S. Geological Survey were of great help with stratigraphic and structural problems. E. H. Bailey, district supervising geologist for the U. S. Geological Survey, provided valuable suggestions during the preparation of the report. Field work was benefited by discussions with M. P. Billings of Harvard University and C. E. Stearns of Tufts University. Many geologists provided capable field assistance for periods ranging from 2 weeks to 3 months. These include L. A. Brubaker, Santi das Gupta, José Hernandez, Victor Mejia, E. H. Pampeyan, D. L. Peck, H. G. Stephens, and D. H. Thamer. The cartography was done under the direction of Esther T. McDermott.

GENERAL GEOLOGY

Rocks in the Darwin quadrangle include sedimentary rocks of Paleozoic age, plutonic and hypabyssal rocks of late Mesozoic age, and volcanic rocks and sediments of Cenozoic age. The stratigraphic sequence is summarized in table 1. Paleozoic rocks range in age from Early Ordovician to Permian in a sequence approximately 14,200 feet thick. Formational contacts are conformable except for local unconformities in the Pennsylvanian and Permian series. Pre-Mississippian rocks are mainly dolomite; Mississippian and younger rocks are predominantly limestone. Similar Paleozoic sections have been described in adjacent areas by McAllister (1952, 1955) and Merriam (1954).

The Paleozoic rocks are intruded by the batholith of the Coso Range in the southwestern part of the quadrangle, the batholith of Hunter Mountain in the northeastern part, and by several small plutons in the Darwin Hills and Argus Range. Volcanic rocks and sediments of late Cenozoic age unconformably overlie the Paleozoic and Mesozoic rocks.

The distribution of the rocks and the location of the ore deposits are shown in plate 1. The purpose of the map is to show the distribution of the mineral deposits with respect to lithology and nearness to igneous contacts. The geology has been simplified and the faults are not shown. The distribution of the mineral deposits about the margin of the batholith of the Coso Range, the restriction of talc deposits to a dolomite and quartzite host rock of Devonian or older age, and the concentration of lead-silver-zinc and tungsten deposits in limestone of late Paleozoic age are the principal geologic features shown on the map.

Sedimentary Rocks of Paleozoic Age

Pogonip Group

The Pogonip group of Early and Middle Ordovician age is the oldest rock sequence exposed in the quadrangle. It crops out in isolated or fault-bounded segments along the southwest side of the Talc City Hills and at the east end of the hills west of the West Virginia claim (pl. 2). Although the base of the sequence is unexposed, most of the Pogonip group is exposed west of the West Virginia claim by a section 1,570 feet thick.

The group consists predominantly of light-gray, medium- to thick-bedded dolomite, but includes limestone, shaly limestone, and siliceous limestone in the

Table 1. Stratigraphic section of the Darwin quadrangle.

	Age		Lithologic unit		Thickness (feet)
CENOZOIC	QUATERNARY	Recent	Alluvium, including fanglomerate, playa deposits, and minor lake beds		
		Pleistocene	Olivine basalt flows, fanglomerate, and Darwin Wash lake beds of Hopper, 1947		0–600
	TERTIARY(?)	Pleistocene or Pliocene	Coso formation of Schultz, 1937		
		Pliocene(?)	Andesite, basaltic pyroclastics, basalt flows, pumice		910+
MESOZOIC	Cretaceous(?)		Hypabyssal rocks—andesite porphyry and alaskite dikes		
	Cretaceous		Batholith of Hunter Mountain, batholith of the Coso Range, and related intrusive rocks—mainly quartz monzonite but includes granodiorite, syenodiorite, gabbro, leucogranite, and aplite		
PALEOZOIC	Permian		Owens Valley formation	Limestone-conglomerate member—includes limestone conglomerate, siltstone, and calcarenite	180+
				Shale member—brick-red and yellowish-brown shale; subordinate siltstone and limestone	200
				Lower limestone member—mainly fine-grained calcarenite; some thick limestone lenses, shale, and siltstone	2,800
	Permian and Pennsylvanian		Keeler Canyon formation	Upper member—calcilutite and fine-grained calcarenite with lesser shale and limestone-pebble conglomerate	1,700
				Lower member—thin-bedded limestone with intercalated limestone-pebble conglomerate	2,300±
	Pennsylvanian(?)		Rest Spring shale—dark-brown fissile shale, minor siltstone. The Rest Spring shale is present only as fault slivers in the northwest part of the quadrangle. It is the stratigraphic equivalent of the upper part of the Lee Flat limestone		0–50+
	Pennsylvanian(?) and Mississippian		Lee Flat limestone—thin-bedded medium-gray limestone; equivalent to the upper part of Perdido formation and to the Rest Spring shale		520+
	Mississippian		Perdido formation—limestone and bedded chert		330
			Tin Mountain limestone—fossiliferous thin- to thick-bedded limestone with chert lenses and nodules		430
	Devonian		Lost Burro formation—coarse-grained white and light-gray marble; dolomite and limestone in lower part of formation; minor quartzite and shale		1,770+
	Devonian and Silurian		Hidden Valley dolomite—light-gray, massive dolomite		1,000±
	Ordovician		Ely Springs dolomite—dark-gray dolomite with chert beds and lenses; some light-gray dolomite		920±
			Eureka quartzite—light-gray to white vitreous orthoquartzite		440
			Pogonip group—light- and medium-gray thick-bedded dolomite; some thinner-bedded dolomite and limestone		1,570+

middle and upper parts. The siliceous limestone beds weather dark brown and are a distinctive horizon marker. Cross-bedding is common near the top of the sequence.

A widespread fossiliferous horizon is in the Pogonip group about 250 feet below its contact with the Eureka quartzite. The fossils, which include *Receptaculites*, abundant large gastropods *Palliseria longwelli* and *Maclurites* Sp?, and probable algal remains, are indicative of Chazy age (Middle Ordovician).

Eureka Quartzite

Eureka quartzite is abundantly exposed in the Talc City Hills, where it forms distinctive, glistening white, outcrops. It is on both flanks of the overturned syncline at the northwest end of the Talc City Hills 1,600 feet northeast of the White Swan mine and at the Hard Scramble talc prospect. Isolated patches of the Eureka crop out between the Alliance talc mine and the Cactus Owen prospect. Most contacts of the Eureka are faults, and isolated blocks of Eureka quartzite as much as several hundred feet long are common in fault zones in the Pogonip group and Ely Springs dolomite.

The Eureka quartzite is 440 feet thick in an unfaulted section on the ridge 2,000 feet N. 30° E. of the northernmost workings of the White Swan talc mine (pl. 2). The formation consists almost entirely of white vitreous quartzite, but brown-weathered, in part platy quartzite crops out locally above the basal contact. Individual quartz grains are mostly of coarse silt size. Cross-bedding is common in the basal part of the formation.

The age of the Eureka is Middle Ordovician. It lies above Middle Ordovician fossils near the top of the Pogonip group and below the fossiliferous Ely Springs dolomite of Late Ordovician age.

Ely Springs Dolomite

Exposures of Ely Springs dolomite are confined to the Talc City Hills. The formation crops out mainly in the northwestern part of the hills on both flanks of an overturned syncline (pl. 2). Other exposures are at the Trinity talc mine, in two bands extending west from the Alliance talc mine, and on the hill 1 mile east of the Viking talc mine. The contact of the Ely Springs dolomite with the underlying Eureka quartzite is marked by abrupt lithologic and color differences and forms the most conspicuous formational boundary in the Paleozoic section. The sharp change from the white vitreous quartzite of the Eureka to the dark-gray, thick-bedded dolomite of the Ely Springs may be readily distinguished even at a distance of a mile.

A complete section of Ely Springs dolomite on the ridge 3,500 feet N. 6° E. of the northernmost workings of the White Swan mine is 920 feet thick. The lower part of the formation consists of dark-gray, thick-bedded dolomite with irregular lenses and nodules of chert. It grades upward through medium-gray to massive, light-gray dolomite. A bed of dark-gray dolomite, 50 feet thick, is present at most places at the top of the formation.

The formation has been dated as Late Ordovician in age by C. W. Merriam of the U. S. Geological Survey based on fossils collected from the lower part of the Ely Springs on the ridge southeast of the Hard Scramble prospect.

Hidden Valley Dolomite

Hidden Valley dolomite crops out for 1¼ miles along the crest of the ridge 1,400 feet west of the Hard Scramble prospect, and other smaller outcrops are present north of the Alliance talc mine, 700 feet south of the Talc City mine, and 300 feet north of the Trinity talc mine. The formation consists entirely of massive, buff to light-gray dolomite. The dolomite is recrystallized, and

very little bedding is preserved. The entire section of the Hidden Valley is not exposed at any one locality within the quadrangle. Approximately 1,000 feet of Hidden Valley dolomite is exposed along the ridge between the White Swan talc mine and the Hard Scramble prospect, although the upper part of the formation is eroded.

Only meager, indeterminate fossil remains were found in the Hidden Valley dolomite in the Talc City Hills. McAllister (1952, p. 16) dated the Hidden Valley dolomite as Silurian and Early Devonian in age in the Quartz Spring area.

Lost Burro Formation

The Lost Burro formation crops out in the Santa Rosa Hills underlying the hill at the Silver Reid prospect, in the Talc City Hills at the Cactus Owen, Homestake, and Talc City mines, and on the west flank of the Darwin Hills. No complete section of the Lost Burro is exposed in the quadrangle, but the thickness is probably greater than 1,700 feet and a composite section may be as thick as 2,400 feet. The accuracy of this estimate is somewhat impaired by minor faulting and folding. The formation consists of light-gray dolomite, quartzite, sandy limestone, shale, and chert in the lower part and white to light-gray marble with local thin quartzite beds in the upper part. The lower part of the formation is exposed at the Talc City mine. It consists of 65 feet of interbedded brown-weathering quartzite, sandy limestone, and chert and is correlated with the Lippincott member (McAllister, 1955, p. 12). This lower part is overlain by about 600 feet of light-gray mottled dolomite that, in turn, is overlain by light-gray limestone and shale. The upper part of the formation is exposed in the Santa Rosa Hills at the Silver Reid prospect, and it consists of white to light-gray marble with minor thin quartzite beds. The marble is finely banded with alternating white and medium-gray layers. Some medium-gray limestone beds within the white marble contain abundant *Cladopora* and *Stromatopora*. The age of the Lost Burro is Devonian.

Tin Mountain Limestone

Tin Mountain limestone crops out for 4 miles along the crest of the Santa Rosa Hills, and smaller exposures are at the Lee mine and locally along the west flank of the Darwin Hills. The formation is 435 feet thick at the south end of the Santa Rosa Hills. The dominant rock type is medium- to dark-gray, fine-grained limestone in beds ½ foot to 12 feet thick. Chert lenses and nodules and crinoidal debris are common throughout the Tin Mountain limestone. At the south end of the Santa Rosa Hills the Tin Mountain limestone is bleached and in part recrystallized to marble, so that it resembles marble of the Lost Burro formation. Elsewhere a sharp color contrast distinguishes the dark limestone of the Tin Mountain from the underlying coarse-grained white marble of the Lost Burro formation.

The Tin Mountain limestone is the most fossiliferous formation in the quadrangle and contains numerous corals, brachiopods, bryozoans, and crinoidal stems. Several collections of fossils from the Tin Mountain of the Santa Rosa Hills were examined by Helen Duncan and by Mackenzie Gordon, Jr., of the U. S. Geological Survey, who summarized his findings of the brachiopods as follows:

"The three collections appear to represent approximately the same faunal assemblage. The small narrow *Spirifer* sp. A, with rather long dental plates and about 5 ribs on each side of a narrow sinus in the pedicle valve, occurs both in collection F-1 and F-7 along with poorly preserved horn corals that have a general lower Mississippian aspect, according to Miss Duncan.

Cyrtina and *Leptaena* are genera that range through Silurian and Devonian rocks and into the lower Mississippian. In the western United States *Leptaena analaga* (Phillips) is typical of the rocks of Madison age and is not definitely known to range higher. In the mid-continent this species and several cyrtinas are known in rocks of Kinderhook and Osage age and are not known to range as high as uppermost Osage. *Rhipidomella oweni* (Hall) with which several partly crushed silicified specimens are here compared is a widespread lower Osage form. The presence of the large productid, though too poorly preserved to identify even as to genus, precludes a Devonian age for the assemblage. The rest of the specimens are not well preserved or entire enough to add any evidence to that discussed above.

In summary, the fossils can be said to represent an early Mississippian (Madison) fauna. In terms of mid-continent stratigraphy they are believed to be not younger than Osage in age and may be Kinderhook in age."

Perdido Formation

The Perdido formation is present mainly in the Santa Rosa Hills conformably overlying Tin Mountain limestone and locally at the south end of the Talc City Hills and on the western flank of the Darwin Hills. The formation is approximately 325 feet thick in the Santa Rosa Hills. It consists predominantly of limestone, silty limestone, and chert. Thin-bedded, medium-gray limestone with thin layers of bedded chert are characteristic of the lower part of the formation. Chert is much more abundant in the upper part of the formation where it is present in beds as much as 60 feet thick at the south end of the Santa Rosa Hills. The lithology of the lower part of the Perdido formation and the upper part of the Tin Mountain limestone is similar and the contact between the two is placed at the base of the lowermost bedded chert in the Perdido formation.

The Perdido formation is much thinner in the Darwin quadrangle than in the Quartz Spring area where McAllister (1952, p. 23) measured a section about 610 feet thick. The Perdido formation in the Darwin quadrangle is similar in lithology to the lower part of the Perdido formation in the Quartz Spring area, although the upper clastic part of the Perdido is missing. The age of the formation, according to McAllister (1952, p. 24) is Mississippian based on fossils in the Ubehebe Peak quadrangle and the Quartz Spring area.

Lee Flat Limestone

The Lee Flat limestone is named here for exposures near Lee Flat, a Joshua-tree-studded, alluviated area east of the Santa Rosa Hills. The type section trends south from near the top of the prominent hill nine-tenths of a mile S. 36° E. of the main shaft of the Lee mine. The formation is exposed for 4½ miles along the northeast side of the Santa Rosa Hills, and it forms the prominent hill 3,000 feet south of the Lee mine. Smaller outcrops of Lee Flat limestone are in the southern part of the Talc City Hills and along the west flank of the Darwin Hills.

The predominant rock type is thin-bedded, medium- to dark-gray limestone. Locally the generally uniform

appearance of the limestone is broken by thin, sandy iron-stained partings or by thin beds and lenses of chert. The Lee Flat limestone is at least 520 feet thick at the type locality where it conformably overlies the Perdido formation. The upper part of the limestone is covered by alluvium. The formation is estimated to be more than 960 feet thick on the hill 3,000 feet south of the Lee mine, but the top of the formation is covered by basalt and alluvium, and faulting in the exposed section vitiates the estimate.

The only fossils found in the Lee Flat limestone are crinoid fragments; consequently the age of the formation is derived from its stratigraphic position. The formation lies conformably on limestone and chert that are correlated with the lower part of the Perdido formation in the Ubehebe Peak quadrangle, where the lowest beds are probably Early Mississippian. (See Helen Duncan *in* McAllister, 1952, p. 24.) The top beds of the Perdido formation in the Quartz Spring area are of Chester age (Late Mississippian) (McAllister, 1952, p. 24). The Lee Flat limestone occupies the same stratigraphic position that the upper part of the Perdido formation and the Rest Spring shale occupy in the Quartz Spring area and Ubehebe Peak quadrangle (McAllister, 1952, pl. 2). Although there are no fossils to show equivalence of age, the Lee Flat limestone probably correlates with the upper part of the Perdido formation of Late Mississippian age and all of the Rest Spring shale of Pennsylvanian (?) age. It then represents a facies change from a clastic section of siltstone, shale, and minor limestone in the Ubehebe and Quartz Spring areas to fine-grained limestone in the Darwin quadrangle.

In the Darwin Hills the Lee Flat limestone is overlain by the Keeler Canyon formation, which ranges in age from probable Atoka or Des Moines (Pennsylvanian) to upper Wolfcamp (Permian). It is probably a time-stratigraphic equivalent of the Chainman shale in the New York Butte quadrangle of Late Mississippian age.

Rest Spring Shale

The Rest Spring shale is present only in fault zones in the Darwin quadrangle in the northern part of the Darwin Hills, in the Santa Rosa Hills, and in the Talc City Hills. The formation consists of dark-brown, fissile shale. The Rest Spring shale conformably overlies the Perdido formation in the Ubehebe Peak quadrangle (McAllister, 1955, p. 13). The Lee Flat limestone conformably overlies the lower part of the Perdido formation in the Darwin quadrangle and the upper part of the Perdido formation is absent. The Rest Spring shale is probably a stratigraphic equivalent of the upper part of the Lee Flat limestone. McAllister (1952, p. 26) considers the Rest Spring shale to be Pennsylvanian (?) in age.

Keeler Canyon Formation

The Keeler Canyon formation is defined by Merriam and Hall (1957, p. 4) as a thick sequence of limestone exposed in Keeler Canyon in the New York Butte quadrangle and east of the portal of the Estelle tunnel 2 miles southwest of Cerro Gordo Peak. The formation crops out in the Darwin quadrangle in the northern part of the Santa Rosa Hills, the eastern part of the Talc City Hills, and in the western part of the Darwin Hills. No complete uninterrupted section is present in the quadrangle, but a composite of measured partial sections in the western part of the Santa Rosa Hills indicates an approximate thickness of 4,000 feet.

The Keeler Canyon formation is divided into two members in the Darwin quadrangle. The lower member, which is estimated to be about 2,300 feet thick, consists of thin- to medium-bedded bluish-gray limestone with minor limestone-pebble conglomerate. It underlies the hill west of the Darwin Antimony mine in sec. 2, T. 19 S., R. 40 E. at the north end of the Darwin Hills, and the calc-hornfels that underlies Ophir Mountain and all of the Darwin mine area is a metamorphosed part of the lower member.

The upper member consists of pink shale, bluish-gray silty limestone, and limy siltstone. Crossbedding is common near the top of the upper member, but it was not observed in the lower member. A measured section along the ridge trending east from the Darwin Antimony mine is 1,700 feet thick. The contact between the lower and upper members is gradational, and it is arbitrarily placed below the abundant pink shale and pink silty limestone of the overlying member. Slopes underlain by the upper member have a pinkish hue in contrast to a grayish hue of slopes underlain by the lower member.

The Keeler Canyon formation ranges in age from probable Atoka or Des Moines (Pennsylvanian) to probable late Wolfcamp (Permian) according to L. G. Henbest and R. C. Douglass of the U. S. Geological Survey. Fusulinids are the most abundant fossils, but in many the internal structures are impaired by silicification to such an extent that assured identifications are unobtainable.

A report by Lloyd G. Henbest of the U. S. Geological Survey concerning a collection of fusulinids from near the base of the Keeler Canyon formation in the Santa Rosa Hills 1.58 miles S. 77° W. of the Lee mine is given below.

F-9591 *Pennsylvanian*, Atoka or Des Moines age.
Solenoporoid Algae
Climacammina sp.
Endothyra sp.
Millerella ? sp.
Fusulinella sp. or *Wedekindellina* sp.
Fusulinella sp. or an early form of *Fusulina*.

"Most of the specimens show massive deformation and poor preservation. The fusulinids are identified generically with fair assurance. The age indicated is Atoka or very early Des Moines. The foraminiferal association gives support of very limited value to this age determination. The species of solenoporoid Algae is a fossil of common occurrence in the Rocky Mountain region. In my experience, it is limited to rocks of Atoka and of approximately the first half of Des Moines age. By the fusulinids alone, in this state of preservation, I could not definitely prove that they are not of early Permian age. The assemblage and especially the peculiar solenoporoid all agree in indicating Atoka or early Des Moines age."

Two collections of fusulinids were made at the top of the upper member of the Keeler Canyon formation at the north end of the Darwin Hills northeast of the Darwin Antimony mine. These collections were examined by R. C. Douglass of the U. S. Geological Survey in 1954, and his reports are given below.

F-9748 "At north end of Darwin Hills in sec. 35 (projected), T. 18 S., R. 40 E., at elevation 5,290 feet. Located 3.92 miles N. 73° E. from road junction of State highway 190 and Darwin turn off and 1.20 miles N.

33° W. of VABM 5979. In thinly bedded blue-gray, fine-grained limestone."

Climacammina sp.
Tetrataxis?
Endothyra?
Schwagerina spp.
One aff. *S. compacta* (White)

"Evidence on the age of this sample is inconclusive. The sample is probably of Wolfcamp age, possibly middle to late Wolfcamp."

F-9749 "At north end of Darwin Hills at elevation 5,400 feet. Located in gully 660 feet north of VABM 5979 and 4.39 miles N. 86½° E. of junction of State highway 190 and Darwin turn off. In 3-foot thick limestone bed interbedded in pink fissile shale."

Calcitornellids
Climacammina sp.
Triticites sp.
Schwagerina spp. (possibly 3 species)
One aff. *S. diversiformis* Dunbar & Skinner
Another aff. *S.* linearis Dunbar & Skinner
Pseudoschwagerina sp.
Parafusulina?

"This assemblage contains elements common to the uppermost Wolfcamp and lower Leonard formations. It can probably be correlated with this boundary zone with fair certainty."

Owens Valley Formation

The name Owens Valley formation is defined by Merriam and Hall (1957, p. 7) as a sequence of limestone and shale exposed extensively on the western slope of the Inyo Range; the type locality is in the foothills between Union Wash and the Reward mine, about 9 miles southeast of Independence. The formation is abundantly exposed in the Darwin quadrangle. It underlies Conglomerate Mesa (pl. 1) and the low group of hills at the head of Santa Rosa Flat in the northwestern part of the quadrangle, and it is in the southeastern part of the quadrangle on the east side of the Darwin Hills, in Darwin Canyon, and on the west flank of the Argus Range.

The Owens Valley formation is more than 3,200 feet thick and consists of interbedded calcarenite, silty limestone, pure limestone, siltstone, and shale. For convenience of description, it is divided informally into 3 members. The lower member is about 2,800 feet thick and consists of calcarenite, shaly limestone, lenses of pure limestone, shale, and siltstone and will be referred to as the lower limestone member. Lenses of bluish-gray, pure limestone as much as 40 feet thick and several thousand feet long are characteristic of the lower member, and cross-bedded calcarenite is abundant. A contact between the Keeler Canyon formation and the lower member of the Owens Valley formation is 4,500 feet east of the Darwin antimony mine. A brown-weathering siltstone 450 feet thick is at the base of the formation, and this is overlain by interbedded calcarenite, pure limestone, and shaly limestone. It was not possible to correlate details of lithology in the Keeler Canyon formation and lower member of the Owens Valley formation in the Darwin Hills to those in the group of low hills at the head of Santa Rosa Flat in the northwestern part of the quadrangle. A gradational contact between these two formations in the northwestern part of the quadrangle is 3 miles east of the northwest corner of the quadrangle. The Owens Valley formation to the west contains abundant lenses of pure limestone in calcarenite while the underlying Keeler Canyon to the east contains abundant interbedded pink shale and silty limestone. No siltstone bed similar to the one in the Darwin Hills was noted at the contact, but another siltstone bed 250 feet thick is in the upper member of the Keeler Canyon formation 1,200 feet below the contact.

The middle shale member of the Owens Valley formation is exposed only in the northwestern part of the quadrangle along the foot of Conglomerate Mesa. It is approximately 200 feet thick, but the incompetence of the beds and poor outcrop preclude an accurate measurement of the thickness. The middle member consists preponderantly of shale but includes subordinate siltstone and limestone. Most of the shale is brick red or yellowish-brown on both fresh and weathered surfaces, but some is dark gray or greenish-gray.

The upper limestone conglomerate member forms the resistant capping and cliff exposures of Conglomerate Mesa. It has a minimum thickness of 180 feet in the Darwin quadrangle, and consists of limestone conglomerate, siltstone, and sandstone. The contact with the underlying middle shale member is disconformable. In the adjacent Ubehebe Peak quadrangle the limestone conglomerate in the stratigraphic equivalent upper part of the Bird Spring(?) formation has a maximum thickness of 600 feet (McAllister, 1955, p. 14). The conglomerate contains fragments of gray limestone and silty limestone mostly 1 inch to 4 inches in diameter in a sand-sized matrix of limestone and chert. In places the conglomerate has been nearly completely silicified.

The age of the Owens Valley formation ranges from late Wolfcamp (Permian) to probably Guadalupe (Permian). The lower limestone member ranges in age from late Wolfcamp (Permian) into Leonard (Permian). The faunal assemblage includes fusulinids, corals, brachiopods, ammonites, and gastropods.

Two collections from near the base of the Owens Valley formation in the northwestern part of the quadrangle were studied by R. C. Douglass of the U. S. Geological Survey and were determined as probably late Wolfcamp in age. Collection F-9645 is 2.85 miles S. 86½° E. of the northwest corner of the quadrangle; collection F-9648 is 2.20 miles S. 80° E. of the northwest corner. The descriptions by Douglass are given below.

F-9645 Permian
California, Inyo County, Darwin quadrangle
Schubertella sp.
Triticites? sp.
Schwagerina sp.
Pseudoschwagerina? sp.

"The material in this collection is fractured and silicified. It is of Permian age, probably upper Wolfcamp."

F-9648 Permian
California, Inyo County, Darwin quadrangle
Schwagerina spp. advanced forms
Pseudoschwagerina sp.

"This sample is of Permian age, probably upper Wolfcamp."

Two collections were made at the top of the lower member of the Owens Valley formation. Collection F-9650 of fusulinids was from a limestone lens 40 feet thick in silty limestone 1.20 miles S. 71° E. of the northwest corner of the quadrangle. Collection F-119 is 1.30 miles S. 58° E. of the northwest corner. It is a collection of gastropods, corals, brachiopods, and bryozoa from a craggy limestone lens 84 feet thick that is stratigraphically a few feet below collection F-9650.

R. C. Douglass studied collection F-9650 and reports:

F-9650 *Permian*
California, Inyo County, Darwin quadrangle

"There are many small forms in this collection most of which seem to be immature individuals of the following genera, but some of which may be *Endothyra* and *Schubertella*.

Schwagerina spp. advanced forms related to *S. guembeli* Dunbar and Skinner
Parafusulina sp.

This sample is the youngest of the lot studied for this report. It is Permian in age and is probably equivalent to the Leonard."

James Steele Williams of the U. S. Geological Survey in 1953 summarized results of paleontological studies of a megafossil assemblage collected from locality F-119 near the top of the lower limestone member as follows:

"Bryozoa (identified by Helen Duncan)
Stenodiscus? sp. indet. (no close age significance)

Brachiopoda
Meekella sp. indet. large form
Dictyoclostus sp. indet., related to *D. ivesi bassi* McKee
Dictyoclostus? sp. indet., possibly related to *D. ivesi* (Newberry)
Enteletes? sp. indet.

Gastropods
Three specimens of gastropods were reported on separately by Ellis Yochelson.

Two are indeterminate and one represents an undetermined species of the genus *Peruvispira* which was described from beds said to be of "Lower Permian" age in Peru but has been found in beds in the U. S. that range from Wolfcamp to Word in age."

"The large *Dictyoclostus* in the above list is crushed and incomplete but as nearly as one can tell it is probably a *D. ivesi* variety *bassi* McKee. The smaller one is related to *D. ivesi* (Newberry) as restricted by McKee but it appears to have coarser costae and a deeper sulcus than are typical of that species. The species of *Meekella* in mature individuals is larger than most Pennsylvanian species. On these rather slender grounds I believe that the collection is probably of Leonard or younger Permian age. It is not the typical Owenyo fauna but appears to me to be older than that fauna. I do not believe it is as old as typical McCloud. It may however be an unusual facies of one of these faunas."

No fossils were found in the middle shale member of the upper limestone conglomerate member of the Owens Valley formation. The middle shale member is probably of Leonard or later Permian age as it conformably overlies the lower member, the upper part of which contains fossils that are considered by James Steele Williams to be of Leonard or later Permian age as cited above. On the basis of Owenyo fauna and fossils from time-equivalent rocks in the New York Butte quadrangle, Merriam believes the limestone conglomerate member is Permian, probably Guadalupe.

Plutonic Rocks of Mesozoic Age

Plutonic rocks are exposed at the surface over approximately 10 percent of the quadrangle, and possibly 10 percent more underlie a thin cover of basalt or alluvium. Plutons include the batholith of Hunter Mountain in the northeastern part of the quadrangle, the batholith of the Coso Range in the southwestern part, and the stocks in the Darwin Hills, Talc City Hills, and at Zinc Hill. Most of the plutonic rocks fall into two lithologic types—biotite-hornblende quartz monzonite and leucocratic quartz monzonite. Small bodies of leucogranite, aplite, and pegmatite are common at the border of bodies of quartz monzonite and as thin dikes intruding them.

Biotite-Hornblende Quartz Monzonite

Biotite-hornblende quartz monzonite is the predominant rock type in the batholith of Hunter Mountain, in the batholith of the Coso Range, and in the stock in the central part of the Darwin Hills. Biotite-hornblende quartz monzonite crops out in the batholith of Hunter Mountain in steep, east-trending canyons where the rock has been exposed by faulting or by erosion of the overlying basalt. This batholith extends northward into the Ubehebe Peak quadrangle where it has been described as the Hunter Mountain quartz monzonite by McAllister (1956). In the Darwin Hills and the Coso Range, biotite-hornblende quartz monzonite is the most easily weathered rock, and forms gentle slopes that commonly are gruss covered. Locally resistant leucocratic differentiates crop out that do not reflect the composition of the gruss-covered areas.

The biotite-hornblende quartz monzonite in Rainbow Canyon and in the canyon to the north probably are satellitic to the batholith of Hunter Mountain and separated from it by Paleozoic rocks of Devonian and Mississippian age beneath a volcanic cover. Two other small masses of biotite-hornblende quartz monzonite at the south end of the Santa Rosa Hills are also satellitic to the batholith of Hunter Mountain. The southerly one, about one mile north of State Highway 190, contains gently dipping flow structures shown by oriented minerals and by light-colored schlieren and is probably a flat-lying concordant intrusion.

Petrography

The biotite-hornblende quartz monzonite is a light-gray rock that has a speckled appearance produced by a scattering of dark ferro-magnesian minerals. The texture ranges from equigranular, with an average grain size of 2 to 3 mm, to porphyritic, with 10 to 20 percent phenocrysts of pinkish potassium feldspar as much as 1½ cm long in a finer grained light-gray equigranular groundmass. The uncontaminated rock is predominantly quartz monzonite in composition but ranges from granodiorite to quartz monzonite. Essential minerals are quartz, potassium feldspar, and plagioclase; commonly at least five percent hornblende and biotite are present. Feldspar makes up 62 to 76 percent of the rock; plagioclase and potassium feldspar are in about equal quantities. Plagioclase is calcic oligoclase or andesine of composition An_{28} to An_{45}, and it is commonly normally zoned. The potassium feldspar is microperthitic; some of it has microcline twinning. Quartz makes up as much as 30 percent of the rock. It is more abundant in the quartz monzonite from the batholith of the Coso Range than that from the batholith of Hunter Mountain. The mafic minerals include biotite, hornblende, and, in the batholith of Hunter Mountain, augite, and they range in volume percent from 8 to 30. Hornblende is predominant in the quartz monzonite from the Coso Range and from the batholith of Hunter Mountain, and biotite is predominant in the quartz monzonite underlying the low hills west of Darwin. Minor accessory minerals are sphene, apatite, magnetite, and tourmaline. Tourmaline is particularly abundant in the satellite bodies south of the Santa Rosa Hills.

The Darwin stock is an heterogeneous intrusive composed predominantly of biotite-hornblende quartz monzonite and granodiorite similar to that in the Coso Range, but the rocks are deeply weathered and few unaltered specimens were found for study. Near the Defiance and Thompson workings of the Darwin mine the intrusive is contaminated and consists largely of granodiorite, quartz diorite, and diorite.

Megascopically the biotite-hornblende quartz monzonite from the batholith of Hunter Mountain, the batholith of the Coso Range, and the least contaminated parts of the stock of the Darwin Hills are similar in color and texture. However there are some overall differences between quartz monzonite from the different plutons. The quartz monzonite in the batholith of the Coso Range contains more quartz and less mafic minerals than the batholith of Hunter Mountain. Augite is a common mafic mineral in the batholith of Hunter Mountain but was not observed in the batholith of the Coso Range. These differences are believed to be due mainly to assimilation of limestone by the batholith of Hunter Mountain rather than to a difference in the parent magmas. The central part of the batholith of Hunter Mountain in the Ubehebe Peak quadrangle (McAllister, 1956) is also relatively low in quartz, and it is probable that the exposures of the batholith are closer to the former roof than the exposures of the batholith of the Coso Range.

Border Facies. The border facies of quartz monzonite of the batholith of Hunter Mountain are quartz-poor rocks that include monzonite, syenodiorite, and gabbro. Generally the border facies rocks are slightly coarser grained and are darker than the typical quartz monzonite, but in some exposures the two are nearly indistinguishable. Except for the low quartz content, monzonite is similar to quartz monzonite in mineralogy and texture. Syenodiorite megascopically also is similar, but in thin section it is seen that some of the amphibole is hastingsite instead of hornblende. The syenodiorite that contains hastingsite also contains minor tourmaline and scapolite in veinlets transecting and replacing plagioclase.

Leucocratic Quartz Monzonite

Distribution

Leucocratic quartz monzonite is present in the stock in the Talc City Hills and in the stock at Zinc Hill in the Argus Range. Most slopes underlain by the stock in the Talc City Hills are gruss covered and only a few shallow gullies expose relatively unweathered rock. The stock at Zinc Hill is in an area of rugged relief and is well exposed.

Petrography

Leucocratic quartz monzonite is a medium- to coarse-grained, light grayish-pink rock that at most places contains less than five percent mafic minerals. The texture ranges from equigranular to porphyritic; locally the rock contains pink feldspar crystals as much as 1½ cm long in a medium-grained equigranular groundmass. Dark fine-grained discoidal inclusions less than 1½ inches long are sparsely disseminated through the stock in the Talc City Hills. The leucocratic quartz monzonite is lighter colored and coarser grained than the more widespread biotite-hornblende-quartz monzonite.

Essential minerals in the rock are quartz, plagioclase, and orthoclase. Feldspars constitute 70 to 75 percent of the rock and are present in about equal quantities. Orthoclase is microperthite and commonly forms phenocrysts that poikilitically enclose all the other minerals. Plagioclase is sodic oligoclase. Biotite is the predominant mafic mineral and generally constitutes less than five percent of the rock, although as much as seven percent has been observed; it is in part altered to chlorite. Hornblende may be present in small quantities. Minor accessory minerals are allanite, apatite, magnetite, pyrite, sphene, and tourmaline.

Other Intrusives

A body of diorite, gabbro, epidote amphibolite, and amphibolite described briefly by Hopper (1947, p. 412) crops out in Darwin Canyon in the vicinity of Darwin Falls. This diorite and amphibolite body grades into hornfels of the Owens Valley formation and is nonconformably overlain by olivine basalt of late Cenozoic age. The amphibolite is a heterogeneous, fine-grained, greenish-gray rock cut by stringers and lenses of epidote. Numerous dioritic dikes cut the surrounding hornfels close to its contact with the main diorite body. In places, bedding of the adjacent hornfels extends into the diorite and amphibolite body and is preserved in it. Contacts between the diorite and hornfels are gradational over distances of 10 to 20 feet. The diorite is believed to have formed from the alteration of impure limestone of Permian age by hydrothermal solutions from a buried intrusive.

Age

In the Darwin quadrangle the age of the granitoid rocks can be determined only as younger than Permian and older than late Cenozoic. In the Inyo Mountains the granitoid rocks intrude shale and volcanic rocks of Triassic age (Knopf, 1918, p. 60). David Gottfried (oral communication, 1955) of the U. S. Geological Survey reports the Hunter Mountain quartz monzonite to be 99 million years old (middle Cretaceous) based on zircon determination by the Larsen method of a sample collected by the writers from the southeast part of the Ubehebe Peak quadrangle. This is about the same age as that determined for the Sierra Nevada batholith (Faul, 1954, p. 265).

Hypabyssal Rocks

Hypabyssal rocks include dikes of andesite porphyry, diorite, and alaskite. Andesite porphyry dikes are widely distributed in the rocks of Paleozoic age and are unconformably overlain by volcanic rocks of late Cenozoic age. The dikes are 2 to 6 feet thick and strike about N. 70° W. and dip nearly vertically. They are greenish-gray on fresh surfaces and weather to shades of brown. The andesite porphyry dikes are highly altered and consist of plagioclase phenocrysts with saussuritic alteration in a fine-grained pilotaxitic groundmass composed mainly of albite, epidote, chlorite, calcite, and stilbite. An alaskite porphyry dike crops out half a mile east of Ophir Mountain. This dike contains phenocrysts of albite and quartz 2 to 4 mm long in a cryptocrystalline groundmass composed of albite, quartz, and minor epidote and chlorite. The dikes are Cretaceous or younger in age. The andesite

porphyry dikes intrude Cretaceous quartz monzonite and are nonconformably overlain by Pliocene(?) pyroclastic rocks. They are considered to be Cretaceous(?) in age.

Volcanic Rocks and Sedimentary Deposits of Late Cenozoic Age

Rocks of Tertiary and Quaternary age are widely distributed throughout the Darwin quadrangle. They can be divided into three groups: (1) Pliocene(?) and Pleistocene sedimentary deposits; (2) volcanic rocks of late Cenozoic age; and (3) Recent alluvial deposits. The ages of the Tertiary and Quaternary deposits are not well documented. Even the relative ages of the rock types is only questionably known, as each rock type is generally in a separate area within the quadrangle with little or no interlayering between types to show relative stratigraphic positions. A tentative correlation is made in table 2.

Table 2. Tentative correlation of Tertiary and Quaternary volcanic and sedimentary rocks.

Age	Volcanic rocks	Sedimentary deposits
Recent		Alluvium including fanglomerate, playa deposits, and minor lacustrine deposits
Pl istocene	Basalt flows	Darwin Wash lake beds of Hopper Fanglomerate derived from the Argus Range
	Basalt flows and minor tuff	Coso formation of Schultz and fanglomerate derived from the Inyo Mountains
Pliocene?	Poorly bedded agglomerate, minor pumice	
	Andesite	
	Poorly bedded agglomerate, mainly red to reddish purple in color. Some basalt dikes and flows.	
	Well-bedded tuff and tuff-breccia, mainly yellow and yellowish brown.	

Pliocene(?) and Pleistocene Sedimentary Deposits

Pliocene(?) and Pleistocene sedimentary rocks include fanglomerate from the Inyo Mountains, Coso Range, and Argus Range and lacustrine deposits in Darwin Wash. The best known deposit is the Coso formation of Schultz, the rocks of which have been described by Knopf (1918, p. 51), Schultz (1937, p. 78), and Hopper (1947, p. 415). The formation is exposed in the western part of the quadrangle on both sides of State Highway 190. It forms low, white dissected hills that protrude 5 to 30 feet above Recent alluvium. The formation consists largely of alluvial-fan material that was derived from disintegrated granite in the Coso Range, but locally it contains pumice and fragments of basaltic scoria and andesite. The formation overlies the batholith of the Coso Range and locally is conformably overlain by basaltic tuff and olivine basalt. It has been tilted by Basin-Range faults to measured dips as great as 40° in the more extensive exposures west of the Darwin quadrangle. Schultz (1937, p. 98), on the basis of vertebrate fossils found west and southwest of the Darwin quadrangle, believes that the formation was formed during the transition period between Pliocene and early Pleistocene.

Erosional remnants of dissected fans are marginal to the Inyo Mountains and to the Argus Range. The fanglomerate at the south end of the Inyo Mountains contains fragments of dolomite, limestone, and quartzite of Ordovician to Devonian age in a clay and silt matrix. It probably is the same age as the nearby Coso formation of Schultz.

The fanglomerate on the west slope of the Argus Range consists of fragments of Pennsylvanian and Permian limestone, quartz monzonite, agglomerate, and olivine basalt in a predominantly sandy matrix. The fan is overlain by, and in part interfingers with, the Darwin Wash lake beds of Hopper (1947). The fanglomerate dips 4° to 6° W., but it has been tilted locally to low east dips.

Conspicuous white lake beds crop out in Darwin Wash east and southeast of Lane Mill. The essentially horizontal beds have a maximum exposed thickness of 58 feet, but the base is unexposed. The lake beds consist of white, fine-grained pumiceous ash, silt, clay, and diatomaceous earth in beds half a foot to 4 feet thick. The lake beds have been dated as middle to late Pleistocene in age by K. E. Lohman (written communication) on the basis of diatoms.

The upper part of the fanglomerate from the Argus Range interfingers with the Darwin Wash lake beds of Hopper and is therefore middle to late Pleistocene in age and is younger than the Coso formation of Schultz of late Pliocene or early Pleistocene age.

Volcanic Rocks

Volcanic rocks, which cover about 30 percent of the quadrangle, include basalt, andesite, basaltic pyroclastics, and minor pumice. Basaltic pyroclastics are the oldest volcanic rock. Andesite and pumice are interbedded near the top of the pyroclastics. Olivine basalt is the youngest rock and is the resistant capping that forms mesas and plateaus in the Inyo Mountains and on Darwin Plateau.

Pyroclastic rocks are widely distributed throughout the northern half of the quadrangle and are best exposed in the Inyo Mountains at the Santa Rosa mine and in the basin a mile and half southwest of the Santa Rosa mine. The section has a maximum thickness of 910 feet near local vents. Pyroclastic rocks rest nonconformably on Paleozoic rocks and granitic rocks. The pyroclastics are unconformably overlain by olivine basalt flows. Most of the pyroclastics dip less than 25°, but dips as much as 41° were measured beneath nearly horizontal basalt, indicating a period of tilting prior to the extrusion of the basalt.

The pyroclastic rocks consist of agglomerate, tuff-breccia, lapilli-tuff, scoria, volcanic cinders—all of basaltic composition—and locally, thin layers of pumice. The lower part of the pyroclastic section contains of well-bedded light-brown and yellowish-brown basaltic tuff and tuff-breccia. The upper part is poorly bedded and consists mainly of red or reddish-brown agglomerate, cinders, volcanic breccia, tuff-breccia, and scoriaceous basalt.

Andesite is exposed over an area of about 3 square miles south and southeast of the Santa Rosa mine. This andesite crops out in bold reddish cliffs and forms a broad dome interbedded in the upper part of the pyroclastics. It is a red or gray porphyritic rock containing phenocrysts and clusters of plagioclase as long as 10 mm and euhedral phenocrysts of hornblende as long as 4 mm in an aphanitic groundmass. The gray variety is light gray on fresh surfaces and weathers dark gray; the other variety is red to reddish gray on fresh surfaces and weathers reddish brown. The red andesite owes its color to oxyhornblende and hematite.

Petrographically, the andesite consists of plagioclase of composition An_{46} to An_{34}, hornblende or oxyhornblende, biotite, volcanic glass, and minor amounts of cristobalite, quartz, orthoclase, augite, apatite, and zircon.

Olivine basalt covers a large part of the northern two-thirds of the quadrangle, and it is present in several isolated patches in the southern one-third of the quadrangle. It is in flows 10 to 100 feet thick with a maximum aggregate thickness of about 600 feet. Thin basalt dikes, some representing feeders for the flows, are abundant near volcanic vents. The basalt is dark gray on fresh surfaces and weathers dark yellowish brown or to brownish-black desert-varnished surfaces. Vesicles are abundant near the tops and bottoms of the flows and in some of the dikes. The basalt is finely porphyritic with 1- to 2-mm phenocrysts of olivine, and a few smaller phenocrysts of plagioclase and augite, in a fine-grained groundmass consisting of plagioclase, olivine, augite, biotite, and volcanic glass. Secondary minerals are iddingsite, antigorite, goethite, calcite, and chalcedony. Minor embayed quartz fragments, probably xenocrysts, are in some of the basalt. The plagioclase is labradorite of composition An_{57} to An_{60}.

Age

The age of the volcanic rocks is only tentatively given in table 2 as their relationship with known Cenozoic deposits is not well established. The basaltic pyroclastic rocks are probably Pliocene in age. Fragments of basaltic agglomerate and scoria that are probably time equivalents of the basaltic pyroclastics in the Inyo Mountains are abundant in the Coso formation of Schultz on the west side of the Coso Range east of Haiwee Reservoir. If the pyroclastics are equivalents, they are older than the Coso formation of Schultz of late Pliocent or early Pleistocene age.

The andesite south of the Santa Rosa mine is interbedded in the upper part of the pyroclastics and is identical to the andesite in the Coso Range east of Haiwee Reservoir. The Coso Range andesite apparently is interbedded with the lower part of the Coso formation below the fossiliferous beds described by Schultz (1937, p. 98). The Coso formation of Schultz on the west flank of the Coso Range contains fragments of andesite, but beds identical in lithology to the Coso formation of Schultz and with contiguous outcrop underlie the andesite in the Coso Range at Cactus Flat 3 miles east of Haiwee Reservoir. The andesite is probably late Pliocene in age.

Olivine basalt flows overlie the Coso formation of Schultz (1937) in the Haiwee Reservoir quadrangle (Hopper, 1947, p. 417) and in the southwestern part of the Darwin quadrangle, and olivine basalt flows overlie fanglomerate in Darwin Canyon near Darwin Falls. They must be early Pleistocene or younger in age.

Recent Alluvial Deposits

Recent alluvial deposits cover about one-fourth of the quadrangle and are particularly abundant in Lower Centennial Flat, Santa Rosa Flat, and Lee Flat. These sediments are largely alluvial fan deposits, but include some playa deposits and lake beds.

STRUCTURE

The Darwin quadrangle is on the west limb of a major anticlinorium, the axis of which trends approximately N. 15° W. near the crest of the Panamint Range about 15 miles east of the quadrangle. The Paleozoic rocks are folded and faulted. Bedding strikes predominantly north to N. 30° W. and dips southwest, except in the Talc City Hills where the strike is N. 60°-80° W. as a result of deformation by forceful intrusion of the batholith of the Coso Range. Thrust faults and steep faults, some probably with large strike-slip displacement, were formed during the late Mesozoic orogeny. Basin and Range faults of Cenozoic age are important in forming the present topography.

The only major unconformity truncates the Paleozoic rocks and the Cretaceous plutonic rocks. Minor unconformities are represented in the Pennsylvanian and Permian strata by recurrent limestone-pebble conglomerates and by local angular discordances. Pronounced differences in lithology between formations of Paleozoic age may represent minor hiatuses.

The Paleozoic rocks are deformed into broad open folds with moderate dips at distances greater than several miles from a major intrusive. The trend of the folds is north to N. 20° W. Within 2 to 3 miles of the batholith of the Coso Range in the Darwin Hills and Talc City Hills folding is much more intense and bedding is overturned. Inverted anticlines and synclines are common, and faults are abundant. The structure of the Darwin Hills is an overturned syncline with an axial plane that strikes N. 15° W. and dips about 50° W. along the eastern margin of the hills. The rocks range in age in a conformable sequence from Devonian on the west to Permian on the east. Bedding, which is overturned, strikes north and dips predominantly to the west, except locally on limbs of minor folds. The structure in the Talc City Hills is also synclinal; Devonian and Silurian rocks are in the core and Ordovician rocks on the flanks of the syncline (pl. 2).

Two general periods of faulting are recognized—a late Mesozoic period of faulting and late Cenozoic faulting producing the present basin-and-range topography. Late Mesozoic faults include thrust faults and steep faults that have mainly a strike-slip displacement. The major thrust fault is in the Talc City Hills where rocks of Devonian to Ordovician age have been thrust toward the northeast over limestone of predominantly Pennsylvanian and Permian age. The stratigraphic throw on the fault is 5,900 feet, and the net slip is estimated to be 3.6 miles. The Davis thrust is an important ore controlling structure in the Darwin Hills.

Strike-slip faults are common in the Darwin Hills and the Santa Rosa Hills. The Darwin tear fault is the major fault in the Darwin Hills. It is a left-lateral transverse strike-slip fault with a displacement of 2,200 feet, north side west. Strike-slip faults in the Santa Rosa Hills are also left lateral, but the net slip is not known.

Faults of late Cenozoic age account for many of the present topographic features. These faults strike north and dip steeply. Most of them are normal faults with an en echelon pattern. A swarm of Basin-Range faults in the northeastern part of the quadrangle is responsible for the escarpment on the west side of Panamint Valley. Most of the faults are normal faults with their downthrown side to the east, but some are reverse faults with the valley or east side faulted up. Another swarm of faults on the western flank of the Argus Range forms a series of step-like benches. The cumulative vertical displacement on these faults is about 1,600 feet; in the northeastern part of the quadrangle on the west side of Panamint Valley it is about 2,000 feet. The Basin-Range faults are less conspicuous in other parts of the quadrangle.

ORE DEPOSITS

The Darwin quadrangle is best known economically for its deposits of lead-silver-zinc ore, but in addition, talc, tungsten, antimony, copper, and gold have been produced, and vast deposits of limestone and dolomite are known. The total value of the ore produced from 1875 to 1952 is approximately $37,500,000. Production from the Darwin district has accounted for $29,000,000 of this amount. Most of the silver, lead, and zinc was mined from the Darwin Hills. Smaller deposits have been developed in the Zinc Hill area, the Lee district, and at the Santa Rosa mine. Steatite-grade talc has been mined continuously since 1917 from the Talc City Hills, principally from the Talc City mine. The only other commodity exploited in any quantity is tungsten, which was first produced in 1941 from mines on the east side of the Darwin Hills, and intermittent production has been maintained since then.

History

Oxidized silver-lead ore bodies were discovered at Darwin in November 1874 (Chalfant, 1933, p. 274), and between 1875 and 1880 the rich near-surface ores were mined extensively. The town of Darwin was reported to have had a population of 5,000 people by 1880 (Kelley, 1938, p. 507). Between 1875 and 1877 three smelters were built near Darwin—the Cuervo with a capacity of 20 tons per day, the Defiance with a capacity of 60 tons, and the New Coso with a capacity of 100 tons (Goodyear, 1888, p. 226).

In May 1875 the New Coso Mining Company purchased the Christmas Gift and Lucky Jim mines, then only prospects, and under the management of L. L. Robinson the company recovered 226,672 ounces of silver and 1,920,261 pounds of lead by April 1, 1877, (Robinson, 1877, p. 38) with a total value of $410,350. By 1883, $750,000 in bullion had been recovered, but the properties were idle at that time (Burchard, 1884, p. 164).

The Defiance and Independence mines were in production by 1875 as reported in the Coso Mining News of December 24, 1875, and by 1883 they yielded bullion worth $1,280,000. The district was nearly dormant by 1888 owing to the exhaustion of the easily mined, high-grade, near-surface ores (Goodyear, 1888, p. 226), and properties were operated only intermittently by lessees until World War I.

The history from World War I until 1945 is quoted from Norman and Stewart (1951, p. 60).

> . . . As these surface ores [of the Darwin district] were exhausted, however, the isolation of the district and unfavorable price fluctuation of metals allowed only intermittent operation until World War I, during which some of the principal mines, the Lucky Jim, Promontory, Lane and Columbia, were operated by the Darwin Development Company, the Darwin Lead-Silver Development Company, and finally by the Darwin Silver Company. The Darwin Silver Company consolidated the Defiance and Independence mines with the others.
>
> In 1919, the brokerage firm of E. W. Wagner and Company gained control of the properties, and under the management of A. G. Kirby, installed surface equipment, prepared some of the properties for production and remodeled the Lane mill. In 1921 the Wagner Company went bankrupt, and the Wagner Assets Realization Corporation, a creditors' organization, was formed to take charge of the assets. From 1922 to 1925 A. G. Kirby operated the properties on a lease. In 1925, C. H. Lord obtained a lease and bond on the properties and operated them as C. H. Lord, Trustee, until 1927. He then formed the American Metals, Incorporated, and continued operations until the end of the year. The Wagner Assets Realization Corporation then attempted to regain possession of the properties, but certain legal difficulties were not straightened out until 1936. Two of C. H. Lord's financial backers formed the Darwin Lead Company, obtained a lease and bond on the properties, and commenced operations in the fall of 1936 and continued until the summer of 1938. The Imperial Smelting and Refining Company, Mr. Sam Mosher and Ralph Davies and associates began operating the property in 1940. Later Mr. Davies withdrew, and Mr. Mosher and an association of officers of the Signal Oil Company continued operations as the Imperial Metals, Incorporated. In March 1943, Arthur J. Theis and associates took over the operation under the name Darwin Mines, although Imperial Metals, Incorporated retained an interest. The Anaconda Copper Mining Company purchased the property on August 1, 1945.

The Anaconda Company has operated the Darwin mines since 1945, except for brief shutdowns in 1948 and from March 1954 to January 1955. Most of their production has come from the Defiance, Essex, Independence, and Thompson mines. The Lucky Jim mine was rehabilitated in 1948, but no ore has been mined from it since then.

Talc was first mined in the Talc City Hills sometime prior to 1919. Waring and Huguenin (1919, p. 126) describe operations at the Talc City mine—then called Simonds talc mine—in their biennial report for 1915-1916. In 1918 the Simonds talc mine was purchased by the Inyo Talc Company, which later became known as the Sierra Talc and Clay Company. The Sierra Talc and Clay Company operated the Talc City mine and several smaller deposits continuously since 1918.

Scheelite was recognized in the eastern part of the Darwin district during World War I and was mentioned by Kelley (1938, p. 543), but no deposits were developed until 1940. The principal production of tungsten was in 1941 and 1942 by the Pacific Tungsten Company.

Lead-Silver-Zinc Deposits

Distribution

Deposits of lead-silver-zinc are widely distributed throughout the Darwin quadrangle. The largest deposits are in the southern part of the quadrangle in the Darwin Hills north and east of the town of Darwin. Other de-

posits have been mined at Zinc Hill 6 miles northeast of Darwin, in the Lee district at the south end of the Santa Rosa Hills, at the Santa Rosa mine in the Inyo Mountains, and at a few small deposits in the Talc City Hills (Pl. 1).

Ore Controls

Most of the lead-silver-zinc deposits are in calc-hornfels close to an intrusive contact. The deposits in the Darwin Hills are in calc-hornfels of the lower member of the Keeler Canyon formation of Pennsylvania and Permian age. The Santa Rosa mine is in calc-hornfels of the lower member of the Owens Valley formation of Permian age. A few small deposits are in marble or limestone.

No individual formation can be considered as particularly favorable for ore deposits, although within mineralized areas certain beds are favorable. In general, all formations consisting of limestone seem to be favorable for lead-silver-zinc deposits, and formations of dolomite and quartzite appear unfavorable. The deposits in the Lee district are in the Lost Burro formation of Devonian age and the Tin Mountain limestone of Mississippian age. The Cactus Owen prospect and the Homestake mine in the Talc City Hills are in a limestone unit of the Lost Burro formation. Deposits in the Zinc Hill district are mainly in Mississippian limestone. The Silver Dollar mine is in limestone of Pennsylvanian age near a thrust fault contact with older dolomite. Dolomite and quartzite in the Talc City Hills contain talc deposits, but only the limy parts of the formations contain lead-zinc deposits.

The generalization that limestone is favorable for lead-silver-zinc deposits and dolomite is unfavorable is also true in the Cerro Gordo area northwest of the Darwin quadrangle. However, the major lead-silver mines in the Ubehebe Peak quadrangle, the Lippincott and Ubehebe mines, are mainly in dolomite (McAllister, 1955, p. 20).

Within mineralized areas, certain beds in a formation are more favorable than other beds. In the Darwin district a medium-grained wollastonite-garnet-idocrase calc-silicate rock formed from a fairly pure limestone is favorable but dense, gray or greenish-gray calc-hornfels formed from silty limestone is unfavorable. At the Zinc Hill mine all the known ore bodies are in one favorable marble bed 200 feet thick, while other limestone beds are only slightly mineralized.

Individual deposits occur within favorable horizons as replacement bodies along faults, as bedded replacements commonly near the crests of folds, and as steep irregular or pipelike ore bodies. A fault control is apparent for nearly all the deposits, although it may be only one of several controls instrumental in localizing ore. In the Darwin district, most of the ore bodies are in favorable beds in or close to steep-dipping strike-slip faults striking N. 50°-70° E. that served as feeder channels for the ore solutions. The ore is in the N. 50°-70° E. faults at the Christmas Gift, Lucky Jim, and Rip Van Winkle mines. At the Thompson mine the ore is in north-striking fractures that are close to the N. 50°-70° E. faults, and the fractures are progressively less mineralized away from the northeast-striking faults. An exception is the Essex ore body, which is in a fault that strikes N. 65° W.

Bedded replacement bodies are at the Defiance, Independence, Jackass, Custer, Promontory, Empress, and Zinc Hill mines. At both the Defiance and Independence mines the bedded replacement bodies are at the crests of gentle folds close to a granodiorite sill. The bedded ore body at the Defiance mine becomes progressively thinner outward along bedding away from the northeast-trending Defiance fault.

The largest steep pipelike ore body is at the Defiance mine; this ore body has been developed from the 400-foot level to the 1000-foot level. It is adjacent to the Defiance fault and is localized in a zone broken up by numerous small fractures that strike northerly from the Defiance fault.

In the Lee district, ore bodies are localized in flat-lying fractures between major steep-dipping faults. The flat fractures may parallel bedding or transect bedding. A similar structural environment at the Ubehebe mine has been described by McAllister (1955, p. 27) and also has been observed by the writers about 11 miles southeast of Darwin at the Defense mine in the Argus Range.

The ore bodies range in size from small pods that contain a few tens of tons of ore, as in the Lee mine, to the large bedded replacement bodies of the Independence mine or pipelike ore body of the Defiance mine in the Darwin district. The bedded ore body at the Independence mine is mineralized, although not all of it is ore grade, for a maximum strike length of 500 feet, a thickness as much as 160 feet, and a distance of 700 feet down the dip. The pipelike ore body of the Defiance mine has been developed 700 feet vertically from 125 feet above the 400-foot level to the 1000-foot level, but its total vertical extent is not delimited. The mineralized area is approximately 5,000 square feet in cross section, but it is not all ore.

Mineralogy

The minerals identified in the lead-silver-zinc deposits in the Darwin quadrangle are listed below.

Hypogene minerals	
Ore and sulfide minerals	
Andorite	$PbAgSb_2S_6$
Argentite	Ag_2S
Arsenopyrite	FeAsS
Bismuth (?)	Bi
Bornite	Cu_5FeS_4
Chalcopyrite	$CuFeS_2$
Enargite-famatinite (?)	Cu_3AsS_4-Cu_3SbS_4
Franckeite	$Pb_5Sn_3Sb_2S_{14}$
Galena	PbS
Guanajuatite (?)	Bi_2Se_3
Matildite	$AgBiS_2$
Pyrite	FeS_2
Pyrrhotite	$Fe_{1-x}S$
Scheelite	$CaWO_4$
Sphalerite	ZnS
Stannite	Cu_2FeSnS_4
Tetrahedrite-tennantite	$(Cu, Fe)_{12}Sb_4S_{13}$-$(Cu, Fe)_{12}As_4S_{13}$
Unknown lead-bismuth-selenium sulfosalt	
Gangue minerals	
Barite	$BaSO_4$
Calcite	$CaCO_3$
Chalcedony	SiO_2
Deweylite	$Mg_4Si_3O_{10}\cdot 6H_2O$
Diopside	$CaMgSi_2O_6$
Fluorite	CaF_2
Garnet sp. andradite	$(Ca)_3(Al, Fe)_2Si_3O_{12}$
Graphite	C
Idocrase	$Ca_6[Al(OH, F)]Al_2(SiO_4)_5$
Jasper	SiO_2
Kaolinite	$H_4Al_2Si_2O_9$
Montmorillonite	$(OH)_4Al_4Si_8O_8\cdot xH_2O$

Quartz	SiO_2
Sericite	$(H, K)AlSiO_4$
Wollastonite	$CaSiO_3$
Supergene minerals	
Sulfide minerals	
Argentite	Ag_2S
Chalcocite	Cu_2S
Covellite	CuS
Oxide zone	
Anglesite	$PbSO_4$
Antlerite	$Cu_3(OH)_4SO_4$
Aurichalcite	$2(Zn, Cu)CO_3 \cdot 3(Zn, Cu)(OH)_2$
Azurite	$2CuCO_3 \cdot Cu(OH)_2$
Bindheimite	$Pb_2Sb_2O_6(O, OH)$
Brochantite	$CuSO_4 \cdot 3Cu(OH)_2$
Caledonite	$Cu_2Pb_5(SO_4)_3(CO_3)(OH)_6$
Cerargyrite	$AgCl$
Cerussite	$PbCO_3$
Chrysocolla	$CuSiO_3 \cdot 2H_2O$
Creedite	$Ca_3Al_2F_4(OH, F)_6(SO_4) \cdot 2H_2O$
Crocoite	$PbCrO_4$
Cuprite	Cu_2O
Goslarite	$ZnSO_4 \cdot 7H_2O$
Gypsum	$CaSO_4 \cdot 2H_2O$
Hemimorphite	$H_2Zn_2SiO_5$
Hydrozincite	$2ZnCO_3 \cdot 3Zn(OH)_2$
Jarosite	$K_2Fe_6(OH)_{12}(SO_4)_4$
Limonite (and goethite)	Hydrous iron oxide
Linarite	$(Pb, Cu)SO_4 \cdot (Pb, Cu)(OH)_2$
Malachite	$CuCO_3 \cdot Cu(OH)_2$
Melanterite	$FeSO_4 \cdot 7H_2O$
Plumbojarosite	$PbFe_6(OH)_{12}(SO_4)_4$
Pyromorphite	$(PbCl)Pb_4(PO_4)_3$
Silver	Ag
Smithsonite	$ZnCO_3$
Sulfur	S
Vanadinite	$(PbCl)Pb_4(VO_4)_3$
Wulfenite	$PbMO_4$

Hypogene Minerals

The hypogene ore and sulfide minerals consist principally of galena, sphalerite, pyrite, pyrrhotite, and chalcopyrite with minor tetrahedrite, scheelite, andorite, franckeite, stannite, enargite-famatinite(?), matildite, bismuth(?) and an unidentified lead-bismuth-selenium sulfosalt. Argentiferous galena is the principal ore mineral. It ranges in texture from coarsely crystalline masses to fine-grained steel galena. Corroded inclusions of tetrahedrite, pyrrhotite, and chalcopyrite are common in the galena. Some of the steel galena from the Essex mine contains tiny lamellar inclusions oriented along cleavage planes that are probably matildite that has exsolved from the galena. The inclusions are similar in color and reflectivity to galena and are distinctly anisotropic from light to dark gray. The galena with inclusions gave distinct bismuth and silver peaks on the x-ray spectrometer. Some galena from the Essex mine gave distinct selenium peaks on the x-ray spectrometer and may be clausthalite.

Sphalerite is common in all the primary ore and is the predominant hypogene mineral at the Zinc Hill mine. It is commonly in coarsely crystalline masses with cleavage faces 1 to 2 inches in diameter. Pyrite is abundant in all the lead-zinc deposits except at the Lee mine. It is also widely distributed through the country rock at the Darwin mines. Pyrrhotite is commonest in the deep levels of the Thompson mine. It commonly forms a banded structure with galena and sphalerite in the bedded ore bodies. Chalcopyrite is a minor constituent of the ore and occurs as corroded inclusions in sphalerite and galena.

Some of the primary lead-zinc ore contains scheelite as subhedral and euhedral octahedral crystals $\frac{1}{4}$ to $\frac{1}{2}$ inch in diameter, and many euhedral crystals have been recovered loosely embedded in oxidized ore (Davis and Peterson, 1948, p. 2). Similar crystals of scheelite surrounded and embayed by galena have been found in the deep levels of the Thompson mine (photo 1).

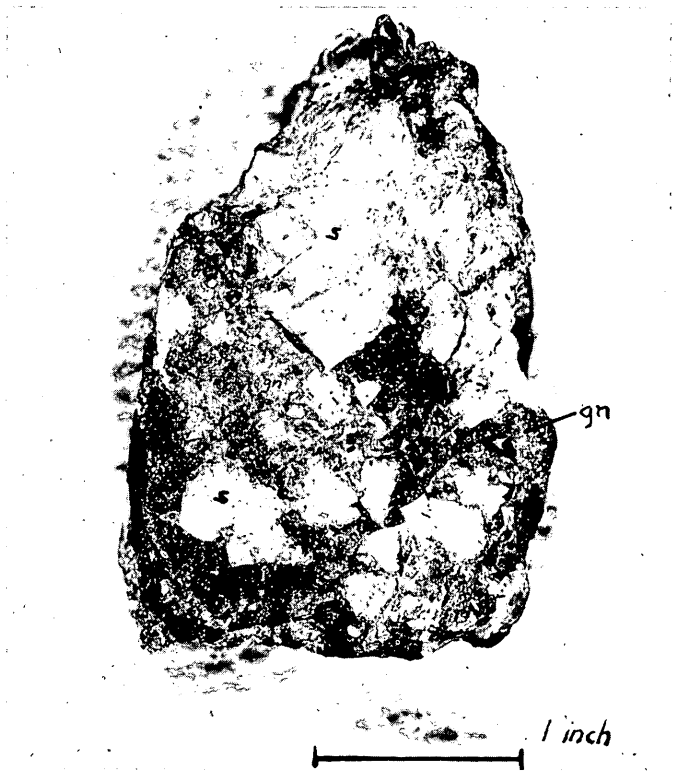

PHOTO 1. Specimen from Thompson mine showing subhedral scheelite crystals (s) embayed by galena (gn).

Franckeite, andorite, bismuth, stannite, and enargite-famatinite(?) were identified by Charles Milton of the U. S. Geological Survey from a silver-rich ore body in the 534 stope above the 400 level of the Thompson mine. Franckeite is in the silver-rich primary ore bodies that contain little galena. It is in thin, tabular, warped crystals as much as $\frac{3}{8}$ inch long that are prominantly striated. In polished section, tiny irregular white inclusions are visible irregularly distributed through the franckeite. The inclusions may be guanajuatite (Bi_2Se_3), as both bismuth and selenium were indicated by the x-ray spectrometer. Andorite is associated with the franckeite and may account for the high silver content where sulfantimonides are present. It is in thin tabular crystals similar in appearance to franckeite, but the presence of both minerals was verified by x-ray diffraction pattern by J. M. Axelrod of the U. S. Geological Survey. An unidentified lead-bismuth-selenium sulfosalt that may be a new mineral is associated with franckeite in the Thompson mine. The sulfosalt is a silver-white tabular mineral that is prominantly striated. The x-ray diffraction pattern does not agree closely with any known sulfide mineral. The presence of bismuth, lead, and selenium was indicated by the x-ray spectrometer.

The gangue minerals consist principally of calcite, fluorite, garnet, and jasper with minor barite, clay minerals, diopside, idocrase, orthoclase, quartz, and wollastonite. Both calcite and fluorite are directly associated

with ore minerals. Calcite is very coarsely crystalline at some of the deposits in the Darwin Hills. Gray calcite rhombohedrons 2 to 6 inches long are abundant at the surface workings of the Defiance mine. It is also particularly abundant at the Custer mine where rhombohedrons as much as 24 inches long make up most of the vein, and the lead minerals form pockets or chimneys interstitial to the calcite. Fluorite is commonly intergrown with galena, and the miners have used it as an indicator of ore. It ranges in color from colorless to light green, light blue, or rose, and was noted at nearly all the mines in the Darwin district. Garnet, idocrase, diopside, and wollastonite were formed by recrystallization of the limestone to silicate minerals before the period of metallization, and they are in part replaced by ore minerals. Jasper is in some of the ore bodies formed in major fault zones. It is particularly abundant as a gangue mineral at the Santa Rosa mine. Only small quantities of barite are found in the Darwin district, but it is an abundant gangue mineral at the Lee mine and Silver Reid prospect in the Lee district.

Supergene Minerals

The zone of oxidation at most places in the Darwin quadrangle is deep. The ore is largely oxidized except where protected from oxidation by an impermeable layer or in the deeper levels of the Darwin mine. The oxidized ore is a porous, crumbly mass composed mainly of limonite, hemimorphite, and cerussite with some unaltered relicts of galena. At the Defiance mine the ore was mainly oxidized to the 400-foot level, and both oxide and primary ore extend from the 400-foot level to the 1,000-foot level. At the Lucky Jim mine, only small relicts of primary sulfide minerals extend down to the deepest workings on the 920-foot level. Anglesite forms a thin alteration halo around some of the galena. Hydrozincite, plumbojarosite, pyromorphite, and smithsonite are less abundant in the oxidized ore. At some places, secondary copper minerals accompany the secondary lead and zinc minerals. Aurichalcite, azurite, bronchantite, caledonite, chrysocolla, linarite, and malachite have been identified from the Darwin district. Some of the oxidized near-surface ore mined during the early history of the Darwin district is reported to have contained as much as 950 ounces of silver per ton (Raymond, 1877, p. 30). Native silver, cerargyrite, and sooty argentite are reported in the oxidized ore at Darwin (Kelley, 1938, p. 546; Davis and Peterson, 1948, p. 2; and Carlisle and others, 1954, p. 46). Euhedral crystals of cerargyrite were identified from the Lee mine. Other minerals found in small quantities in the zone of oxidation are bindheimite, creedite, crocoite, goslarite, jarosite, melanterite, pyrolusite, sulfur, vanadinite, and wulfenite. Small quantities of chalcocite and covellite are in some of the sulfide ore.

Primary Zoning

The hypogene mineralization within the Darwin area shows a general zonal distribution, which probably can be correlated with an overall temperature gradient at the time of ore deposition. In general the near-surface ore contains more lead and silver, but with depth the zinc-to-lead content increases and the silver content decreases. The Defiance workings of the Darwin mine will be used as an example. The near-surface primary ore in the bedded deposits consisted mainly of galena with an above-average content of silver. The gangue minerals are largely calcite, fluorite, and jasper. The upper part of the steep pipelike Defiance ore body consisted predominantly of galena that had a lower content of silver than the overlying bedded deposits. Some sphalerite is present in this ore. With increasing depth in the Defiance ore body the proportion of zinc to lead shows a definite increase and the silver content of the ore shows a slight decrease. Pyrite also shows a marked increase in the deeper levels of the mine. The gangue minerals are predominantly garnet, wollastonite, and calcite. It must be emphasized, however, that there are many local variations within this general zonal distribution.

Zoning is also evident between the lead-silver ore bodies and the tungsten ore bodies on the east side of the stock of the Darwin Hills; the lead-silver ore bodies are farther out along the same faults that control tungsten ore bodies.

Scheelite with little or no associated galena is found in tactite and calc-hornfels in the Fernando adit for a distance of 660 feet from the portal west to the contact of the stock of the Darwin Hills. Lead-silver ore is 450 feet N. 70° E. of the tungsten ore—farther from the main stock—in the Fernando fault at the old Fernando workings. Similarly at the St. Charles No. 3 workings the scheelite ore is close to the stock of the Darwin Hills, and the ore at the Custer mine is localized by one of the same fractures but farther from the intrusive. In Lane Canyon, scheelite is found in tactite along the crest of an anticline 450 feet from the contact of the intrusive but silver-lead ore at the Lane and Santa Ana mines to the east is still farther from the intrusive.

The Jackass mine, where both scheelite and lead-silver ore are found within a few feet of each other, is an exception to the zoning on the east side of the stock. Scheelite is disseminated in tactite while the lead-silver ore with no scheelite is in a bedding plane fault at the footwall contact of the tactite with calc-hornfels and is undoubtedly later.

Darwin Silver-Lead-Zinc District

by W. E. Hall, E. M. Mackevett, and D. L. Davis *

The Darwin silver-lead-zinc district, which is in the southern part of the Darwin quadrangle, is within the New Coso mining district. The Darwin district is coextensive with the Darwin Hills. The district is 39 miles by paved road from Lone Pine, the nearest supply center. The nearest railroad is at Keeler, the southern terminus of the Southern Pacific Railroad Company's narrow gauge line from Keeler to Laws, Calif. The Anaconda Company maintains a modern mining camp, including housing, grocery store, and recreational facilities, 1 mile north of Darwin.

The Darwin district can be divided into two parts. Lead, zinc, and silver are the principal commodities mined in the western part, while tungsten is the principal commodity mined in the eastern part. Most of the mines in the western part of the district have been consolidated under one management since World War I, and they are commonly referred to as the Darwin mines. The Darwin mines consist of the Bernon, Columbia, Defiance, Driver, Essex, Independence, Lane, Liberty

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Table 3. Ore produced from the Darwin silver-lead-zinc district. †*

Year	Gold (oz)	Silver (oz)	Copper (lbs)	Lead (lbs)	Zinc (lbs)	Operator or Mine
1875-1883	--	1,571,000 (estimated)		--	--	Defiance mine; New Coso Mining Co.
1888-1892	23.51	--	--	--	--	Phoenix mine
1893	7.26	26,759	--	--	--	Custer mine; J. A. McKenzie; H. Mettler; Phoenix mine
1894	--	70,095	--	--	--	Christmas Gift mine; Henry Mettler
1895	--	19,362	--	--	--	Custer mine; J. A. McKenzie; Henry Mettler
1897	--	5,517	--	--	--	J. A. McKenzie and W. W. Boswell
1898	64	54,800	--	--	--	R. C. Troeger
1899	53	37,349	--	--	--	Custer mine; Last Chance Mining Co.; J. A. McKenzie; Phoenix mine
1900	741	13,178	--	--	--	W. W. Boswell; J. A. McKenzie; Phoenix mine
1901	591	14,333	--	--	--	W. W. Boswell; J. A. McKenzie; Phoenix mine
1902	--	4,360	--	--	--	J. A. McKenzie; Phoenix mine
1903	39	14,814	--	11,905	--	J. A. McKenzie
1904	25	12,276	--	3,200	--	Inyo County Mining and Dev. Co.; J. A. McKenzie
1905	24.19	5,036	2,600	2,042	--	Christmas Gift mine; Inyo County Mining and Dev. Co.
1906	--	3,970	--	36,842	--	C. R. Bradford; Inyo County Mining and Dev. Co.; New Coso Mining Co.
1907	--	12,600	--	100,000	--	New Coso Mining Co.
1908	4	17,785	--	182,405	--	New Coso Mining Co.
1909	23.87	3,271	462	75,235	--	Christmas Gift mine; New Coso Mining Co.; S. H. Reynolds
1910	75	11,358	904	170,609	--	New Coso Mining Co.; S. H. Reynolds
1911	1	4,292	--	5,667	--	C. A. Bradford; Custer mine; New Coso Mining Co.; S. H. Reynolds
1912	38.32	11,670	13,210	215,710	--	Christmas Gift mine; Independence Mining Co.; New Coso Mining Co.
1913	62.99	28,174	6,097	440,624	--	Christmas Gift mine; Custer mine; New Coso Mining Co.; J. C. Roeper; M. J. Summers
1914	6.02	13,043	1,256	195,667	--	New Coso Mining Co.
1915	3.0	10,028	314	121,363	--	Christmas Gift mine; Darwin Development Corp.; Theo Peterson
1916	38	103,546	27,207	1,361,401	--	Christmas Gift mine; Darwin Mines Corp.
1917	275	145,870	232,222	1,672,569	--	Christmas Gift mine; Custer mine; Darwin Mines Corp.; Theo Peterson; M. J. Summers
1918	114.61	50,568	11,854	997,038	--	A. A. Belin; Custer mine; Darwin Silver Co.; A. G. Kirby; Rooney and Bradford
1919	7.06	12,698	1,400	149,945	--	Custer mine; Darwin Silver Co.; Theo Peterson; M. J. Summers
1920	4.66	6,827	648	92,613	--	Custer mine; Darwin Silver Co.; Theo Peterson; M. J. Summers
1921	--	1,186	--	18,918	--	Darwin Silver Co.; A. G. Kirby
1922	61	89,116	7,712	937,538	--	A. G. Kirby
1923	152	125,899	18,098	2,026,692	--	Christmas Gift mine; A. G. Kirby
1924	54	40,242	8,920	731,249	76,947	A. G. Kirby
1925	3	10,467	3,804	84,822	--	A. A. Belin; L. D. Foreman and Co.
1926	31.11	33,145	4,320	978,001	--	American Metals Inc.; Christmas Gift mine; L. D. Foreman and Co.
1927	48	38,238	7,916	1,223,534	--	American Metals Inc.; Christmas Gift mine; L. D. Foreman and Co.
1928	1	635	--	22,395	--	American Metals Inc.
1935	90.21	1,161	1,935	21,192	--	Custer mine
1937	111	64,076	9,521	1,049,491	--	Custer mine; Darwin Keystone Ltd.; Darwin Lead Co.; L. D. Foreman and Co.; Louis Warnken, Jr.
1938	23	6,829	2,457	119,679	--	Darwin Keystone Ltd.; Darwin Lead Co.; Louis Warnken, Jr.
1939	5	146	--	--	--	J. B. Anthony
1940	7	748	170	32,712	--	Custer mine; Theo Peterson
1941	77	32,244	16,501	1,424,236	--	Imperial Metals, Inc.
1942	175	53,072	4,422	1,510,000	--	Imperial Metals, Inc.; L. D. Foreman and Co.
1943	--	138,662	--	4,896,000	--	Darwin Mines
1944	--	252,900	--	5,218,000	1,110,000	Darwin Mines; L. D. Foreman and Co.; Wonder mine
1945	377	575,069	130,931	10,428,000	1,992,000	The Anaconda Co.; L. D. Foreman and Co.
1946	442	871,091	198,307	15,416,000	1,708,000	The Anaconda Co.; L. D. Foreman and Co.
1947	529	1,093,709	86,690	13,102,000	1,206,000	The Anaconda Co.; Custer mine; L. D. Foreman and Co.; Wonder mine
1948	472	393,761	131,022	12,156,000	8,994,000	The Anaconda Co.; Custer mine; L. D. Foreman and Co.; Keystone mine; St. Charles mine
1949	232	352,482	130,527	9,856,000	8,124,000	The Anaconda Co.; Custer mine; Keystone mine
1950	361	600,440	202,829	16,958,000	10,474,000	The Anaconda Co.
1951	441	570,595	225,140	14,382,000	9,440,000	The Anaconda Co.; Belle Union; Lane; Promontory
	5,913.81	7,630,492	1,489,396	117,566,900	52,124,947	
short tons	--	--	744.7	58,783.5	26,062.5	

* See text page 19 for sources of production data.
† Published with the permission of the mine owners.

Group, Lucky Jim, Promontory, Rip Van Winkle, and Thompson. In this report the name Darwin mine will be restricted to the mines through which the Radiore tunnel passes. This includes the Rip Van Winkle, Defiance, Bernon, Thompson, Essex, and Independence mines, and each of these deposits will be referred to as workings—the Defiance workings, Essex workings, etc. All the production of The Anaconda Company from the Darwin district has come from the Darwin mine. The term Darwin mines will be used in the former unrestricted sense. The mines in the eastern part of the district were originally mined for their lead and silver content, but since 1940 they have been mined only for tungsten.

Production

The total known production of lead, silver, zinc, copper, and gold from the Darwin district is given in table 3. The production from 1875 to 1883 was estimated by the writers from smelter returns listed in the report to the stockholders in 1877 by the New Coso Mining Company and from value of production given in early descriptions of the district in the Coso Mining News and by Burchard (1884, p. 164). The production data from 1888 to 1942 for the Darwin mines were compiled by the Mineral Production and Economics Division of the U. S. Bureau of Mines. The production figures for the other mines in the district are from annual records from the U. S. Bureau of Mines, Metal Economics Branch, San

Francisco office. All production figures are published with the permission of the mine owners. The production of lead, zinc, and silver from 1943 through 1951 is from the Minerals Yearbook.

No record of production was found for some of the smaller mines. Possibly their production was combined with shipments from other properties, and they did not receive recognition for their ore.

Grade of Ore

Before 1942 mainly high-grade oxidized silver-lead ore with some relict galena was mined from shallow workings at the Darwin mine. Smelter returns of the New Coso Mining Company prior to April 1877 show that 20.5 percent lead and 47 ounces of silver per ton of ore were recovered from its furnaces (Robinson, 1877, p. 38). Burchard (1884, p. 164) reports that ore from the Defiance and Independence mines averaged 30 percent of lead and $40 (31 ounces) of silver per ton. The grade of ore must have been very erratic as Raymond (1877, p. 30) reports ore at the Defiance mine assayed up to $1,225.29 (950 ounces) of silver per ton and 56 percent lead.

Production data compiled during World War II by the U. S. Bureau of Mines, Metal Economics Branch, indicate that 102,524 tons of ore was mined from the Darwin mines from 1902 through 1942. The average recovery from this ore was 0.03 ounces of gold per ton, 8.7 ounces of silver per ton, 0.2 percent copper, and 7.3 percent lead. The zinc content of the ore is not known, and probably little zinc was recovered.

Since 1942, production of sulfide ore from the Darwin mine has exceeded that of oxide ore. The grade of sulfide ore averages approximately 6 percent lead, 6 percent zinc, and 6 ounces of silver per ton. A considerable tonnage of high-grade ore containing approximately 20 to 30 percent lead was produced and direct-shipped from 1944 through 1952.

Geology

The rocks in the Darwin district are marble, limestone, silty limestone, shale, and siltstone in an overturned section that ranges in age from Devonian at the northwest end of the Darwin Hills to Permian on the east side. A stock intrudes the Pennsylvanian and Permian rocks along the east side of the Darwin Hills. The Paleozoic rocks strike northerly and dip predominantly to the west. Within 4,000 feet of the stock the sedimentary rocks are mostly altered to calc-hornfels, marble, and tactite.

The Lost Burro formation of Devonian age is the oldest formation present. It crops out on the west side of the Darwin Hills 3,700 feet N. 47° W. of Ophir Mountain. It is about 600 feet thick and consists of banded white and light gray coarsely crystalline marble and minor gray limestone. The marble is correlated with the Lost Burro formation on the basis of stratigraphic succession, lithology, and very poor fragmentary fossils that resemble *Cladopora*.

The Tin Mountain limestone of Mississippian age crops out in a band east of the Lost Burro formation. The formation is about 300 feet thick and consists of thin- to medium-bedded gray limestone that locally is bleached white. Fragmentary solitary corals and *Syringopora* are present. The Tin Mountain limestone is in fault contact with the Lost Burro formation, but the bedding-plane fault probably has little displacement, and almost all of the formation is believed to be present.

The Perdido formation of Mississippian age crops out on the west side of the Darwin Hills in a band approximately 350 feet thick adjacent on the east to the Tin Mountain limestone. It consists of thinly bedded medium-gray limestone, bedded chert, and siltstone. Bedding-plane faults of small displacement separate the Perdido formation from the Tin Mountain limestone on the west and from the Lee Flat on the east. The previously described formations—the Lost Burro, Tin Mountain, and Perdido—are present only at the north end of the Darwin Hills northwest of Ophir Mountain, and they project into alluvium in the vicinity of the Darwin mine.

The Lee Flat limestone of Mississippian and Pennsylvanian (?) age is the oldest formation in the Darwin mine area. It crops out from the north end of the Anaconda Company mining camp to the north end of the Darwin Hills. The formation consists of thin- to medium-bedded gray limestone that contains thin beds of chert and iron-stained hornfels. Locally the limestone is bleached white and is recrystallized to marble. The formation is about 500 feet thick, but part of the section may be cut out by faulting.

The Keeler Canyon formation of Pennsylvanian and Permian age underlies most of the Darwin Hills, and it is the host rock for most of the ore deposits in the Darwin district. It crops out along the crest and east slope of the Darwin Hills north of the Darwin mine, and constitutes all of the Paleozoic rocks in the Darwin Hills south of the Darwin mine. The formation is about 4,000 feet thick and consists of bluish-gray limestone, silty limestone, sandy limestone, pink shale, and siltstone. The lower part of the formation is mostly limestone, and the upper part contains abundant shale and interbedded limestone. The unaltered formation is well exposed north of the Darwin tear fault in the vicinity of the Darwin Antimony mine. South of the Darwin tear fault the formation is mostly altered to calc-hornfels and tactite.

The Golfball horizon, which is thinly bedded bluish-gray limestone with ½- to 1½-inch spherical chert nodules and which locally contains sparse tiny fusulinids, crops out along the western contact of the limestone sequence between Ophir Mountain and the Darwin mining camp. This horizon is characteristic of the base of the formation throughout the Darwin, New York Butte, Panamint Butte, and Ubehebe Peak quadrangles.

The Owens Valley formation of Permian age is present on the east side of the Darwin Hills 2,700 feet east of the Darwin Antimony mine and 3,500 feet east of the Christmas Gift mine. It consists of light- to medium-gray thin- to medium-bedded calcarenite, siltstone, shale, and lenses of massive pure limestone. The calcarenite commonly is cross-bedded.

The rocks of Paleozoic age are intruded by a stock along the central part of the Darwin Hills and by a small concordant pluton on the west slope of Ophir Mountain. The batholith of the Coso Range crops out locally along the west edge of the Darwin Hills.

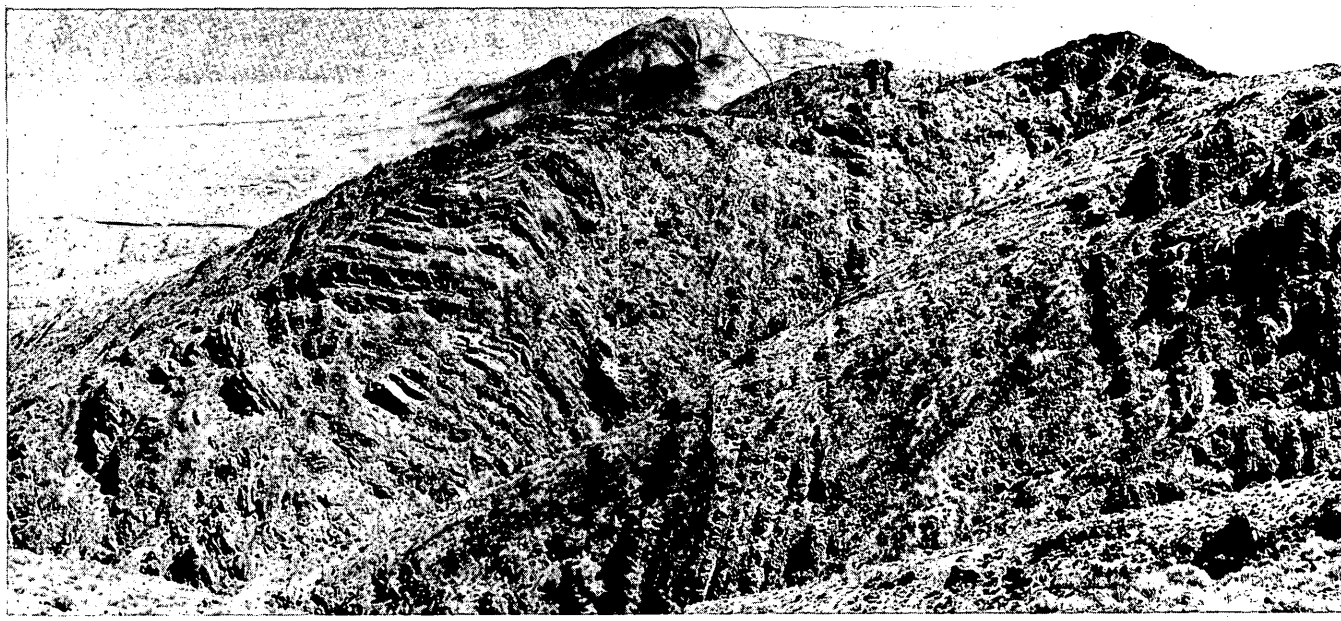


PHOTO 2. Folded beds in the transition zone between overturned beds in the west and central parts of the Darwin Hills and right-side-up beds on the east side. View looking south 1,700 feet southeast of the Christmas Gift mine.

Structure

Structurally the Darwin Hills are an overturned syncline with an axial plane that dips west; the syncline is intruded by the stock of the Darwin Hills along the crest of the hills. The Paleozoic rocks west of the stock strike northerly and dip mainly 30° to 70° W. in an overturned section on the west limb of the overturned syncline. East of the stock the beds also dip west in an overturned section as far east as the Lucky Jim, Christmas Gift, Wonder, St. Charles, and Durham-Fernando mines, that is, about 800 to 1,200 feet east of the stock. The evidence for the overturning is mainly on stratigraphic succession. The oldest beds are on the west side of the Darwin Hills, and the rocks become progressively younger to the east. Bedding, however, dips predominantly west. Paleozoic rocks on the west side are similar lithologically to Devonian and Mississippian rocks elsewhere in the quadrangle, while fossiliferous Pennsylvanian and Permian rocks underlie the central and eastern parts of the Darwin Hills. The lithology of some of the formations is sufficiently distinctive to recognize that the lower parts of some formations are to the west. The Golfball horizon is the best example. The faunal evidence is also suggestive of an overturned section, but fossils are poorly preserved and the faunal evidence is not conclusive except for fusulinids of late Wolfcamp age (Permian) in many places along the east side of the hills.

Locally the upper part of the Keeler Canyon formation and much of the Owens Valley formation is cross-bedded. Cross-bedding in the silty limestone of the upper Keeler Canyon formation 2,000 feet northeast of the Darwin Antimony mine corroborates the overturned section there.

East of the Lucky Jim, Christmas Gift, Wonder, St. Charles, and Durham-Fernando mines is a belt of highly iron-stained, dense calc-hornfels that is intensely folded. This belt of iron-stained calc-hornfels is the axis of the syncline and forms the transition between overturned beds to the west and right-side-up beds along the east edge of the hills (Photo 2).

In some places, bedding in this deformed belt is readily apparent and the folds are easily resolved, but in most places the rocks are fractured and their folded nature is not apparent except by close examination. The crests of folds, in particular, are commonly shattered. Fracture cleavage locally is well developed in this deformed belt and is an aid in determining tops of beds. In tight, overturned folds fracture cleavage is usually well developed on the right-side-up limb, but it is poorly developed on the overturned limb where it tends to be nearly parallel to bedding.

The folded beds are exposed in the canyon that drains east from the Lucky Jim mine and in the canyon to the north. At the Lucky Jim mine the overturned beds strike northerly and dip west. An overturned minor syncline with an axial plane that dips west is about 600 feet northeast of the main shaft. If one continues east down the canyon from the mine, the beds may be seen to pass through several tight minor anticlines and synclines before passing into right-side-up beds with broad folds 2,200 feet east of the mine. The beds continue to dip gently east in Darwin Wash to Darwin Canyon, and the beds dip west on the east side of the canyon.

In the Durham-Fernando mine area the beds likewise are overturned and dip to the west. The axis of an overturned syncline crops out in the gully 500 feet N. 77° E. of the Durham shaft. (See pl. 9.) An open anticline is 30 feet east of the overturned syncline, and the beds pass through gentle folds with right-side-up beds continuing to the east.

At many places, although the exact nature of the transition from right-side-up to overturned beds is not evident because of inadequate exposures, some tight folds are recognized. At some places, as at the Custer mine,

faults separate overturned from right-side-up beds (see pl. 9).

The Paleozoic rocks are intersected by four sets of faults. The four sets are described under the subtopic "Darwin mine" as the faults are important in localizing ore. The largest fault is the Darwin tear fault, which is a left-lateral strike-slip fault that strikes N. 70° W. Displacement on the fault is 2,300 feet, the north block moving west.

Belle Union Mine

The Belle Union mine, owned by The Anaconda Company, is in sec. 12, T. 19 S., R. 40 E., at altitudes near 5,200 feet. It is one of the old mines in the district but in recent years has been inactive. Mine workings including three shafts are largely inaccessible and their size and extent are not known. The mine is in calc-hornfels of the Keeler Canyon formation near a salient of the Darwin Hills stock. The ore is in a near-vertical vein trending N. 58° E. Observed ore minerals on the dumps and in the highly iron-stained vein include galena, cerussite, and hemimorphite.

Buckhorn Mine

The Buckhorn mine, which is owned by Andrew Sundberg, is in sec. 31, T. 18 S., R. 41 E., at an altitude of 4,240 feet. The mine is developed by two shafts, one about 30 feet deep inclined northerly at 70°, and the other inclined to the northwest at 30°. Other workings include minor pits and open cuts south of the main workings. Production from the property is small.

The mine is in silty limestone of the lower member of the Owens Valley formation. Ore is a replacement of a fault zone that strikes N. 70° E. and dips 30° N. Another fault, which strikes N. 28° W. and dips 70° N., apparently cuts off and displaces the N. 70° E. fault. Ore minerals consist of cerussite, hemimorphite, and minor galena in an iron-stained quartz-calcite gangue. The size or grade of the ore body is not known.

Christmas Gift Mine

The Christmas Gift mine is 2½ miles north of Darwin in secs. 1 and 12, T. 19 S., R. 40 E., at an altitude of 5,440 feet. The property is accessible by a dirt road 2½ miles long that branches off the Darwin to Lone Pine highway 2.2 miles northwest of Darwin. The mine is owned by C. B. Skinner of Morro Bay, Calif.

The recorded production from the Christmas Gift mine since 1893 is given in table 4. The total production from 1875 to 1893 is not known. Both the Christmas Gift and Lucky Jim mines were owned by the New Coso Mining Company during the early history of the district and the production of both mines was lumped. Burchard (1884, p. 164) reports the production of the two mines by 1883 to be $750,000. The Christmas Gift mine was worked extensively in 1875 and early 1876 according to the annual report of 1877 to the stockholders, and 8,871 bars of silver were produced from the Christmas Gift during this period (estimated by the writers to contain 83,500 ounces of silver and 700,000 pounds of lead). Apparently most of the production between the spring of 1876 and 1883 came from the Lucky Jim mine.

*Table 4. Ore produced from the Christmas Gift mine since 1893.**

Year	Ore (tons)	Gold (oz.)	Silver (lbs.)	Copper (lbs.)	Lead (lbs.)
1894	--	--	12,952	--	--
1895	--	--	7,692	--	--
1905	50	24.19	4,918	--	--
1909	21	0.87	908	85	12,835
1912	135	14.32	6,813	535	82,620
1913	400	19.01	14,677	2,801	254,062
1914	183	4.02	7,553	910	137,641
1915	69	3.00	2,817	314	48,724
1916	368	--	2,522	4,520	90,218
1917	385	--	14,000	--	213,000
1918	235	2.61	6,027	1,279	119,014
1923	7	--	256	83	2,724
1926	6	0.11	115	83	2,688
	52	--	615	21	10,075
Total	1,911	68.13	81,865	10,631	973,601

* Published with the permission of the mine owners.

The mine workings consist of 5 shafts, several adits totaling more than 600 feet in length, and many open cuts and shallow shafts. The Christmas Gift shaft was sunk on the vein to a depth of 250 feet, and a winze extends 126 feet below the 250-foot level. There are approximately 1,900 feet of levels from the shaft and winze. The Johnny John shaft is reported by Norman and Stewart (1951, p. 59) to be 250 feet deep, but it was inaccessible. The other shafts are 90 to 100 feet deep.

The Christmas Gift area is underlain by quartz monzonite and by calc-hornfels and hornfels that is metamorphosed limestone and silty limestone of the lower and upper members of the Keeler Canyon formation (pl. 3). The ore deposits are in calc-hornfels that correlates with the uppermost part of the lower member of the Keeler Canyon formation (photo 3). The lower member consists of white to light-gray dense calc-hornfels with 1- to 2-inch thick greenish-gray dense hornfels bands that are metamorphosed shale. The calc-hornfels of the lower member of the Keeler Canyon formation is intruded by small irregular bodies of quartz monzonite and granodiorite that line up in a northerly direction. The contact with the upper member of the Keeler Canyon formation is 370 feet northeast and 825 feet east of the Christmas Gift shaft. The upper member consists of dense greenish-gray hornfels that weathers dark brown.

Bedding is overturned in the metasedimentary rocks. It strikes predominantly north to N. 40° W. and dips 25° to 50° W. The rocks are cut by many faults that strike N. 30°-70° E. and dip steeply northwest. The displacement where recognized is left lateral. Nearly horizontal slickensides exposed underground confirm the strike-slip displacement on the fault through the Christmas Gift shaft.

Ore in the Christmas Gift mine is localized in faults that strike N. 30°-70° E. Seven faults have been prospected, but most of the ore was mined from the Christmas Gift vein, which is exposed in the Christmas Gift shaft. Ore minerals are exposed along the Christmas Gift vein intermittently for a strike length of 700 feet and to a depth of 334 feet, but only locally is the grade sufficiently high to be ore. Most of the ore in the vicinity of the Christmas Gift shaft has been mined between the surface and the No. 6 level, a vertical distance of 146 feet.

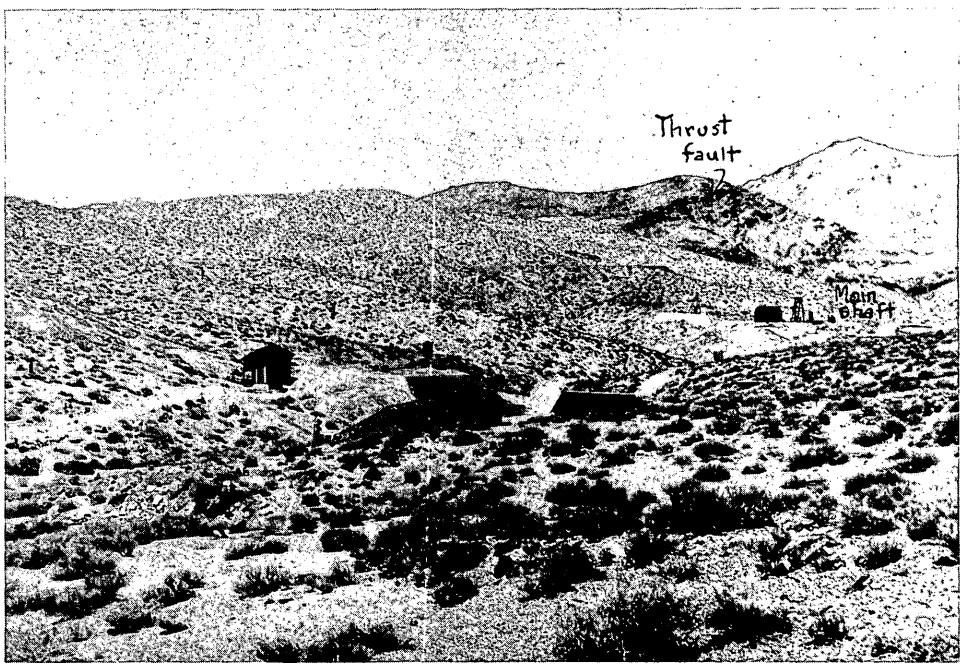


PHOTO 3. View looking north at Christmas Gift mine. The area is underlain by quartz monzonite and by calc-hornfels of the lower unit of the Keeler Canyon formation of Pennsylvanian and Permian age. The thrust fault near the skyline probably is an extension of the Davis thrust.

The ore shoot strikes N. 40°-50° E. and dips 70°-80° NW.; it rakes steeply to the southwest. Average thickness of the vein is about 3 feet.

The ore is oxidized in the deepest mine workings, where only minor relicts of galena remain. The vein consist predominantly of limonite and cerussite in a gangue of calcite and jasper and locally they contain blue and green secondary copper minerals.

A structural control for ore shoots related to strike of the fault zone seems evident. The ore is localized where the faults strike approximately N. 45° E., and the faults are only slightly mineralized where the strike is N. 65°-70° E. As the faults had a left-lateral displacement, the fault zones were open where the strike is N. 45° E.—thus favorable for ore deposition—and tight where the strike is N. 65°-70° E. This is illustrated by the ore shoot on the No. 10 level (pl. 4). The mineralization was restricted to the part of the fault southwest of the winze where it strikes N. 35° E. and dips 68° NW. The fault is unmineralized northeast of the winze where the strike changes to N. 70° E. and the dip steepens to approximately vertical.

A pocket of ore was mined from a shaft 670 feet N. 6° W. of the Christmas Gift shaft. The shaft is 98 feet deep and has 5 short levels. Ore was stoped from the bottom nearly to the surface but the tonnage mined was small. Some ore was also mined from shallow adits and open cuts along the veins at the north end of the property.

Custer Mine

The Custer mine is in sec. 19, T. 19 S., R. 41 E., on the east side of the Darwin Hills a mile N. 70° E. of Darwin in the narrow canyon half a mile south of Lane mill at an altitude of 4640 feet. The mine is accessible by a road 1 mile long that leads east from Darwin down the canyon past the St. Charles mine or by a road 1.1 miles long that heads southerly from Lane mill (see pl. 9).

The mine is owned by Harry R. Staples and Paul C. Staples of Oxnard, Calif. The property is developed by an inclined shaft 400 feet deep that bears S. 60° W. at -50°. The collar of the shaft is at an altitude of 4,641 feet and levels extend off the shaft at altitudes of 4,600 feet (50-foot level), 4,503 feet (200-foot level), 4,452 feet (250-foot level), 4,396 feet (300-foot level), and 4,308 feet (400-foot level). A winze extends 240 feet below the 400-foot level.

The recorded production from the Custer mine is 994 tons from which 96,614 pounds of lead and 10,492 ounces of silver were recovered. In addition, 6,123 ounces of silver were recovered during the 1890's from an unknown amount of ore. The total production is given below:

*Table 5. Ore produced from the Custer mine.**

Year	Tons	Gold (oz.)	Silver (oz.)	Copper (lbs.)	Lead (lbs.)	Zinc (lbs.)
1893	--	--	1,575	--	--	--
1895	--	--	3,978	--	--	--
1899	--	--	570	--	--	--
1911	21	--	1,116	--	5,667	--
1913	13	1.98	2	251	6,709	--
1917	109	--	2,020	--	15,302	--
1918	16	2.00	355	--	3,236	--
1919	8	1.19	396	--	1,615	--
1920	8	1.19	396	--	2,100	--
1935	29	90.21	1,161	1,935	21,192	--
1937	20	1.00	60	--	--	--
1940	20	6.00	304	102	2,700	--
1947	166	6.00	942	664	11,124	--
1948	579	30.00	3,635	3,254	24,295	--
1949	5	2.00	105	416	2,674	72
Total	994	141.57	16,615	6,622	96,614	72

* Published with the permission of the mine owners.

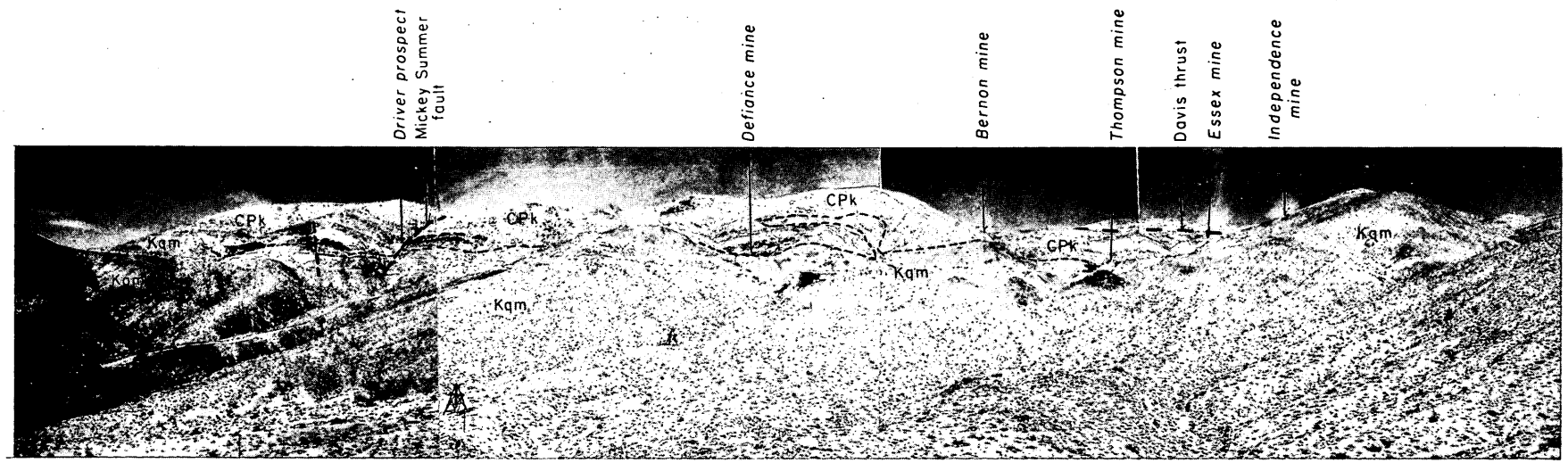


PHOTO 4. View looking west at the east slope of the Darwin Hills showing the surface workings of the Darwin mine. The smooth slopes in the foreground are underlain by the stock of the Darwin Hills (Kqm) and the skyline is calc-hornfels of the Keeler Canyon formation (CPk).

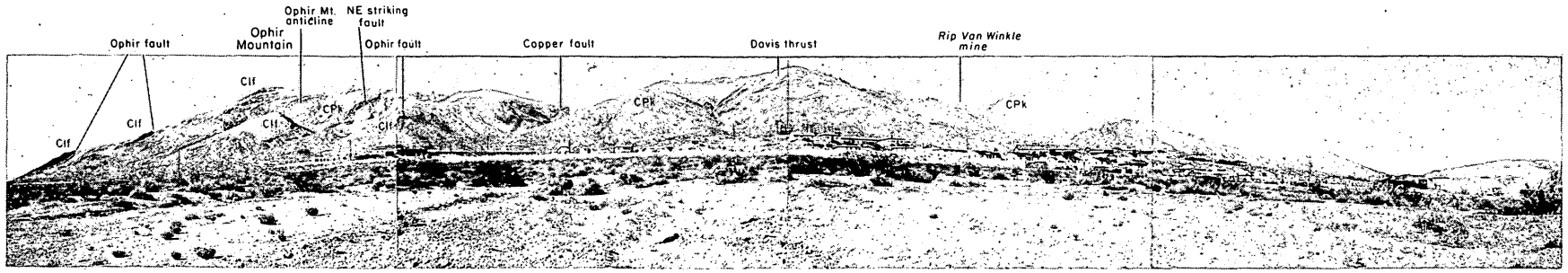


PHOTO 5. View looking east at the Darwin mining camp and the west side of the Darwin Hills. The hills are composed mainly of an overturned section of calc-hornfels of the lower part of the Keeler Canyon formation (CPk). On the left side are remnants of the Lee Flat limestone (Clf) of Mississippian and Pennsylvanian (?) age in fault contact with the Keeler Canyon formation. The Copper fault and the parallel northeast-striking fault are one of the structural controls for ore.

The uppermost part of the lower member of the Keeler Canyon formation crops out in the mine area. It consists of aphanitic light-gray, greenish-gray, and brown calc-hornfels and beds of bluish-gray limestone that are in part altered to tactite. A fault contact between the lower and upper members of the Keeler Canyon formation is about 150 feet northeast of the inclined shaft. The upper member consists of aphanitic greenish-gray calc-hornfels that is characteristically highly iron stained on weathered surfaces.

The Keeler Canyon formation is intruded by a quartz monzonite dike 300 feet S. 65° W. of the collar of the inclined shaft and by a small irregular intrusion of quartz monzonite 100 feet S. 10° W. of the main shaft.

The Paleozoic rocks are folded and tilted into an overturned section and are intersected by many faults. Bedding at the shaft strikes N. 2° W. and dips 56° SW. The Paleozoic and intrusive rocks are cut by several faults that strike N. 50° to 70° E. and dip steeply either to the north or south. Displacement on the faults is small.

The ore body at the Custer mine is in calc-hornfels and is parallel to bedding. The bedded deposit consists predominantly of coarse calcite and quartz with pockets and interstitial material composed of cerussite, galena, limonite, jarosite, pink and green fluorite, and locally minor amounts of malachite. The calcite is gray to white in color and commonly occurs as rhombohedrons 12 to 24 inches on a side. Some scheelite is exposed in the winze.

The ore body is inconspicuously exposed at the surface. On the 50-foot level it is approximately 60 feet long and 6 to 10 feet thick, and is stoped for about 30 feet above the level. The shape of the ore body is lenticular in plan view, and it has a long axis that pitches nearly straight down the dip. The bedded deposit is strong on both the 200-foot and 300-foot levels. On the 200-foot level it is 110 feet long and is terminated on the north by a pre-mineral fault that strikes N. 70° E. and dips 75° N. The thickness of the ore body is erratic. Within a few feet it ranges from a few inches to 10 feet thick. The ore body is stoped for about 70 feet above the level and for 18 feet below the level. On the 300-foot level the lead content of the ore body has decreased, and the bedded deposit consists mainly of quartz and calcite. It is 150 feet long and a maximum of 40 feet wide. Locally it contains pockets of galena and cerussite. The calcite-quartz vein extends to the 400 level, but it carries very little lead at this depth except locally at the northwest end.

Darwin Mine

The Darwin mine includes the workings owned by the Anaconda Company that are developed by the 6,300-foot long Radiore adit. They are the Bernon, Defiance, Essex, Independence, Rip Van Winkle, and Thompson workings and Driver prospect—most of which are visible in photo 4. The mine is about a mile north of Darwin.

Geology. The rocks in the Darwin mine area are limestone, silty limestone, and minor siltstone in an overturned section that ranges in age from Mississippian on the west side of the Darwin Hills to Permian on the east side (pl. 5). A stock intrudes the Pennsylvanian and Permian rocks along the east side of the Darwin Hills in the vicinity of the Defiance, Thompson, and Independence workings. The Lee Flat limestone of Mississippian and Pennsylvanian (?) age is the oldest formation in the mapped area. It crops out in a band along the west side of the Darwin Hills and at the top of Ophir Mountain (photo 5). It is a thin- to medium-bedded, medium- to dark-gray limestone. Locally the limestone is bleached white and recrystallized to marble close to its contact with the batholith of the Coso Range. The limestone is altered to massive, buff-colored dolomite 1,300 feet west of the Bernon workings (pl. 5). The dolomite resembles the Hidden Valley dolomite except for occasional relicts of the Lee Flat limestone.

The Keeler Canyon formation underlies most of the mine area. It is in fault contact with the Lee Flat limestone on the west side of the Darwin Hills and along the prominent ridge trending S. 60° W. from the top of Ophir Mountain. The lowermost part of the Keeler Canyon formation is exposed on the southeast side of the Ophir fault. The golfball horizon (limestone with spherical chert nodules) and limestone with sparse tiny fusulinids are in the prominent inverted syncline on the west flank of Ophir Mountain. Between the golfball horizon and the Davis thrust on the east side of the hills are interbedded bluish-gray thinly bedded limestone, silty limestone, and minor siltstone. Much of the limestone is altered to a white, gray, brown, or greenish-gray dense calc-hornfels.

Nearly all of the ore is in the Keeler Canyon formation between the Davis thrust and the stock of the Darwin Hills. The formation in this interval consists of dense white calc-hornfels and white, fine- to medium-grained calc-silicate rocks. Idocrase crystals commonly $\frac{1}{8}$ to $\frac{1}{4}$ inch in diameter are characteristic of the calc-silicate rocks on the east side of the Davis thrust and are rare or absent in the calc-hornfels on the west side of the thrust. The idocrase-bearing calc-silicate rocks are west of the stock from the Independence workings south to the Susquehanna mine. This horizon also crops out north of Ohpir Mountain as far as Belle Union mine.

The Keeler Canyon formation is intruded by the stock of the Darwin Hills in the vicinity of the Independence, Thompson, and Defiance workings, and by a nearly concordant intrusive on the southwest side of Ophir Mountain. The stock is made up of a heterogeneous mixture of diorite, granodiorite, quartz monzonite, and aplite. The intrusive rocks are deeply weathered, and north of the Defiance workings they are highly iron stained, which makes them easy to distinguish from the hard, lighter-colored calc-hornfels. The stock is composed predominantly of quartz monzonite and granodiorite. Granodiorite and quartz diorite are prevalent around the Defiance and Thompson workings but quartz monzonite and minor aplite are prevalent in the area extending from the Thompson workings to the Independence workings. Aplite also crops out south of the Defiance workings.

Quartz monzonite crops out on the west flank of Ophir Mountain as an essentially concordant intrusive 1,400 feet long and 600 feet wide. The sill is 1,100 feet east of the batholith of the Coso Range and is probably an offshoot from it. The south end of the sill is in contact with diorite and gabbro. Several small diorite and

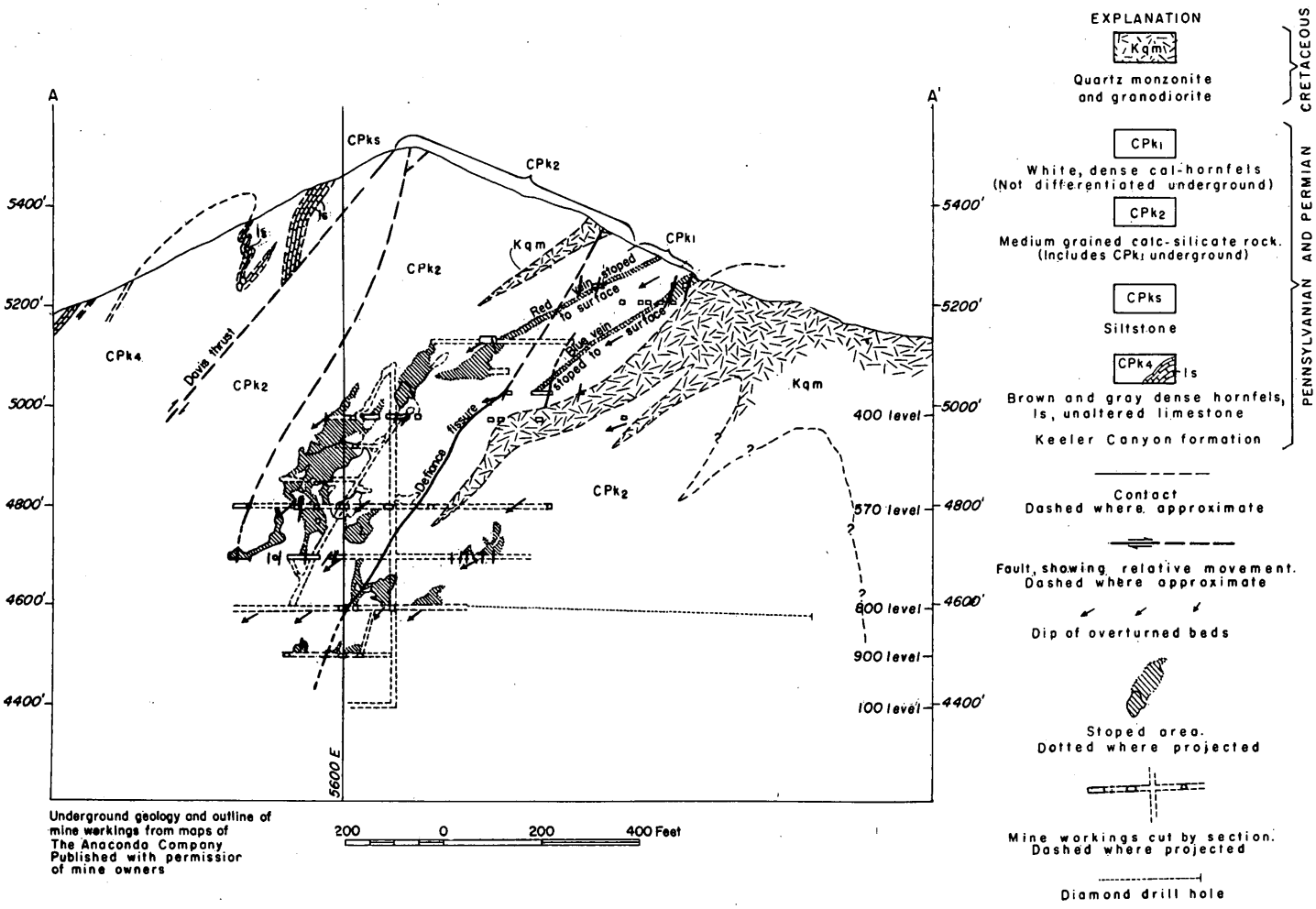


FIGURE 2. Geologic section of the Defiance workings showing stope outlines.

gabbro bodies are 200 to 700 feet west of the Bernon workings and are similar to the diorite at Darwin Falls, which is considered a granitized silty limestone.

Structure. The Paleozoic rocks in the mine area strike northerly and dip mostly 30° to 70° W. in an overturned section that ranges in age from Mississippian to Permian on the west limb of a major overturned syncline. The stock of the Darwin Hills intruded near the axis of the syncline. Several minor open folds are superposed on the overturned limb of the syncline. One of these folds on the west flank of Ophir Mountain is visible from the Darwin mining camp. The strata are folded into the form of an open anticline that plunges gently to the north, but younger strata are in the core and older rocks are on the flanks of the fold. Therefore, this fold, which commonly is referred to locally as the Ophir Peak anticline, is a minor inverted syncline according to the definition of White and Jahns (1950, p. 196). Similar inverted synclines are exposed in the Defiance and Bernon workings, in the Intermediate workings, and on the west side of the Darwin Hills adjacent to the Darwin mining camp.

The Paleozoic rocks are intersected by four sets of faults. One set strikes N. 50°-70° E. and dips steeply to the north. Displacement on the faults is left lateral with the north block moving west a few feet to 100 feet relative to the south block. The horizontal displacement is shown by offset of beds and by abundant nearly horizontal slickensides and mullion structure exposed on fault planes in underground workings. The N. 50°-70° E. faults are mineralized and many ore bodies are localized in or close to them. The Defiance fault, Copper fault, Water Tank fault, and Mickey Summers fault are in this group.

A second set strikes N. 65° W. and dips steeply. They are parallel to the Darwin tear fault, which is a left-lateral strike-slip fault. The Essex vein exemplifies this set.

The third set of faults are thrust faults that strike northerly and dip 30° to 40° W. The Davis thrust crops

out along the side of the hill above the Independence, Essex, and Bernon workings, and at the south end of the mine area it is exposed on the west side of the hills above the mining camp at the water tanks. This fault is well exposed in the Essex workings and in the upper Independence workings. Right-hand drag folds localized close to the fault plane indicate that the west block moved upward toward the east relative to the east block (pl. 5). The amount of displacement is not known. The Ophir fault is west of, and parallel to, the Davis thrust, but the amount of displacement on it is small. The drag folds associated with it are left-hand drag folds instead of right-hand drag folds like those along the Davis thrust. Four parallel faults also are exposed between the Ophir fault and the alluvium on the west side of the Darwin Hills. The writers believe that the overthrust block above the Davis thrust broke along several parallel planes as it was moving and that each underlying block moved slightly farther to the east than the overlying block. Therefore, the overlying block on the west side of the Ophir fault moved downward relative to the overthrust block between the Ophir fault and the Davis thrust. Thus, left-hand drag folds were formed along the Ophir fault while right-hand drag folds were formed along the Davis thrust.

The fourth set of faults strikes northerly and dips mainly steeply to the west. The displacement is small. The faults are mineralized, and many of the ore bodies in the district are localized along them.

Ore Bodies. Ore in the Darwin mine occurs mainly in a favorable stratigraphic zone more than 840 feet thick close to pre-mineral feeder faults that strike N. 50°-70° E. and dip steeply to the northwest. Individual ore bodies occur as replacements of certain favorable beds close to the N. 70° E. faults, as replacement bodies in fault zones, and as irregular or pipelike bodies in calc-hornfels. The bedded deposits have sharp contacts with the wall rock both stratigraphically above and below the favorable bed, although the ore within a mineralized bed has a considerable range in grade and some blocks of low grade ore were left behind as stope pillars.

A description of the ore bodies and ore controls for each of the workings is given below.

Bernon Workings. The Bernon workings adjoin the Defiance workings on the north and the Thompson workings on the south. The workings are in white, medium-grained calc-hornfels along the crest of a minor inverted syncline that extends southward to the Defiance workings. The Paleozoic rocks are intruded by a sill of quartz monzonite south of the 434 fault, and by a dike south of the Bernon fault. The rocks are cut by the pre-mineral Bernon fault and the 434 fault, both of which strike N. 50°-60° E. and dip steeply to the northwest. The faults are cut off on the west by the Davis thrust. All ore is in the Bernon fault in medium-grained calc-silicate rock.

Defiance Workings. The Defiance workings are in the southeast part of the Darwin mine area 0.7 miles north of the town of Darwin. Two bedded ore bodies crop out along the crest of an inverted syncline where it is cut by the Defiance fault. The Blue vein is in dense white calc-hornfels near the upper contact of a granodiorite sill. The vein is 300 feet long and has been mined 400 feet down the dip from the surface to the 215-foot level (fig. 2). The Red vein is in dense white calc-hornfels 60 feet stratigraphically above the Blue vein and 80 feet stratigraphically below an upper sill of granodiorite. This vein is 460 feet long at the Defiance tunnel level, 5 to 10 feet thick, and has been mined 670 feet down the dip from the surface to the 400-foot level. Other smaller bedded ore bodies have been mined in the deeper mine workings. Both the Red and Blue veins lie between two sills of granodiorite that are stratigraphically about 200 feet apart. Both sills pinch out in depth. The upper sill does not extend to the 110-foot level from the surface; the lower sill terminates between the 570-foot and 700-foot levels. The lower sill cannot be delimited on the surface as it merges with the main Darwin Hills stock at the level of the present erosion surface (fig. 2). The bedded ore in the Defiance workings is approximately coextensive in depth with the extent of the sills.

Below the 400-foot level the principal ore bodies change from concordant veins to an irregular, vertical replacement ore body that has been developed for 570 feet vertically to the 1,000-foot level. The ore is localized close to the Defiance fault but extends outward from the fault along closely spaced fractures for distances as much as 270 feet. On both the 800- and 900-foot levels about 25 percent of the calc-hornfels over an area 200 feet by 270 feet is replaced by ore (pl. 6). Insufficient exploration work has been done to delimit the ore on the 1,000-foot level.

Driver Prospect. The Driver prospect is 1,000 feet S. 10° E. of the Defiance workings. The prospect is developed by several small open cuts, adits, and winzes. It is in dense white calc-hornfels 30 to 50 feet west of the contact with the stock of the Darwin Hills. Bedding in the calc-hornfels strikes northerly and dips 35° to 53° W. The Mickey Summers fault displaces the contact of the quartz monzonite and calc-hornfels 75 feet, the north side moving west relative to the south side. A parallel fault cuts the calc-hornfels 230 feet south of the Mickey Summers fault.

The calc-hornfels is highly iron stained parallel to bedding close to the N. 70° E. faults. A belt of white calc-hornfels 20 to 30 feet wide is highly iron stained 30 feet west of the stock of the Darwin Hills and north of the Mickey Summers fault. Gossan 1 to 2 feet thick is locally distributed along a bedding-plane fault on the east side of the iron stained zone. The calc-hornfels is similarly heavily iron stained for 50 feet north of the fault that is south of the Mickey Summers fault and parallel to it. It is not known if any ore was mined from the shallow workings.

Essex Workings. The Essex workings are 230 feet southwest of the portal of the Independence workings and 820 feet northwest of the portal of the Thompson workings. The surface workings are in medium-grained calc-silicate rock 50 feet east of the Davis thrust. Bedding strikes northerly and dips 32° to 68° W. The calc-hornfels is cut by the Essex fault, which strikes N. 70° W. and dips vertically to very steeply south. The Essex fault is cut off by the Davis thrust.

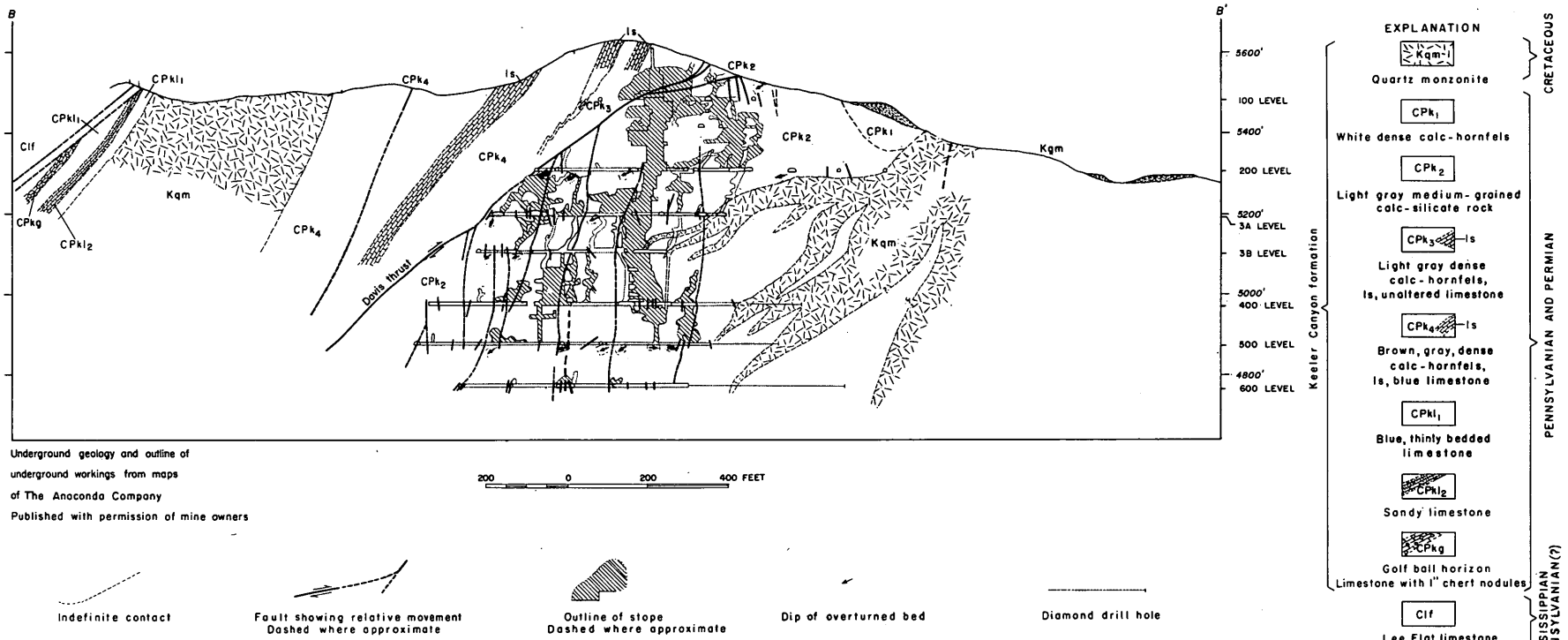


FIGURE 3. Longitudinal section of the Essex workings showing stope outlines.

Ore minerals are not conspicuous at the surface of the Essex workings. The Essex fault is iron stained over a width of 10 feet and contains jasper near the Essex shaft. The open cut and short adits 40 feet northeast of the shaft are on a branch of the Essex fault, and they expose only minor iron staining. The main ore body in the Essex workings does not crop out at the surface, but lies below the Davis thrust in the Essex fault zone and along steep north-striking fractures in calc-hornfels close to both the Essex fault and an intrusive contact (fig. 3).

Ore has been mined from the Essex fault from 50 feet below the surface to the 600-foot level, a vertical distance of 780 feet. The ore is localized in the fault in calc-silicate rock between the stock of the Darwin Hills and the Davis thrust. Between the surface and the 3B level, the Davis thrust and the west contact of the stock are approximately parallel and are about 360 feet apart. Ore is discontinuous over this distance and has a maximum thickness of 30 feet. This is one of the few places in the mine where ore extends up to the Davis thrust (fig. 3). Below the 3B level the trend of the contact between the calc-silicate rock and the Darwin Hills stock dips vertically or steeply to the east. As the distance between the stock and the Davis thrust becomes progressively greater with depth, the amount of known ore is proportionately less. Ore along north-striking fractures is best developed on the 200- and 400-foot levels (see pl. 7, plan of 400-foot level). On the 200-foot level ore extends 175 feet north of the Essex fault, and on the 400-foot level it extends 400 feet north of Essex fault close to the intersection of a steep north-striking fault and a sill of quartz monzonite that dips 34° W. The ore is localized within 40 feet of the intrusive contact.

Independence Workings. The Independence workings are at the north end of the Darwin mine 850 feet N. 25° W. of the Thompson workings. Medium-grained calc-silicate rock is exposed at the surface in most of the area over a width of 130 feet from the stock of the Darwin Hills west to the Davis thrust. Fine-grained gabbro and diorite crop out southwest of the portal of the Independence adit around the base of the mine dump. North of the Independence workings the favorable calc-silicate rock is cut off by the Davis thrust, and an unfavorable overthrust block of dense greenish-gray calc-hornfels is in contact with the stock. Gossan is exposed at the surface in medium-grained calc-silicate rock along its contact with the stock. The contact strikes northerly and dips 43° to 72° W. A prospect pit 30 feet deep 60 feet north of the Independence adit exposes a highly iron stained zone 10 feet thick along a fault contact between the stock and calc-silicate rock. An open cut at the crest of the ridge 250 feet N. 25° E. of the Independence adit exposes gossan about 20 feet thick that dips 43° W. along the calc-hornfels-intrusive contact.

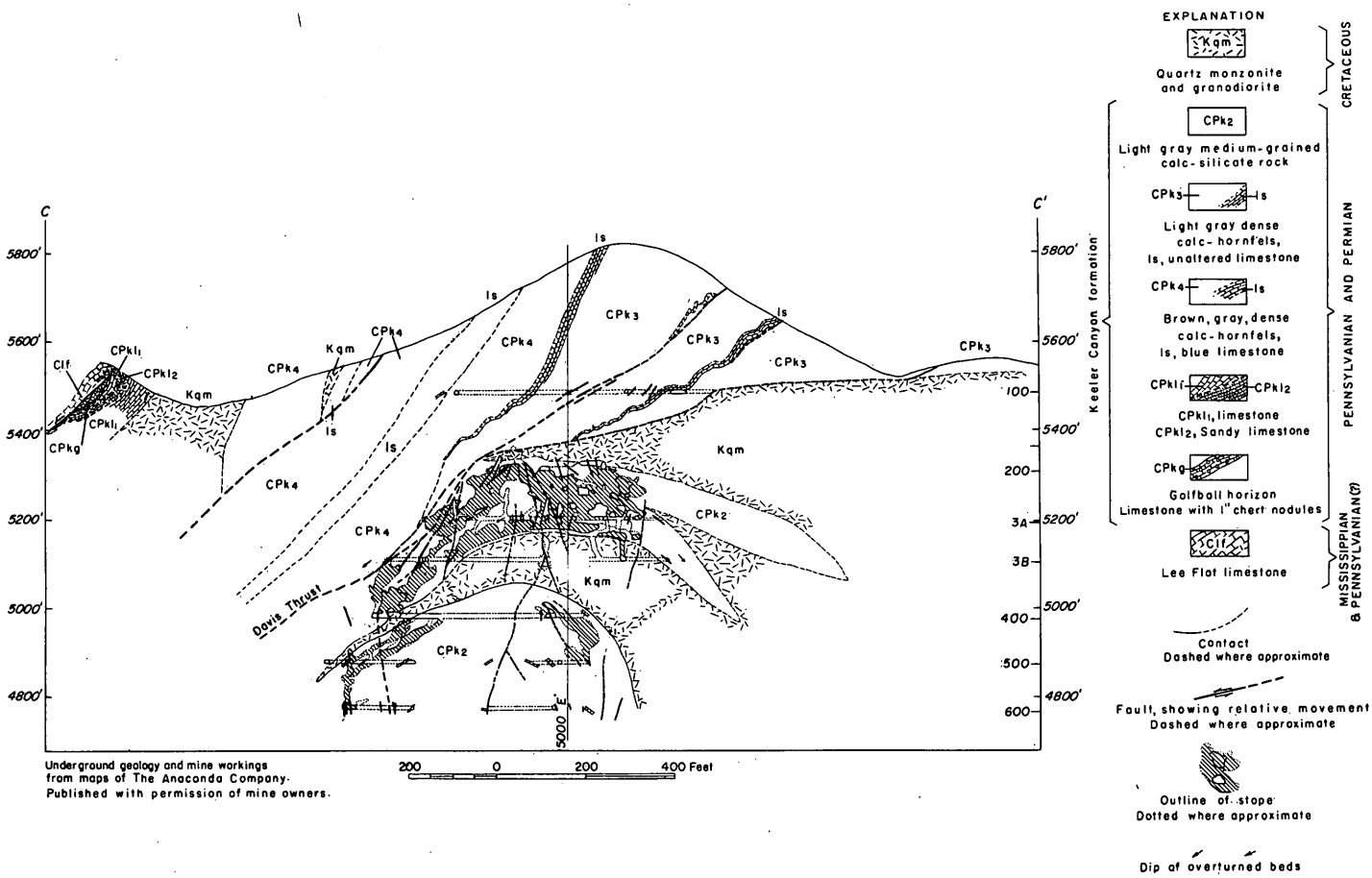


FIGURE 4. Geologic section of the Independence workings showing stope outlines.

The underground workings show that the stock of the Darwin Hills terminates to the west in a series of sills that commonly are anticlinal shaped and pinch out in depth to the west (fig. 4). Ore above the 100-foot level is in medium-grained calc-silicate rock above the uppermost sill and below the Davis thrust. The Davis thrust terminates the favorable calc-hornfels in the workings on both the Independence and 100-foot levels. The ore is an irregular bedded replacement body that has a strike length of 250 feet and a width of 120 feet on the Independence level. Approximately 30 percent of the calc-silicate rock over this area is replaced by ore. The ore is stoped from the 100-foot level to the surface. A sill of quartz monzonite is between the 100- and 200-foot levels.

The largest bedded ore body in the district is between the 200-foot and 3B levels over a lower anticlinal-shaped quartz monzonite sill (fig. 4). Bedded ore has been stoped discontinuously between the quartz monzonite sills, a vertical distance of 160 feet, along the crest of the anticlinal-shaped fold (an inverted syncline) for a maximum strike length of 500 feet on the 3B level. Ore has been mined westward down the dip above the upper contact of the lower sill for a distance of 700 feet to the 400-foot level.

Smaller bedded ore bodies are below the lower sill between the 400-foot and 600-foot levels (fig. 4). All the known ore is within 100 feet of the lower contact of the sill. The ore body on the west limb of the inverted syncline is 200 feet long and as much as 50 feet thick; it has been mined 260 feet down the dip below the 400-foot level. A smaller bedded ore body was mined on the east limb of the inverted syncline from the 400 level to 40 feet below the 500 level.

Rip Van Winkle Workings. The Rip Van Winkle workings are on the west side of the Darwin Hills above the Darwin mine camp. They include the workings on the Water Tank fault, the Mickey Summers fault, and the workings 680 feet N. 40° E. of the portal of the Radiore adit (pl. 5).

The shaft on the Water Tank fault 80 feet east of the water tanks is in calc-hornfels at the intersection of the Water Tank fault with the Davis thrust. The favorable medium-grained calc-silicate rock lies east of the Davis thrust and unfavorable dense, greenish-gray calc-hornfels is west of the thrust. An irregular plug of quartz monzonite crops out at the surface 300 feet northeast of the shaft. The Water Tank fault, which strikes N. 70° E. and dips 85° N., is highly iron stained at the surface.

The Radiore adit crosses the Water Tank fault in the favorable calc-silicate rock on the east side of the Davis thrust, and the fault is mineralized on this level along its strike for 360 feet (pl. 6).

The Mickey Summers fault strikes N. 74° E. and dips 80° SE. A parallel mineralized fault 60 feet north of the Mickey Summers fault is developed by two shafts 220 feet apart. Mineralization is continuous between the two shafts. Kelley (1938, p. 558) reports one of the vertical shafts to be 250 feet deep but inaccessible at the time of his fieldwork. He states the ore is highly pyritic but is reported to be unusually high in silver.

The inclined shaft 680 feet N. 40° E. of the portal of the Radiore adit is on a vein 6 feet thick that strikes N. 20° W. and dips 54° SW. parallel to bedding. The vein, which can be traced for about 50 feet on the surface, is in dense white to light-gray calc-hornfels 70 feet east of a small outcrop of quartz monzonite. Only a small amount of ore minerals is exposed in the Radiore adit 218 feet below the collar of the shaft.

Thompson Workings. The Thompson workings are 1,200 feet N. 25° W. of the Defiance workings near the western contact of the stock of the Darwin Hills. Quartz monzonite crops out at the portal of the Thompson adit, and it extends 370 feet N. 67° W. into the adit and 220 feet on the surface west of the adit. White medium-grained calc-silicate rock is exposed west of the quartz monzonite and extends over an outcrop width of 300 feet to the Davis thrust. Bedding in the calc-silicate rock strikes north and dips 16° to 53° W. The Copper fault, which strikes N. 60° E. and dips steeply to the north, is exposed near the portal of the Thompson adit. Two parallel faults cut the calc-silicate rock 300 and 360 feet north of the Copper fault.

The ore in the Thompson workings is in medium-grained calc-silicate rock in the same stratigraphic horizon as in the Independence and Bernon workings. Gossan 1 foot to 6 feet thick is exposed in a surface stope in calc-silicate rock at the contact with quartz monzonite 250 feet S. 75° W. of the Thompson portal and 40 feet north of the Copper fault. Most of the ore mined underground was north of the gossan that is exposed at the surface, and only minor mineralization is exposed on the 200-foot level 77 feet below the surface stope. The ore underground is in faults striking N. 50°-70° E. in calc-silicate rock close to intrusive contacts and also in fractures in calc-silicate rock closely parallel to intrusive contacts. The 234 and 229 northeast-striking faults are mineralized discontinuously for distances as much as 400 feet from a minor sill or dike of quartz monzonite. Ore has been stoped along the 234 fault for as much as 190 feet along its strike. The thickness of ore ranges between 4 and 20 feet between the 200-foot and 3B levels, a vertical distance of 200 feet. Above the 200-foot level and below the 3B level the ore is in north-striking faults between the 234 and 229 faults. The 229 fault has been less productive than the 234 fault, and has yielded ore for 135 feet along strike with a thickness of 10 feet between the 200-foot and 3A levels. A nearly horizontal sill cuts out the ore at the 3B level, but the faults and a little ore continue beneath the sill. In addition a considerable tonnage of ore has been mined from bedded replacement bodies between the 229 and 234 faults.

Fairbanks Mine

The Fairbanks mine is 3 miles north of Darwin in secs. 1 and 2, T. 19 S., R. 40 E., at an altitude of 5,600 feet. The mine is owned by Mrs. Marie Wilson of San Francisco. The workings consist of a shaft, reported to be 150 feet deep (Tucker and Sampson, 1938, p. 440), on a strand of the Darwin tear fault, and a number of open cuts and shallow shafts.

The host rock is the lower member of the Keeler Canyon formation and consists of thinly bedded bluish-gray limestone that is in part altered to calc-hornfels. The Darwin tear fault cuts across the north end of the mine area. It is a strongly sheared zone 50 to 100 feet wide

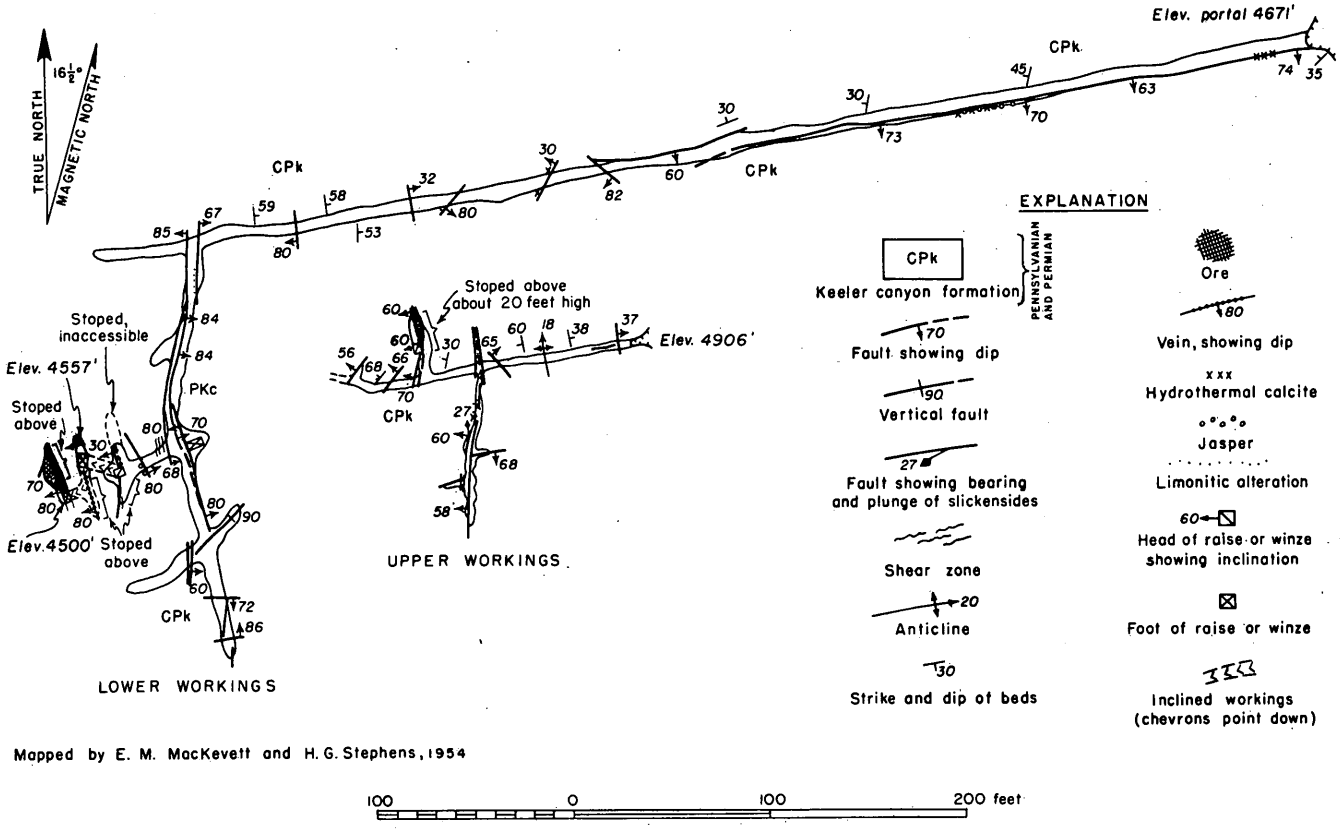


FIGURE 5. Geologic map of the underground workings of the Keystone mine.

that strikes N. 70° W. The Darwin tear fault is highly iron stained, but apparently contains little or no lead minerals. Kelley (1938, p. 554) reports a small chimney of ore was mined from a vertical vein that strikes northeast within the shear zone of the Darwin tear fault. The vein is 2 to 4 feet thick and consists of galena and cerussite in a gangue of calcite and limonite.

Jackass Mine

The Jackass mine is in sec. 18, T. 19 S., R. 41 E., 1 mile N. 60° E. of Darwin and half a mile southwest of Lane mill on the east side of the Darwin Hills at an altitude of 5,000 feet. A dirt road 1 mile long extends easterly from Darwin to the mine. The property consists of a patented claim owned by George F. Seeman of Fresno, Calif. It is developed by an inclined shaft 140 feet deep with about 150 feet of drifts. An inclined shaft about 35 feet deep with a short drift at the bottom is about 600 feet N. 15° W. of this shaft.

No record was found of the production from the Jackass mine. Tucker (1921, p. 288) reports the mine to have been in operation at the time of his visit and that the ore was carried to the Lane mill by an aerial tram line. The tram line has since been dismantled. George F. Seeman acquired control of the property in 1950. He has mined 20 tons of ore from workings at the north end of the property that he reports assayed 21 percent lead and 17 ounces of silver per ton (written communication, 1955).

The rocks in the mine area are brown-stained dense calc-hornsfels and bluish-gray limestone that is in part altered to tactite. The beds strike N. 20° W. and dip 78° W. The 140-foot inclined shaft is on a bedding-plane vein between a bluish-gray limestone and tactite bed 50 feet thick on the west and brown-stained, dense calc-hornfels on the east. Open cuts at the surface expose the vein with a thickness of 1 to 4 feet over a length of 80 feet. The vein contains some galena and secondary copper minerals in a gangue of limonite and calcite.

On the 66-foot level a drift has been driven S. 38° E. for a distance of 75 feet along the vein and 70 feet N. 18° W. from the shaft. The vein south of the shaft is 1 to 2 feet thick, and ore in the vein is in pockets. The tactite contains a little scheelite disseminated through it over a thickness of 2 to 4 feet several feet into the hanging wall of the vein. North of the shaft a chimney of ore has been stoped for 20 feet along the level to a height of 20 feet and a thickness of 10 feet.

The 35-foot shaft 600 feet N. 15° W. of the main inclined shaft is on a vein that strikes N. 63° E. and dips 77° SE. The vein is 3 feet thick at the surface and contains galena, cerussite, sphalerite, and pyrite in a gangue of calcite and limonite. The vein thins to 1 foot at the bottom of the shaft.

Keystone Mine

The Keystone mine is in secs. 19, 20, 29, and 30, T. 19 S., R. 41 E. It lies mainly on the east slope of the Darwin Hills about 1.75 miles southeast of Darwin. The mine is owned by Hilda Bickley, Helen Gunn, and Jess G. Sutleff of Independence, Calif.

The lower workings (fig. 5) include the Keystone adit 626 feet long, a drift 210 feet long, 120 feet of crosscuts,

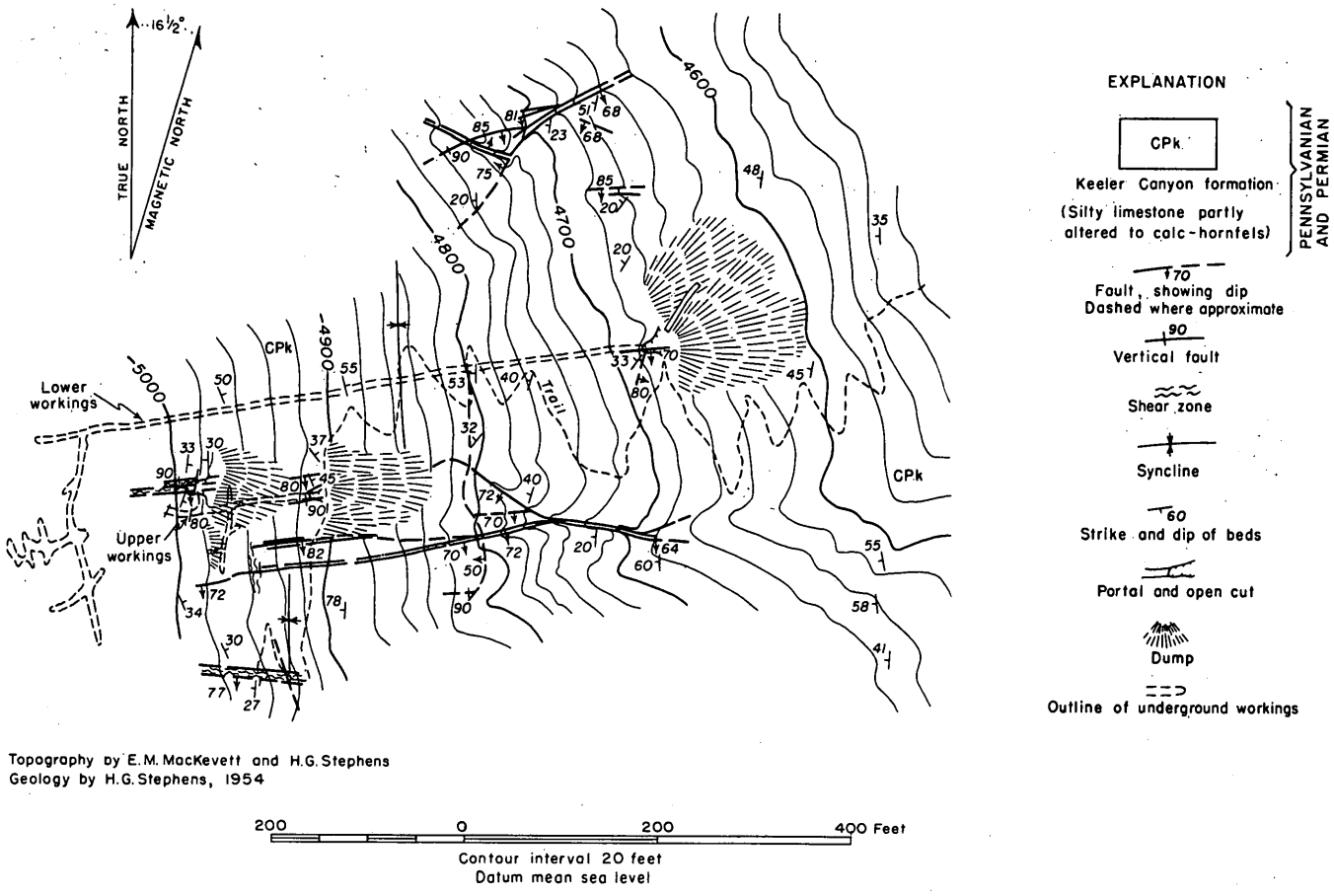


FIGURE 6. Geologic map of the Keystone mine.

a 175-foot steeply inclined winze, and small stopes, The upper workings consist of the McDonald adit, which is caved 145 feet from its portal, 135 feet of drifts, and minor crosscuts. A connecting raise and adjacent stopes between the lower and upper workings are largely inaccessible.

Production data are rather scanty. Tucker and Sampson (1938, p. 435) report that 800 tons of sorted ore was shipped from the lower winze and the zone between the lower and upper workings. This ore contained 15 percent lead, 28 ounces of silver per ton, and minor amounts of gold. Shipments during 1940 and the early part of 1941, according to the records of Mr. Sutleff, consisted of 205 tons of ore containing 0.04 ounces of gold per ton, 27.9 ounces of silver per ton, 25 percent lead, 0.6 percent zinc, and 20 percent iron.*

The mine is in folded and faulted rocks of the upper member of the Keeler Canyon formation (fig. 6). The rocks are brown-weathering silty limestone and blue-gray limestone. The limestones are partly altered to calc-hornfels, particularly in the western part of the mine area. The dominant faults trend between N. 70° E. and east and dip steeply.

Ore is in a poorly exposed vein 2 to 10 feet thick that strikes north and dips 60° W. to vertical. It has been exploited for a strike length of about 40 feet underground. The ore is highly oxidized and contains cerussite as the chief ore mineral with only minor relict galena. Gangue minerals are limonite, jasper, and calcite.

* Published with permission of the mine owners.

Lane Mine

The Lane mine is 1.4 miles northeast of Darwin in sec. 18, T. 19 S., R. 41 E., on the east side of the Darwin Hills at an altitude of 4,440 feet. The mine is adjacent to the Lane mill. The road from Darwin to Panamint Springs passes through the mill site. The Anaconda Company owns the property but has not operated it to date.

Development work consists of two vertical shafts 300 feet apart that are 600 and 800 feet deep with levels at 280, 350, 470, 610, and 700 feet according to an undated old company assay map of the mine. Waring and Huguenin (1919, p. 98) report the shafts as 725 and 750 feet deep. Both shafts are inaccessible. Two other shafts 300 and 600 feet west of the main shaft are each 200 feet deep. An adit reported by Kelley (1938, p. 559) to be 1,300 feet long and now accessible for about 1,000 feet trends S. 85° W. from the gully just west of the shafts.

The mine was discovered early in the history of the Darwin district, but was not extensively developed until the early 1890's by the Inyo Mining and Development Company according to Crawford (1894, p. 24). The mine was not mentioned by Goodyear in the Eighth Annual Report of the State Mineralogist for 1888. By 1893 Crawford (1894, p. 24) reports shafts 30, 80, and 250

Table 6. Ore produced from the Lane mine.†‡

Year	Ore (tons)	Gold (oz.)	Silver (oz.)	Copper (lbs.)	Lead (lbs.)	Operator
1888-1899	--	--	--	--	--	
1900	--	796	4,927	--	--	W. W. Boswell
1901	--	581	4,167	--	--	W. W. Boswell
1904	4	1	207	--	3,200	Inyo County Mining & Dev. Co.
1905	2	--	118	2,600	2,042	Inyo County Mining & Dev. Co.
1906	20	--	1,176	--	8,772	Inyo County Mining & Dev. Co.
1909	41	23	1,756	342	38,016	Silas H. Reynolds
1910	120	58	43	--	--	Silas H. Reynolds
1911	122	15	6,780	904	83,406	Silas H. Reynolds
1912	300	24	3,828	4,938	114,495	Silas H. Reynolds
1913	198	34	10,237	2,614	108,377	Silas H. Reynolds
1915	20	--	1,387	--	12,511	Theo Peterson
1917	31	--	245	--	16,000	Theo Peterson
1925*	816	1	2,876	3,484	59,214	L. D. Foreman & Co.
1926*	859	--	4,390	2,237	130,770	L. D. Foreman & Co.
1927*	1,764	7	10,123	5,215	282,985	L. D. Foreman & Co.
1937*	769	--	3,250	4,150	137,342	L. D. Foreman & Co.
1940	44	1	444	68	30,012	Theo Peterson
1944	5,890*	1	15,066	9,298	649,495	L. D. Foreman & Co.
1945	334*	--	888	926	51,618	L. D. Foreman & Co.
1946	579*	5	3,804	1,962	89,948	L. D. Foreman & Co.
1948	31*	--	154	--	2,685	L. D. Foreman & Co.
Total	11,944	1,547	75,866	38,738	1,820,888	

* Tailings and dumps.
† Production figures for 1900 through 1940 furnished by U. S. Bureau of Mines.
‡ Published with the permission of the mine owners.

feet deep, and by 1896 the main shaft was 500 feet deep (Crawford, 1896, p. 32). In 1898 a 25-ton blast furnace was built at the mine, but it operated only briefly (Waring and Huguenin, 1919, p. 99).

The Darwin Development Company began construction of a 25-ton mill in 1915 (Waring and Huguenin, 1919, p. 98). The mill was rebuilt and enlarged in 1919 and was operated intermittently until 1926 when it was rebuilt to a 200-ton capacity according to Kelley (1938, p. 553). Ore from the Defiance and Independence workings and from the Lucky Jim mine was treated at it until 1942 when Imperial Metals built a 150-ton mill at the Darwin mining camp to treat the oxide ore.

The recorded production from the Lane mine, which includes the Last Chance (Sorba), Last Chance 2, Last Chance 3, Southwest, Major Butt, and Lane Mill claims, totals 11,944 tons of ore from which 75,866 ounces of silver and 1,820,888 pounds of lead were recovered. For certain years the Lane mine production was not reported separately but was included in the Darwin group. The production for 1888 to 1942 was compiled by the U. S. Bureau of Mines.

The upper member of the Keeler Canyon formation of Pennsylvanian and Permian age crops out in the mine area. The rocks consist of bluish-gray, silty limestone that is in part altered to light-gray and greenish-gray calc-hornfels and is locally highly iron stained.

The rocks are deformed into gently dipping open folds. The axis of a syncline that trends southward just above the edge of the alluvium is between the two deeper shafts. The rocks are intersected by several faults that strike N. 65°-85° E., and dip steeply; displacement is small and is of left-lateral sense.

The ore is in a fissure-vein that strikes N. 65°-85° E. and dips steeply north. At the collar of the westernmost shaft the shear zone is 12 feet thick and contains gossan and some copper minerals over a width of 30 inches. Crawford (1896, p. 32) reports that the main shaft extends along the vein to a depth of 300 feet and that the ore shoot is 100 feet long and plunges vertically. On the 300-foot level a cross vein is exposed that strikes northwest and averages 4 feet in thickness. The shaft is on this cross vein below the 300-foot level.

The ore is mainly cerussite with small pockets of relict galena in a gangue of calcite, jasper, and minor fluorite. A company assay map shows that some of the ore on the deeper levels locally contains 1 to 2 percent copper.

The long adit west of the main working is along the same shear zone that is in the shafts, but it exposes little lead-silver ore. Locally the shear zone is iron stained and contains pockets of calcite and jasper. Minor scheelite is in the adit between 700 and 800 feet from the portal.

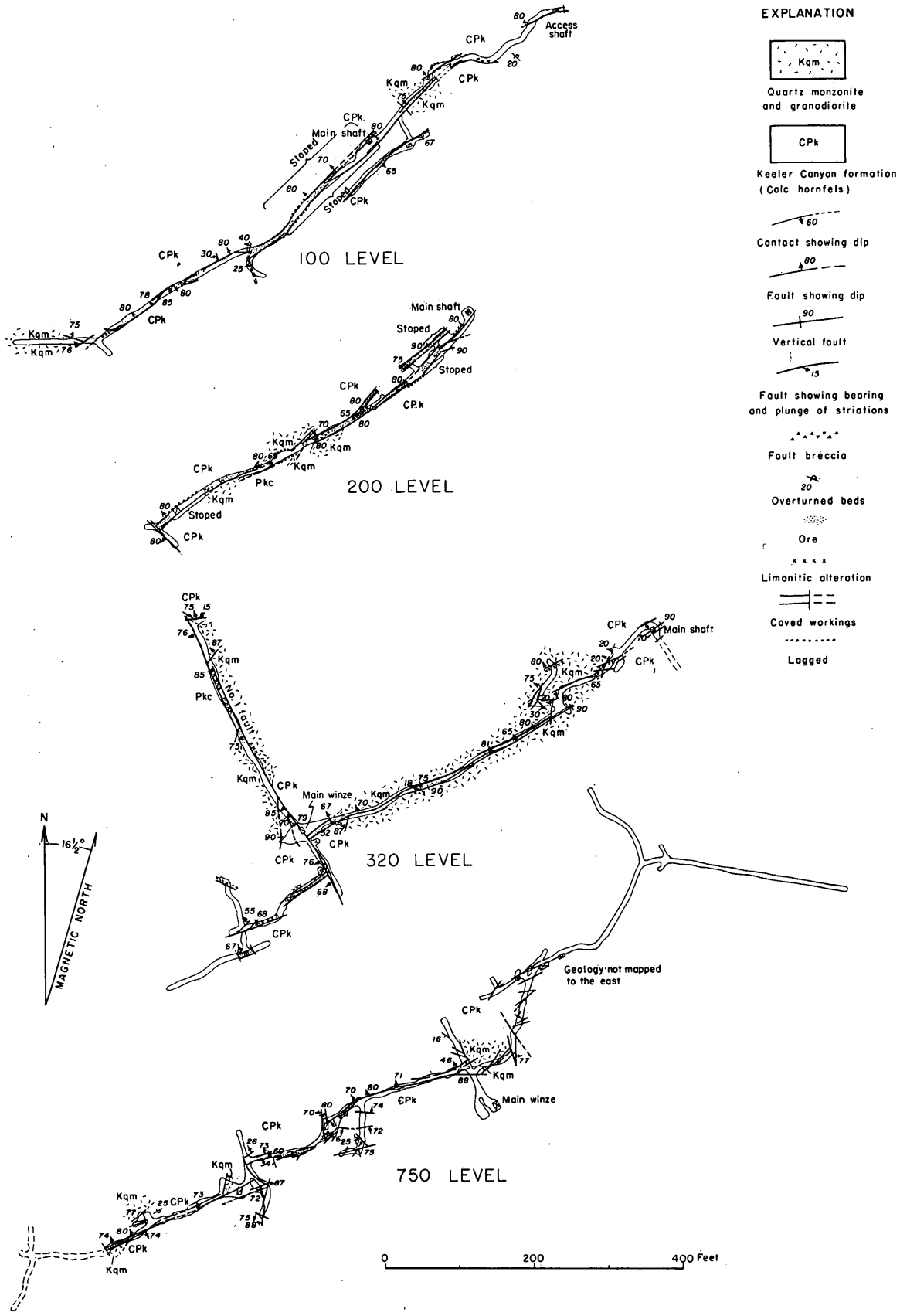
Lucky Jim Mine

The Lucky Jim mine is 2.7 miles N. 3° W. of Darwin in sec. 1, T. 19 S., R. 40 E., at an alititude of 5,240 feet. The Anaconda Company owns the property. The mine was formerly one of the major producers in the district. Kelley (1938, p. 553) estimates the value of ore produced at $2,000,000.

Workings (figs. 7, 8) consist of a 320-foot vertical shaft, several shallower shafts, approximately 7,690 feet of level workings distributed among 12 levels, about 1,000 feet of winzes and raises, and large steep stopes. The deepest level is 860 feet below the collar of the main shaft. The Anaconda Company renovated the main shaft and most of the main levels in 1948, but most of the stopes and some of the levels are still inaccessible. A view of the main workings is shown in photo 6.

The mine is in strongly faulted calc-hornfels and quartz monzonite host rocks (fig. 9). The calc-hornfels is correlated with the lower member of Pennsylvanian and Permian Keeler Canyon formation and has been divided into a light unit and a dark unit. The light unit is a light-gray to white, fine-grained, diopside-rich rock with minor quartz and calcite. Its bedding is generally

PHOTO 6. Lucky Jim mine. The Christmas Gift mine is in the background. The area is underlain by calc-hornfels of the lower member of the Keeler Canyon formation.



Modified from maps of The Anaconda Company by W. E. Hall and E. M. MacKevett, 1954
Published with permission of mine owners

FIGURE 7. Geologic maps of the underground workings of the Lucky Jim mine.

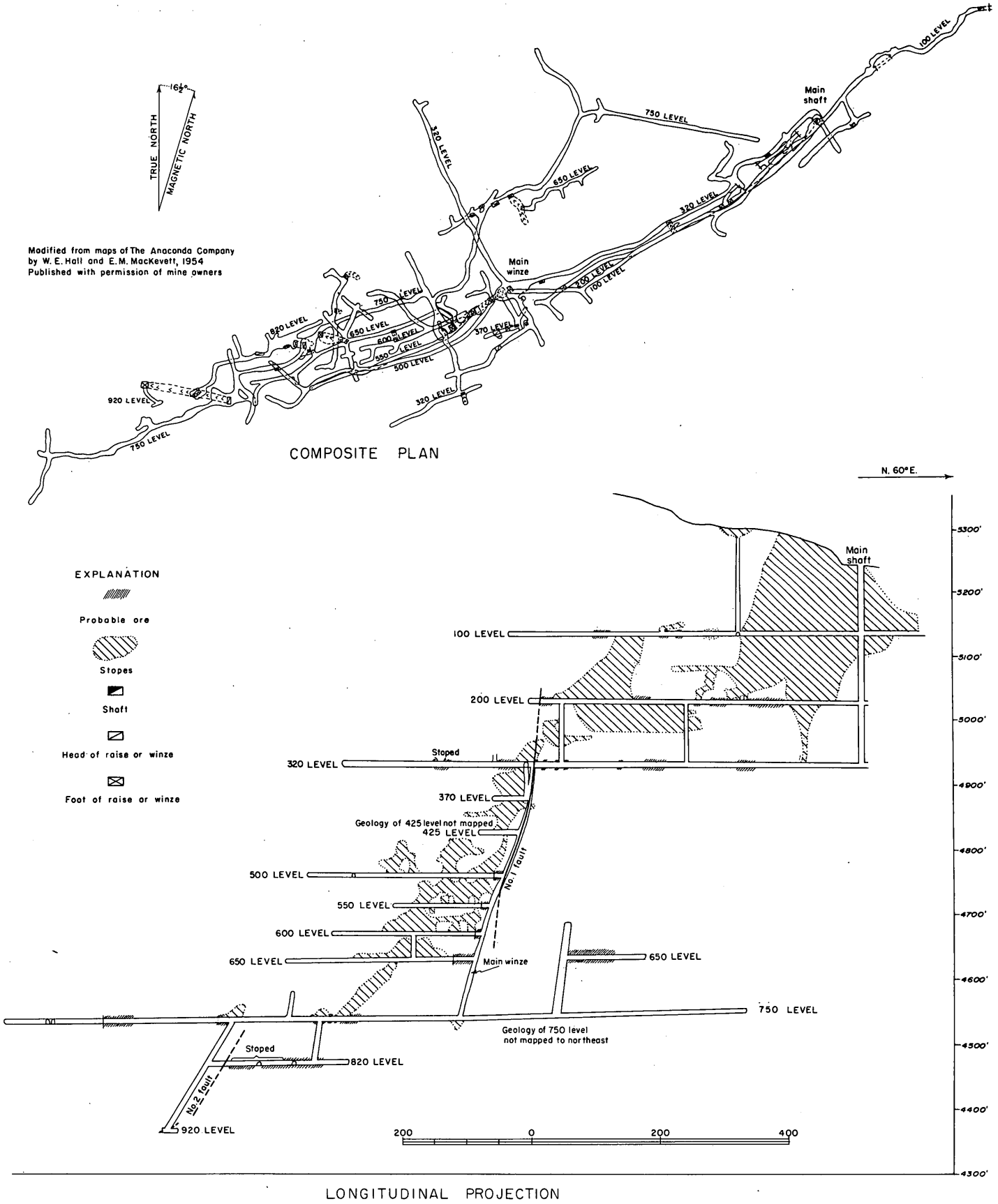


FIGURE 8. Composite map and longitudinal projection of the Lucky Jim Mine.

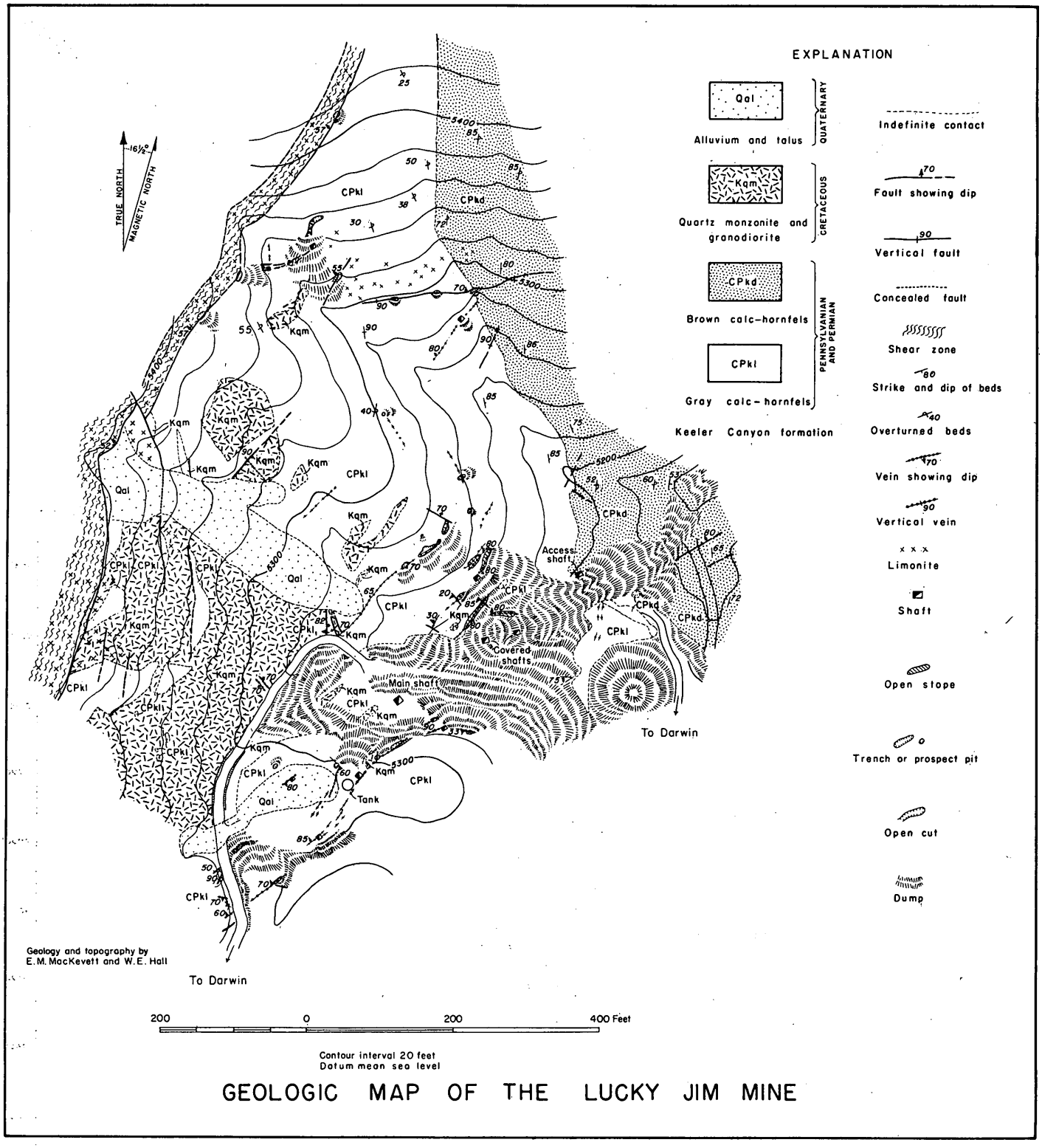


FIGURE 9. Geologic map of the Lucky Jim Mine.

*Table 7. Partial ore production from the Lucky Jim mine.**

As given in report on Darwin Mines by Ira Joralemon (1940):

Year	Dry tons	Average grade					Metal content		
		Au	Ag	Pb	Zn	Cu	Gold (oz.)	Silver (oz.)	Lead (lbs.)
1915-1923 Crude ore	11,592	0.017	36.0	18.0	6.8	0.3	--	--	--
1917-1924 Ore milled†	28,848	.009	11.3	10.4	4.0	--	--	--	--
Total	40,440	.011	18.39	12.58	--	--	456.7	743,759	10,178,148

From old records of Darwin Mine and of Lane Mill:

Year		Tons
May 1922-Jan. 1923	Crude ore	210
May 1922-Jan. 1923	Mill ore	8,590‡
Feb. 1923-Jan. 1924	No data	--
Jan. 1924-July 1924	--	34 (probably from dump)

* Data furnished by the Anaconda Company.
† Includes dump ore.
‡ Includes 2,850 tons of dump ore.

obscure, but locally 1- to 2-foot thick beds are discernible. The dark unit conformably overlies the light unit. It is light gray on fresh surfaces and weathers to medium brown. The dark unit is a fine-grained calc-hornfels composed mainly of quartz, calcite, and diopside in beds ½ to 2 feet thick. Local lenses of fusulinid-bearing blue limestone 1 to 2 feet thick are in this unit. The quartz monzonite is a greenish-gray, altered porphyritic rock that crops out as numerous irregularly shaped masses throughout the mine area and is exposed as dikes and sills in the mine workings.

The metasedimentary sequence strikes northerly and dips west except for minor folds in the eastern part of the mine area and minor divergences in attitude near plutonic salients. Rocks in the mine area are strongly faulted. The major faults and the economically important faults, exemplified by those in the Lucky Jim fault zone, strike N. 60°-75° E. and except for local divergences dip steeply northwest. The faults of this zone generally are not traceable for more than 150 feet. They commonly branch into other faults, which become dominant, or are superseded by en echelon faults (fig. 7). The fault zone ranges from a foot to approximately 20 feet in thickness. Locally faults of the Lucky Jim fault zone encompass horses of country rock or splay out into weak faults. Some faults in the Lucky Jim fault zone have well-developed mullion structures that rake from 18° to 30° SW. Near-vertical slickensides are locally superposed on the mullion surfaces and indicate later dip-slip movement. The major displacement was strike-slip and left lateral. This movement is similar to that on the nearby northwest-trending Darwin tear fault. The number 1 fault, which strikes N. 30° W. and dips steeply southwest, displaces the Lucky Jim fault zone causing the west segment to be offset about 50 feet to the south. Whether this is a manifestation of dominant strike-slip or of dip-slip movement is not known. The number 2 fault is similar to the number 1 fault in attitude. The number 2 fault apparently truncates ore on the 820-foot level, but only minor mineralization is exposed on the 920-foot level southwest of the number 2 fault. Very little work has been done southwest of this fault on the deeper levels, where the ore shoot would project, however.

Ore occurs mainly as fissure fillings within the steep northeast-trending Lucky Jim fault zone and is commonly bounded by fault surfaces. Stope outlines (fig. 7) indicate that the bulk of ore was mined between the surface and the 320-foot level northeast of the number 1 fault. Another productive shoot was mined southwest of the number 1 fault between the 320- and 820-foot levels. This shoot may represent a segment of the shoot above the 320-foot level that has been down-faulted by the number 1 fault. The ore shoots are as thick as 15 feet and average about 3 feet; they rake moderately southwest. Much of the Lucky Jim fault zone is tight and lacks vein minerals. The ore shoots appear to be localized where the fault diverges to a more northeasterly strike, similar to an ore control at the Christmas Gift mine. Minor quantities of ore occur in some of the gently dipping fissures.

The ore consists mainly of galena and its oxidation products cerussite and anglesite. Heavy iron staining pervades the veins and masks many of the mineralogic details. Galena occurs as small relicts 2 or 3 inches in diameter surrounded by cerussite and minor anglesite. Secondary copper minerals are present locally. The chief gangue minerals are quartz, calcite, pyrite, and limonite, accompanied by lesser amounts of jasper, fluorite, jarosite, and clay minerals.

Assays by The Anaconda Company show that the metal content of the Lucky Jim vein ranges from less than 1 ounce of silver per ton and 1 percent lead to about 70 ounces of silver per ton and 30 percent lead. The assays show some zinc, but no zinc minerals were identified.

Promontory Mine

The Promontory mine is near the south end of the Darwin Hills 1.3 miles southeast of the town of Darwin in sec. 30, T. 19 S., R. 41 E., at an altitude of 5,000 feet. The property is accessible by a dirt road that leads south from Darwin. The Anaconda Company owns the mine but has not operated it. The property is developed by an inclined shaft with a vertical depth of 283 feet and with levels at depths of 40, 67, 140, 170, 180, 210, 240, and 280 feet. The production from the Promontory mine is not known, as the production in the past gen-

*Table 8. Ore produced from the Promontory mine since 1911.**

Year	Dry tons	Average grade					Metal content		
		Au	Ag	Pb	Zn	Cu	Gold (oz.)	Silver (oz.)	Lead (lbs.)
1911	21	--	--	--	--	--	--	1,116	5,667
1916-1919[2]	1,932[3]	0.086	37.4	21.6	3.0	0.17	--	--	--
1937[2]	87.6[3]	.053	24.0	17.8	5.2	--	--	--	--
Total	2040.6	.08	37.0	21.3	--	--	170	75,571	871,119

* Data supplied by the Anaconda Company, 1956, and published with their permission.
[2] Data from report on Darwin Mines by Ira Joralemon, 1940.
[3] Crude ore.

erally has been reported with that of the Darwin Silver Group.

The average grade of ore that has been shipped is not known. According to records in the San Francisco office of the U. S. Bureau of Mines, however, 1,116 ounces of silver and 5,667 pounds of lead were recovered from a 21-ton shipment of ore in 1911 by C. A. Bradford and 1,042 ounces of silver and 17,738 pounds of lead were recovered from 82 tons of ore shipped in 1918 by the Darwin Development Company. The average grade of this ore is 21 ounces of silver per ton and 11.3 percent lead.

The lower member of the Keeler Canyon formation of Pennsylvanian and Permian age crops out in the mine area. It consists of light-gray dense calc-hornfels with some relicts of limestone and light-gray dense calc-hornfels with interbedded chert and hornfels. The beds strike northerly and dip 33° to 55° W. in an overturned section. The beds in the mine area are cut by three faults that strike N. 70°-80° E. and dip steeply south and by a fault 240 feet west of the main shaft that strikes northerly and dips 82° W. (fig. 10).

The ore occurs as a bedded replacement of limestone and light-gray calc-hornfels close to faults that trend N. 70° E. Three mineralized beds are exposed in the open cut at the main inclined shaft. The westernmost vein is a replacement of a bluish-gray limestone bed that is exposed in the collar of the shaft. Gossan is also exposed in light-gray calc-hornfels 12 feet and 40 feet farther

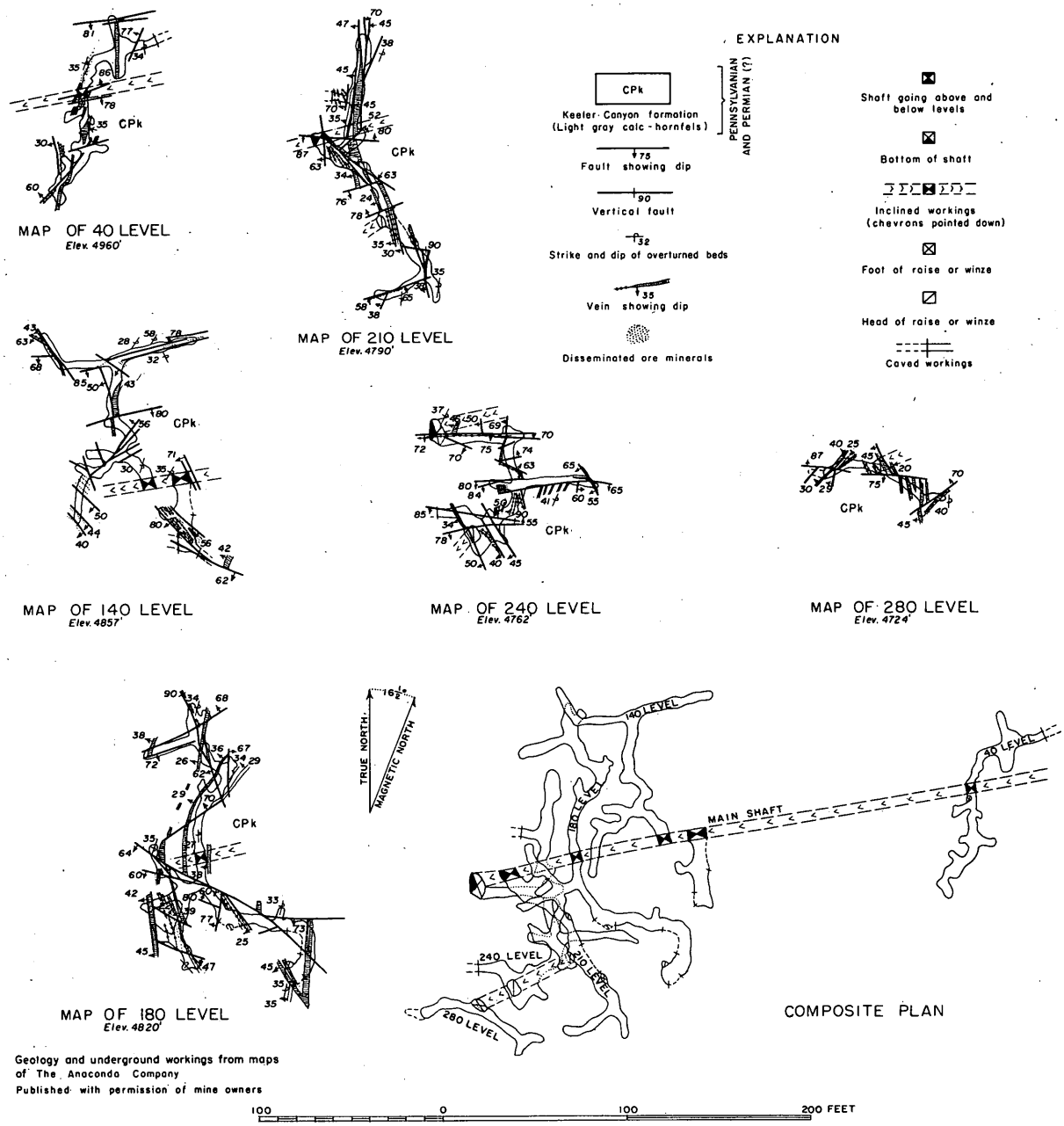


FIGURE 11. Geologic maps of the underground workings of the Promontory mine.

east of the shaft. The veins can be traced on the surface for only a few feet north of the open cut.

The most extensive ore exposed in the mine is on the 180- and 210-foot levels. On the 180-foot level ore is exposed discontinuously for 180 feet as a replacement of 3 or 4 thin beds (fig. 11). The veins range from a few inches to 5 feet thick. On the 210-foot level one vein is exposed for 133 feet that ranges in thickness from a few inches to 8 feet. Mineralization below the 210-foot level is weak.

Gossan is exposed in several shallow workings south and southeast of the main inclined shaft. A shallow surface stope 52 feet long, 350 feet S. 10° W. of the inclined shaft exposes gossan 2 to 4 feet thick parallel to bedding and a shallow inclined shaft has been sunk on gossan 210 feet S. 54° E. of the main inclined shaft.

The ore consists of cerussite and minor wulfenite, plumbojarosite, and hydrozincite in a gangue of jasper, iron oxides, and calcite. Kelley (1938, p. 561) reports some siderite in the gangue also.

Santa Ana Mine

The Santa Ana mine is in sec. 18, T. 19 S., R. 41 E., on the east slope of the Darwin Hills at an altitude of 4,560 feet. According to claim notices the mine was located by L. D. Owen in July 1926, sold to Alex Ruona in February 1927, and subsequently deeded to the present owners, Hilma Ruona of Huortana, Finland, and Marie Ruona Wilson, of San Francisco. According to Kelley (1938, p. 559) the mine probably was worked during the nineties. The main workings consist of a 200-foot vertical shaft with drifts at the 75-, 150-, and 200-foot levels and with a 30-foot winze from the lowest drift. Other workings are an inclined shaft about 30 feet deep and shallow surface pits.

The country rock is blue limestone and greenish-gray, brown-weathering calc-hornfels of the upper member of the Keeler Canyon formation. The main workings are on a vein striking N. 42° E. and dipping 85° SE. The vein ranges from 1 foot to 6 feet in thickness at the surface, and Kelley (1938, p. 559) states it is as much as 10 feet thick where exposed in underground workings. The vein is highly iron stained and contains jasper and coarse gray calcite. Galena and cerussite are the chief ore minerals.

Standard Group

The Standard Group includes several claims in the eastern part of sec. 13, T. 19 S., R. 40 E., and in the western part of sec. 18, T. 19 S., R. 41 E. The claims were explored and mined mainly during the early 1920's by Alex Ruona. They are now owned by Mrs. Marie Wilson of San Francisco and Hilma Ruona of Finland. A small mine camp in the canyon north of Lane Canyon was largely demolished by a cloudburst. The mine workings consist of many adits and open cuts. No record of production was found.

Workings of the Standard Group are near the irregular eastern border of the stock of the Darwin Hills, mainly in calc-hornfels of the Keeler Canyon formation, but locally within granitic rocks. Bedding strikes north and dips mainly west except for minor open folds, one of which is well exposed near the old mining camp. Two nearly vertical branches of a N. 60°-80° W.-trending fault zone near the old campsite are the most conspicuous structural features. These faults, which are parallel to the Darwin tear fault, are marked by iron-stained breccia and gouge zones 10 to 40 feet thick with pockets of jasper, calcite, and minor pyrite, chalcopyrite, and galena. These faults have been extensively explored by adits, but little ore has been found. The ore-bearing veins, which are 1 foot to 4 feet thick, strike N. 50°-75° E. and dip from 70° NW. to vertical. The most important of these are the Standard vein, the Standard Extension vein, and an unnamed vein, possibly a faulted segment of the Standard vein, north of the northwest-trending fault zone.

The Standard vein is exposed for about 1,000 feet in the northeast part of sec. 13. Workings on the vein consist of a vertical shaft 70 feet deep, adits 100 and 200 feet long, and extensive surface workings. The vein strikes N. 50°-55° E. and dips from 75° NW. to vertical. Ore is in four closely spaced, thin parallel veins that contain pockets of galena, cerussite, pyrite, chrysocolla, and anglesite in a gangue of highly iron-stained quartz, jasper, and fluorite.

The Standard Extension vein crops out for about 600 feet in secs. 13 and 18, about 600 feet south of the Standard vein. Workings on the vein consist of three shafts, each about 100 feet deep, two adits, drifts, and minor surface workings. The vein strikes N. 60°-70° E. and dips from 75° NW. to vertical. A salient of the stock of the Darwin Hills is adjacent to the western extremities of the vein. Away from the stock the vein cuts calc-hornfels of the Keeler Canyon formation. The vein averages about 2 feet in thickness and is composed of coarse calcite, quartz, jasper, and limonite with lesser amounts of galena, cerussite, hemimorphite, and chrysocolla.

A possible faulted segment of the Standard vein crops out near the extreme northeast corner of sec. 13 north of a strong northwesterly trending fault. This vein is explored by a northeast-trending adit and by surface workings. The vein, which is 2 feet thick, strikes N. 60° E. and dips 75° NW. It is similar to the Standard vein in mineral content.

The strong northwest-trending faults in the mine area are explored by long adits, but apparently they lack ore. Small quantities of ore minerals are locally distributed on steep minor subsidiary faults that strike between N. 25° W. and N. 25° E.

Susquehanna Mine

The Susquehanna mine is in sec. 24, T. 19 S., R. 40 E., between The Anaconda Company mining camp and Darwin at an altitude of 4,880 feet. The property is owned by the Mickey Summers' estate, and it is leased to Ross Finley and Tom Vignich of Darwin. The mine is accessible by hard-surfaced roads both from Darwin and from The Anaconda Company mining camp. It is developed by an inclined shaft 43 feet deep that bears S. 28° E. at –79°. A drift at the bottom of the shaft heads N. 50°-70° E. for approximately 870 feet with a few short crosscuts from it. Little stoping was done. Local residents state the mine has had a small production, but no record of it was found.

The lower member of the Keeler Canyon formation of Pennsylvanian and Permian age crops out in the mine area. The rocks near the collar of the shaft consist of

aphanitic light-gray and greenish-gray calc-hornfels. The Davis thrust fault is exposed about 300 feet east of the shaft. East of the Davis thrust and extending to the stock of the Darwin Hills, 800 feet east of the shaft, the rocks are aphanitic white and light-gray calc-hornfels. The calc-hornfels east of the Davis thrust is cut by a vertical fault that strikes N. 50° E. A bedding-plane fracture can be traced for about 100 feet north of the N. 50° E. fault.

Both the N. 50° E. fault and a bedding-plane fracture 600 feet northeast of the shaft are mineralized locally. The N. 50° E. fault is iron stained and locally contains minor amounts of malachite through a thickness of 8 feet. A vertical shaft 30 feet deep on the fault exposes no ore. The bedding-plane fracture is limonite stained through a thickness of 3 feet and contains minor jasper. An inclined shaft bearing S. 70° W. at minus 33° exposes no ore.

The Davis thrust fault is exposed in the underground workings about 300 feet northeast of the main inclined shaft. On the east side of the thrust fault, the drift is along a fault that strikes N. 50° E. and dips 50° SE. At the intersection of the two faults the sheared calc-hornfels is highly iron stained and is reported to have contained some ore. The N. 50° E. fault away from the intersection is only slightly mineralized.

Wonder Mine

The Wonder mine is in sec. 18, T. 19 S., R. 41 E., on the south side of Lane Canyon 3,000 feet west of Lane Mill at an altitude of 4,720 feet. The Wonder No. 1 claim is on the north side of Lane Canyon adjacent on the north to the Wonder claim. The Anaconda Company owns the property, which has been idle for many years. The mine was first described by Knopf (1914, p. 16) and briefly by Kelley (1938, p. 559).

The Wonder claim is developed by an adit about 100 feet long trending S. 20° E., an inaccessible inclined shaft reported by Tucker (1926, p. 465) to be 100 feet deep, and several surface pits. The Wonder No. 1 claim is developed by an inclined shaft, reported by Tucker (1926, p. 465) to be 225 feet deep.

The rocks in the mine area are calc-hornfels and locally tactite at the top of the lower member of the Keeler Canyon formation. Between the workings on the Wonder and Wonder No. 1 claims the rocks are intersected by a number of N. 70° E. fractures that are part of the Lane fault. Bedding south of the Lane fault strikes north and dips 55° W. North of the fault the workings are along the crest of an open anticlinal-shaped fold that may be an inverted syncline.

The ore in the Wonder claim is along a vein that strikes N. 27° W. and dips 55° SW. A steep N. 70° E.-trending fault cuts the vein in the adit about 60 feet from the portal and offsets the southern segment approximately 8 feet to the west. The vein is 2 to 6 feet thick and consists predominantly of coarse gray calcite, limonite, and garnet with local pockets of galena, cerussite, fluorite, pyrite, quartz, oxidized copper minerals, and minor scheelite.

Similar ore is exposed along the crest of an anticlinal-shaped fold at the collar of the inclined shaft on the Wonder No. 1 claim. The ore extends down the west limb of the fold as a bedding-plane vein 4 to 6 feet thick that strikes N. 10° W. and dips 55° SW.

Mines and Prospects in the Argus Range

Darwin Zinc Prospect

The Darwin Zinc prospect is in sec. 2, T. 19 S., R. 41 E., on the west slope of the Argus Range at altitudes of about 3,700 feet. Workings include a crosscut adit 174 feet long trending N. 74° E., a 20-foot raise from the adit, and northwest-trending surface pits and trenches on the slope above the adit. An ore chute about 120 feet long connects the surface workings with the access road near the portal of the adit. Additional older workings are accessible from the canyon north of the new workings and consist of a S. 15° W.-trending open stope 70 feet long and an 87-foot long adit that trends S. 12° W. The portal of a caved north-trending adit is on the north wall of the canyon.

The workings explore a major N. 10°-30° W.-trending fault zone that is marked by numerous fault surfaces and steep parallel brecciated and shattered zones. Fossiliferous silty limestone of the lower member of the Owens Valley formation of Permian age is west of the fault and Mississippian marble lies to the east. The marble appears identical to much of the marble at the Empress and Zinc Hill mines. Minor amounts of hydrozincite in the open stope constitute the only identified ore mineral. Iron staining is locally abundant throughout the fault zone, and in places coarse calcite crystals coat some of the brecciated rock.

Empress Mine

The Empress mine includes four unpatented claims in sec. 2, T. 19 S., R. 41 E., on a precipitous west slope of the Argus Range at altitudes about 4,500 feet (pl. 1). The mine is connected to the Darwin Canyon road by a steep narrow road about 1.2 miles long. The property is operated by W. E. McCulley of Darwin, Calif. The mine production, which is from records of the U. S. Bureau of Mines, is given in the following table.

*Table 9. Ore produced from the Empress mine.**

Year	Crude Ore (tons)	Gold (oz)	Silver (oz)	Copper (lbs)	Lead (lbs)	Zinc (lbs)
1946	79	1	530	2,033	34,891	12,539
1947	89	2	1,450	2,453	66,403	8,141
1948	136	2	2,824	5,880	62,354	22,300
1949	91	1	726	3,699	39,329	12,388
1950	None recorded					
1951	25	--	170	199	13,209	1,670
	420	6	5,700	14,264	216,186	57,038

* Production figures furnished by the U. S. Bureau of Mines and published with the permission of the owner.

Mine workings consist of 412 feet of level workings, less than 100 feet of winzes and raises, small stopes, and minor surface pits and trenches (fig. 12).

The Empress mine is in an unfaulted block of Cretaceous quartz monzonite and a roof pendant of Mississippian limestone that is cut by minor quartz diorite, aplite, and basalt dikes (fig. 13). The limestone beds are 1 foot to 2 feet thick and contain numerous 1- to 4-inch thick chert lenses. The limestone is similar to the

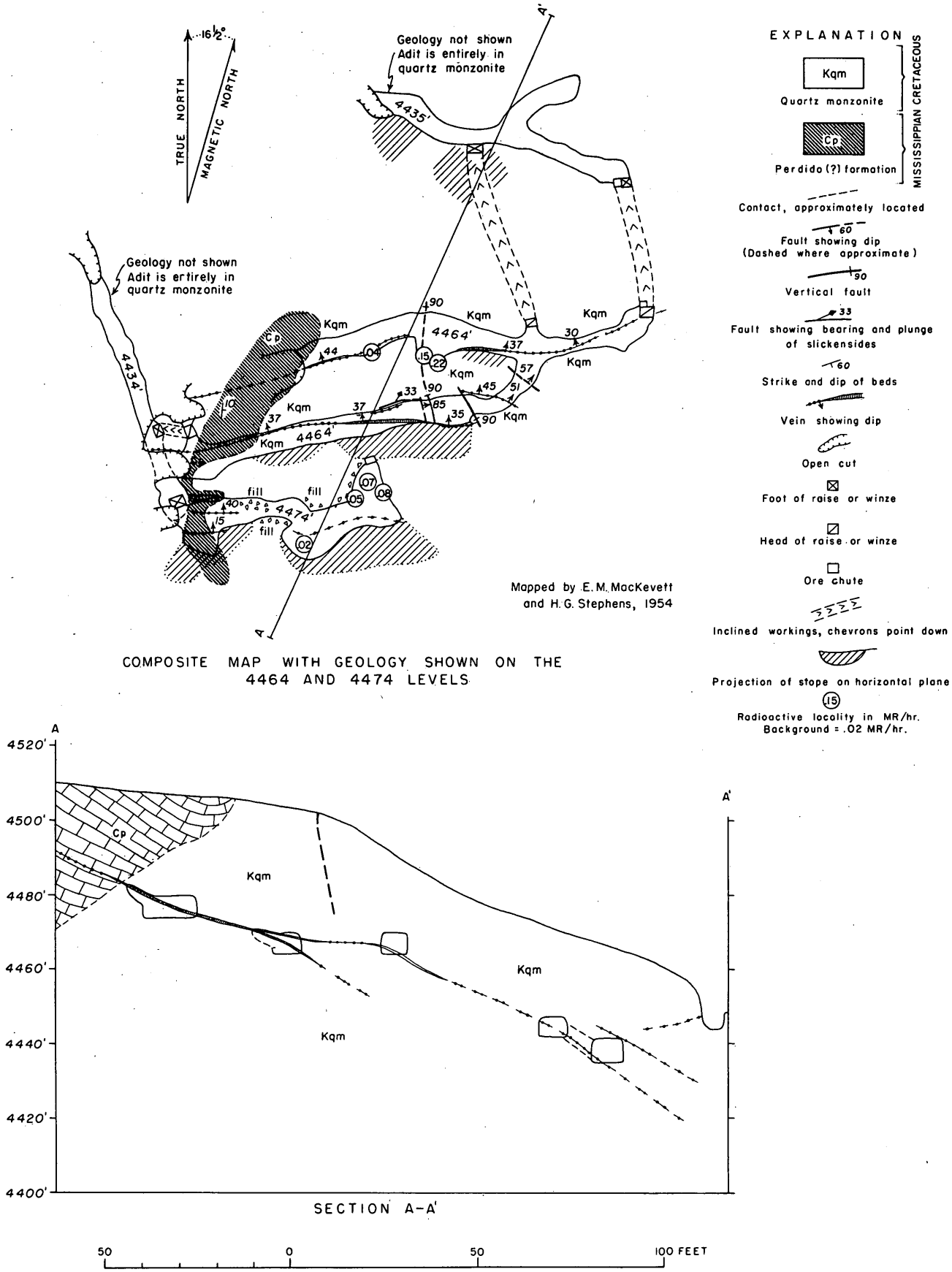


FIGURE 12. Cross section and geologic map of the underground workings of the Empress mine.

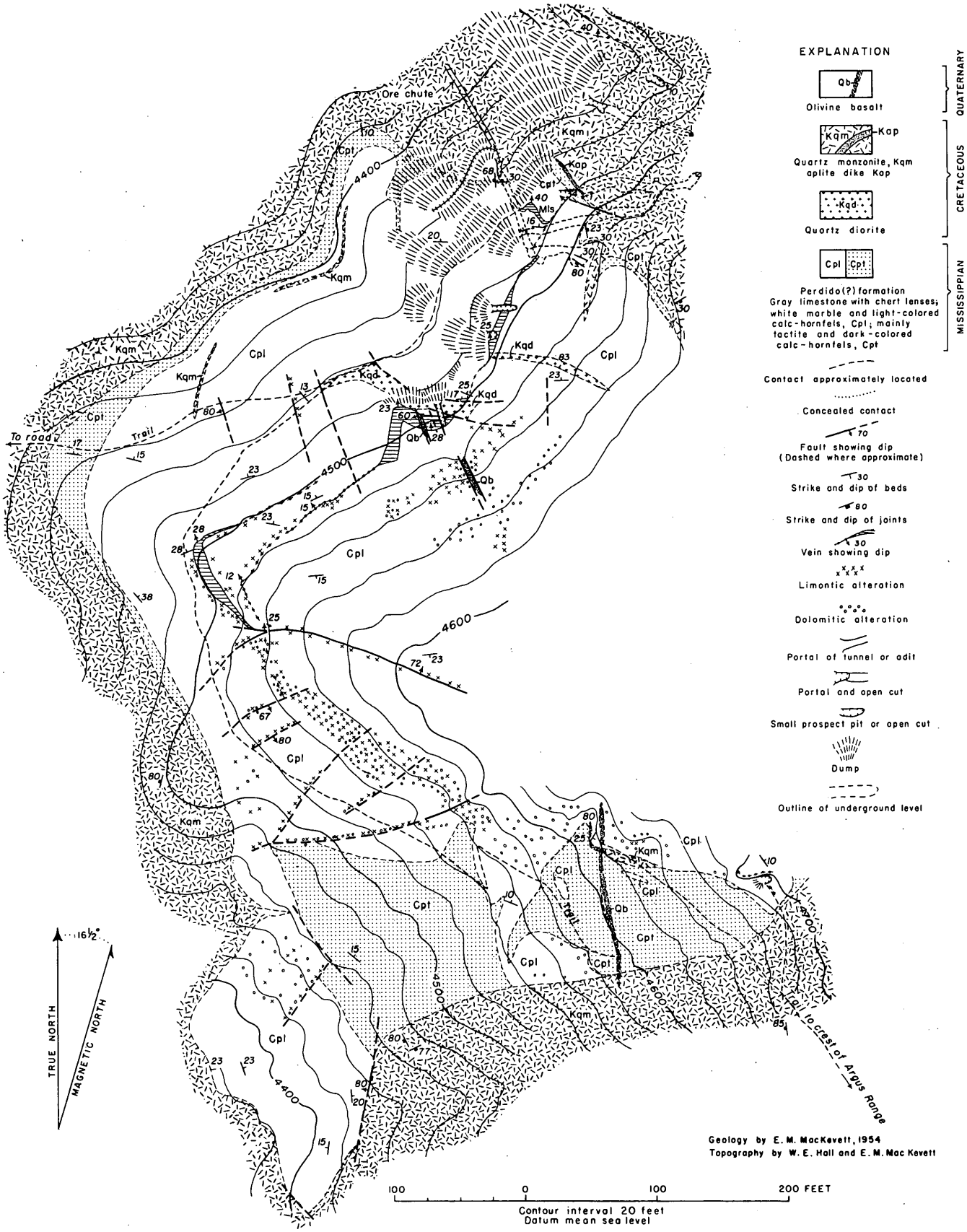


FIGURE 13. Geologic Map of the Empress mine.

Perdido formation of Mississippian age and is tentatively correlated with it. Where unaltered, the limestone is medium gray and the chert is light gray. Most of the limestone is metamorphosed to white marble, light-colored calc-hornfels, and dark-brown tactite; the chert is bleached white. The marble consists predominantly of coarse-grained white calcite, but locally it contains minor amounts of antigorite. Wollastonite is the predominant mineral in the light-colored calc-hornfels. The dark-brown tactite, which attains a maximum thickness of about 70 feet, is generally contiguous to quartz monzonite. It consists of garnet and epidote with lesser amounts of quartz, calcite, pyroxene, limonite, antigorite, and very minor amounts of scheelite and chrysotile.

The quartz monzonite is a medium-grained, pinkish-gray rock containing quartz, orthoclase, oligoclase, and biotite with minor amounts of pyrite, apatite, and sphene. The quartz diorite is a fine-grained, dark-gray speckled rock made up of hornblende, biotite, quartz, and plagioclase with a lesser quantity of apatite and opaque minerals. It occurs in irregular dikelike masses as much as 20 feet thick that are cut by a few aplite dikes 1 inch to 4 inches thick. An altered, grayish-brown basalt dike 3 to 4 feet thick strikes N. 20° W. across the mine area. The dike is intermittently exposed, as its upper limits only locally reach the present erosion surface. The dike consists predominantly of labradorite and olivine. Secondary minerals are calcite, limonite, chlorite, epidote, and iddingsite. Dolomitic alteration of limestone and iron staining are abundant in or near the ore horizon and adjacent to some faults.

Three sets of steep faults cut the rocks in the mine area. These faults strike N. 20°-30° W., N. 70°-80° W., and N. 50°-60° E. Most of the faults can be traced for only short distances. They have little displacement and appear to be closely associated with ore deposition. The ore horizon cuts across some of the faults, but in others the faults displace the ore horizon slightly, a probable attribute to minor movement on the faults after ore deposition.

Bedding mainly strikes nearly east and dips 15° to 40° N. Aberrant southerly dips are near intrusive contacts and in a minor flexure in the east-central part of the mine area.

Ore at the Empress mine is a bedded replacement of limestone and a continuation as a flat-lying quartz vein in quartz monzonite. The ore zone in limestone is well exposed on the surface for about 400 feet where it ranges from a few inches to about 6 feet thick. In places local bifurcations give rise to two separate and generally thinner veins. Extensive iron stains and some dolomite mark the ore horizon in limestone. Most of the early workings exploited the north end of the vein within quartz monzonite near the contact with the limestone. The ore in the southern part of the mine is lower grade and consists of thin discontinuous galena-bearing stringers in a heavily iron-stained and dolomitized host rock. Both limestone and chert of the host rock were replaced by ore.

The primary ore consists of pockets of argentiferous galena, sphalerite, and chalcopyrite in a quartz-rich gangue. Secondary ore minerals are cerussite, anglesite, azurite, malachite, chrysocolla, hemimorphite, and very little wulfenite. The gangue consists mainly of quartz and chalcedony with lesser calcite, limonite, pyrite, kaolinite, and gypsum. The same minerals are in the quartz veins that cut quartz monzonite, and the ore minerals generally occur as irregular replacements in the veins.

Anomalous radioactivity was measured in the mine workings. Local radioactivity ranged from 0.04 to 0.15 MR/hr in the A-15 and A-17 workings; the background count averaged 0.02 MR/hr (fig. 12). In the A-14 workings radioactivity averaged about 0.03 MR/hr. The source of the radioactivity is not known.

Wynog Prospect

The Wynog prospect is in sec. 11, T. 19 S., R. 41 E., at an altitude of about 4,080 feet on the west slope of the Argus Range. The prospect is 2,000 feet S. 18° W. of the Empress mine. It is accessible by a trail 1,000 feet long from the sharp bend in the road to the Empress mine. According to claim notices W. W. Tice and Bert Quinn of Darwin located the prospect on March 26, 1946. No production has been recorded, and the prospect is currently idle. The main workings consist of a 50-foot adit trending N. 15° W., a 44-foot drift trending northeast, and a surface trench 500 feet long about 110 feet N. 60° E. of the portal.

The prospect is in an upfaulted area underlain by marble and tactite metamorphosed from Mississippian limestone and by irregular salients of biotite-quartz monzonite. Garnet and epidote are the most abundant constituents of the tactite.

Ore is in a quartz vein 1 inch to 12 inches thick that strikes northeast and dips about 35° SE. The host rock in the main workings is marble. The vein cuts the quartz monzonite where explored by the trench, and it apparently pinches out in the intrusive rock north of the trench.

Three nearly vertical faults trending N. 20° W. cut the vein and each elevates the east side 1 foot to 6 feet relative to the west side. The vein is truncated by the southernmost of these faults about 10 feet south of the portal of the main workings.

The ore minerals include galena, cerussite, chrysocolla, and minor quantities of chalcopyrite, cuprite, and azurite. Quartz is the dominant gangue mineral associated with minor calcite, barite, hematite, and limonite. The ore minerals are in small pods an inch or two long that are irregularly distributed in the quartz vein. Parts of the vein are slightly radioactive and have about twice the background count.

Zinc Hill Mine (Utacala Group, Colorado Group)

The Zinc Hill mine is 5¾ miles northeast of Darwin in sec. 2, T. 19 S., R. 41 E., at the north end of the Argus Range at an altitude of 3,875 feet. The mill site and abandoned mining camp is on the old State Highway 190 between Darwin and Panamint Springs. The mine is accessible by a pack trail 4,400 feet long that leads northeast from the mill site. A small jeep can negotiate the trail.

The property consists of five unpatented claims owned by the Combined Metals Reduction Company of Salt Lake City, Utah. The early history of the mine is incompletely known. The mine was not mentioned by Waring and Huguenin in the 15th Annual Report of the State

Mineralogist for the years 1915-1916. From 1917 to 1920 the mine was owned by the Utacala Exploration Company of Salt Lake City, Utah, during which time it was the major zinc producer in California. The property was operated by the Combined Metals Reduction Company from 1941 to 1943 and in 1946, and it was leased to Royal J. Wright and Tom Taylor from January to April 1947 and January to May 1949 (Norman and Stewart, 1951, p. 83). The property has been idle since 1949.

The known production from the Zinc Hill mine totals 4,945.9 tons, of which 2,959.8 tons was oxide ore and 1,986.1 tons was sulfide ore. All the ore produced before 1940 was oxide ore from the lower mine workings. This ore averaged 44.18 percent zinc. The production since 1940 has been from the upper workings and has been mainly sulfide ore. The sulfide ore shipped averaged 22.28 percent zinc, 1.33 percent lead, and 1.43 ounces per ton of silver.

*Table 10. Ore produced and grade of ore from the Zinc Hill mine.**

Year	Oxide ore		Silver (oz/ton)	Gross Value
	Tons	Zinc (percent)		
1917	100.7	39.02	1.82	--
1918	1,150	45.2	--	$50,375.90
1919	293.3	49.7	--	13,479.78
1920	667.8	50.1	--	33,413.17
1922	103.9	40.2	--	--
1925	243.1	30.94	--	7,309.09
1926	109.3	39.37	--	2,683.85
1941	250.8	37.32	--	--
1942	40.9	34.45	--	--
Total	2,959.8	--	--	--
Avg.	--	44.18	--	--

Year	Sulfide ore		Lead (percent)	Silver (oz/ton)	Gold (oz/ton)
	Tons	Zinc (percent)			
1941	385.8	25.47	1.38	1.74	0.01
1942	1,433.2	21.71	1.18	1.3	0.007
1943	104.9	18.47	2.58	2.08	0.003
1947	40.2	21.76	3.15	1.60	0.005
Total	1,964.1	--	--	--	--
Avg.	--	22.28	1.33	1.43	--
	Undifferentiated ore				
1949	22	27.4	35.7	--	--

* Published with the permission of Combined Metals Reduction Co. Data from Company files.

The property is developed by numerous open cuts, near-surface stopes, and short adits into a steep hillside. The workings develop four separate mineralized areas, and there are no interconnecting workings between them. They are designated workings A, B, C, and D, for convenience in writing. The ore from the westernmost workings was brought up to the end of the pack trail by an inclined tramway, and that from the upper workings was brought down by an aerial tram line.

The rocks in the mine area are marble and limestone of Mississippian age faulted against silty limestone of Permian age (fig. 14). The sequence of rocks is given below:

Age	Stratographic unit	Lithology
Cretaceous(?)		6. Diorite dike
Permian	Owens Valley formation	5. Silty blue-gray limestone
Fault contact		
Pennsylvanian(?) and Mississippian	Lee Flat(?) limestone	4. Marble, white 130+
		3. Blue-gray limestone with bedded chert 130
Mississippian	Perdido(?) formation	2. Ore horizon. Marble. Contains bedded chert in lower part. 200
Mississippian	Tin Mountain(?) limestone	1. Blue-gray limestone, in part altered to marble. Contains bedded chert near top. Lower part probably Tin Mountain limestone. 120+

The oldest rock in the mine area is thinly bedded blue-gray limestone that is locally bleached and recrystallized to marble. It is overlain by a 200-foot-thick marble bed that contains all the known ore bodies. Most of the mineralization is in the upper half of this ore horizon. It is overlain by 130 feet of gray to bluish-gray limestone with 1- to 4-inch-thick beds of chert, which in turn is overlain by marble. The above units lithogically resemble the Mississippian formations found elsewhere in the quadrangle, and Hopper (1947, p. 409) found Mississippian fossils in limestone that is probably about the same stratigraphic horizon 4 miles to the southeast. The lithology is similar to that of the Lee Flat limestone, Perdido formation, and Tin Mountain limestone.

The Mississippian limestones are faulted on both the east and west sides of the mine area against silty bluish-gray limestone of the Owens Valley formation of Permian age.

A fine-grained diorite dike 1 foot to 2 feet thick cuts the Mississippian rocks in the southern part of the mine area. It strikes N. 65° W. and dips vertically. The dike has been stoped at the surface for 250 feet along strike, but the nature of the ore removed is not known.

Faulting is the main structural feature in the mine area. The mine is in a horst of Mississippian limestone that has been faulted up against the Owens Valley formation by steep north to N. 20° W.-trending faults. Beds within the horst strike northwest to west and dip 10° to 38° N.; those in the Permian limestone strike northeast to east and dip 35° to 80° N.

The Zinc Hill fault bounds the horst of Mississippian limestone on the west and has a stratigraphic throw of over 2,700 feet. It is displaced 150 feet, north side west, by 3 northwest-trending faults that are locally dolomitized. Many discontinuous north- to northeast-trending faults are near the ore bodies. They are important in localizing ore bodies, although they have only a few feet of displacement. A major fault striking N. 20° W. bounds the horst on the east. It also has a stratigraphic throw of over 2,700 feet.

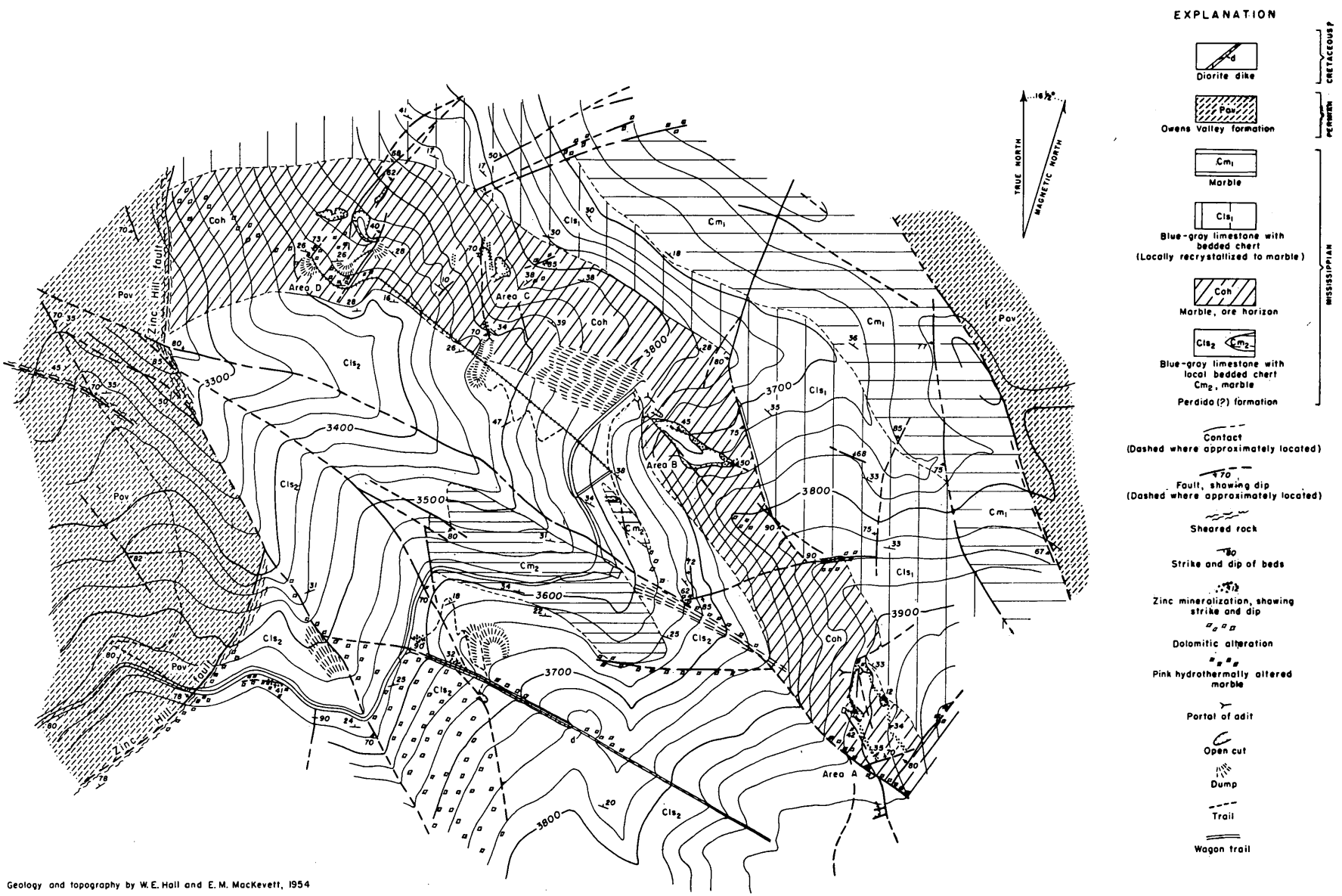


FIGURE 14. Geologic map of the Zinc Hill mine.

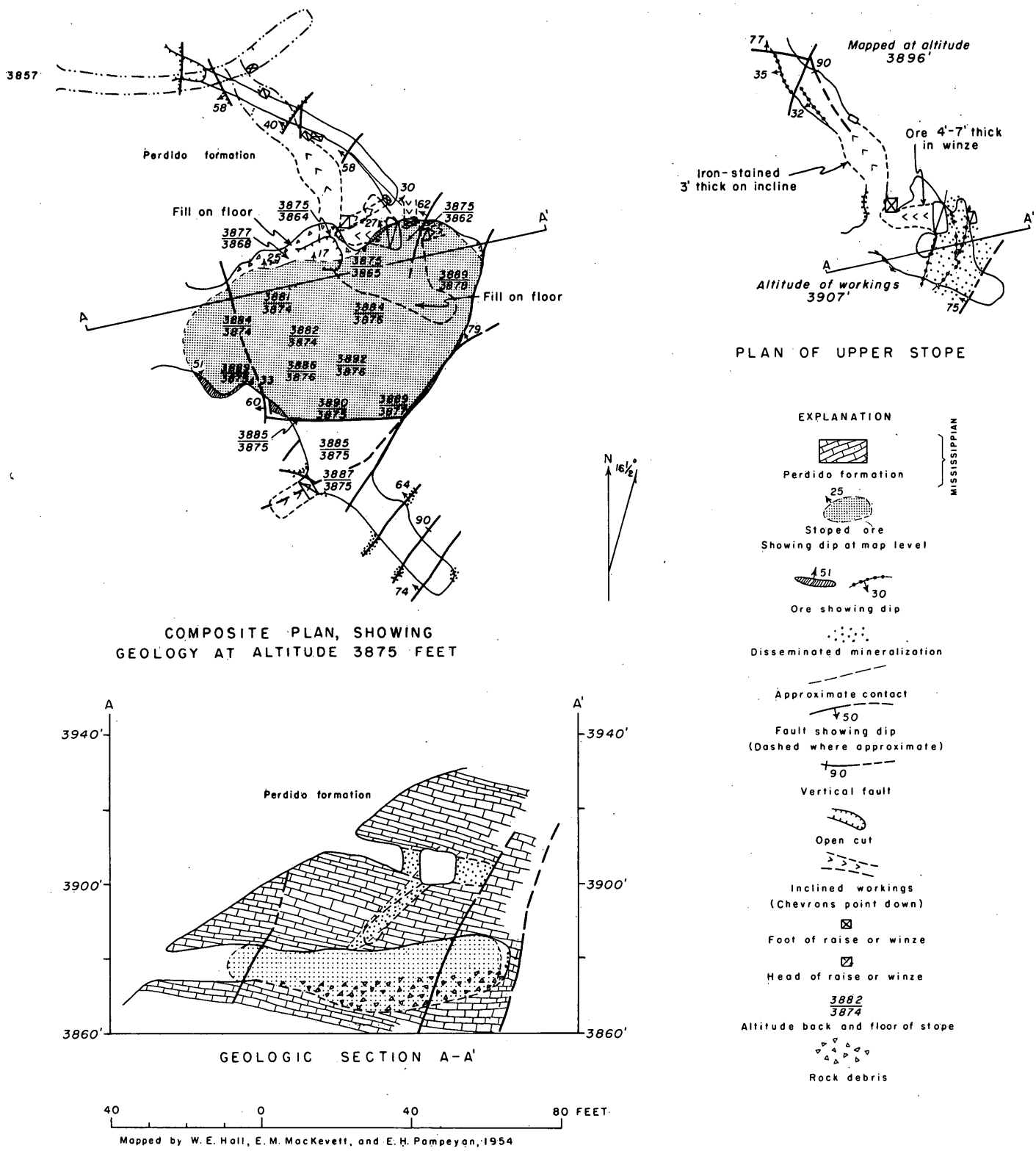


FIGURE 15. Geologic maps and section of the upper workings in Area A, Zinc Hill mine.

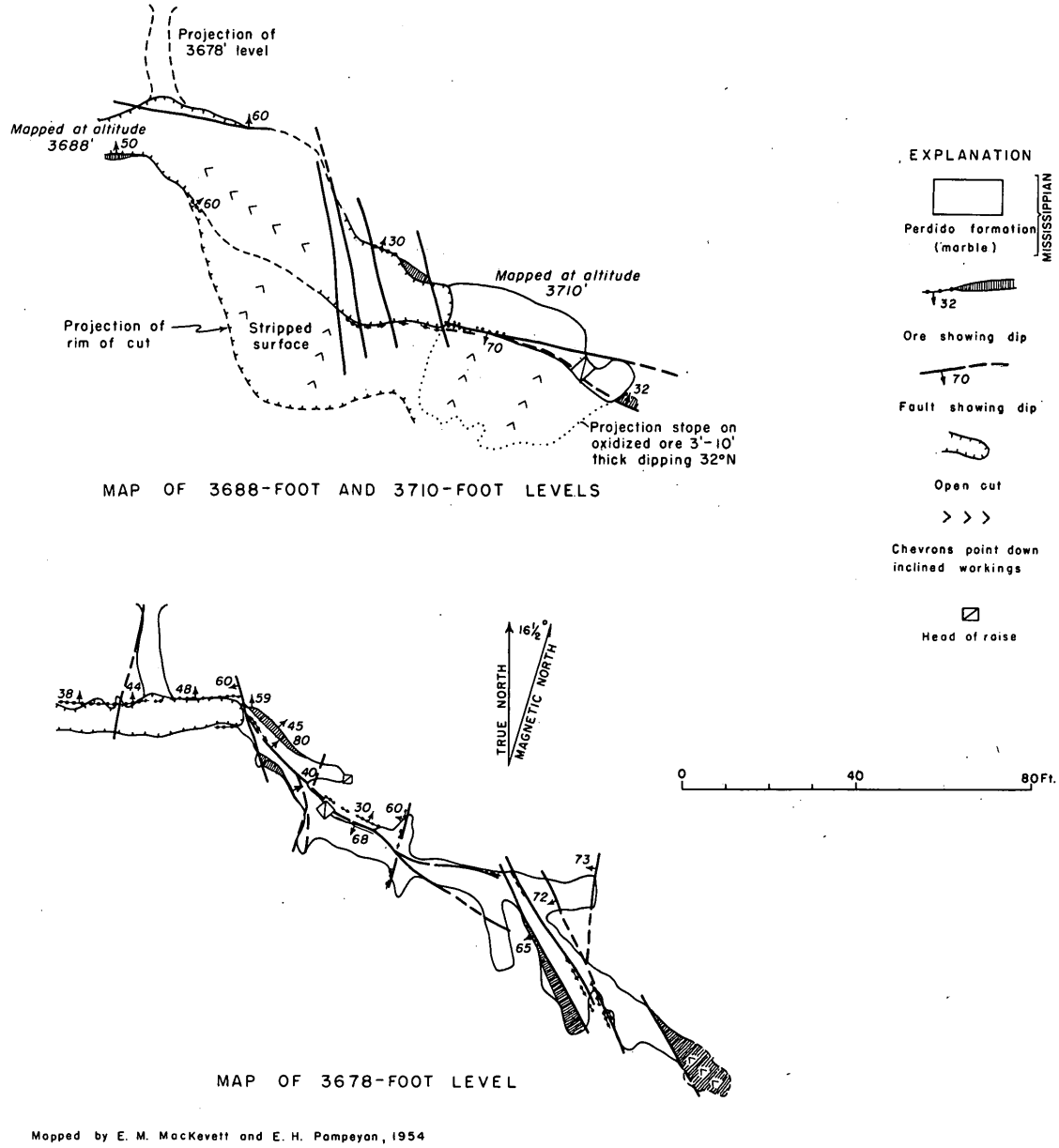


FIGURE 16. Map of workings in Area B, Zinc Hill mine.

The faults must have had several periods of movement. Many of the northwest- and northeast-trending faults are mineralized or dolomitized, yet the northwest-trending faults apparently displace the Zinc Hill fault, which has had late Tertiary or Quaternary displacement.

The ore occurs as replacement bodies parallel to bedding and to a lesser extent along faults where they cut a favorable stratigraphic horizon (fig. 14). The favorable ore horizon crops out for 1,500 feet in a northwesterly direction, and it is cut off by faults at both ends. Mineable ore bodies are in four localities within this favorable horizon. The ore in areas A and D is mainly parallel to bedding, while the ore bodies in areas B and C are mainly along steeply dipping faults (fig. 14).

Ore in the upper workings in area A is mainly in bedded replacements in what is called the Colorado bed by the Combined Metals Reduction Company (written communication). The Colorado bed is at the top of the favorable ore horizon. As the ore within the Colorado bed was mined out when the mine was mapped, details within the bed were not evident. The Colorado bed is described by L. G. Thomas (written communication), geologist for Combined Metals Reduction Company, as follows:

"The deposit is a replacement type composed of at least 3 and possibly 4 distinct beds intercalated between ribs or partings within the Colorado bed and adjacent to a feeder fissure, called the Herbert fissure, which strikes N. 35° E. and dips 60° to 75° to the northwest. The sequence within the Colorado bed is in general as follows:"

Upper bed No. 4	Ore, 2+ feet
Limestone parting	Waste, 6 feet
Bed No. 3	Ore, 4 to 6 feet
Limestone parting	Waste or low grade, 3-4 feet
Main bed No. 2	Ore, 5-8 feet
Limestone parting	Waste or low grade
Bottom bed No. 1	Ore, 3-4 feet

Ore in the upper workings in area A was mined from two stopes (fig. 15). The lower stope is approximately 80 feet long, 60 feet wide, and 10 to 16 feet high. Ore from beds Nos. 1 and 2 was mined from this stope. Approximately a third of the ore removed from this stope was primary ore and the rest oxidized ore. The upper stope is approximately 25 feet long, 25 feet wide, and 4 feet to 7 feet high. It apparently contained only oxidized ore. The Royal Wright winze was sunk 22 feet from the upper stope on oxidized ore 4 to 7 feet thick with some relict sphalerite and galena along fractures striking N. 20° E. and dipping 37° NW. These fractures are continuous between the upper and lower stopes. Two bedded ore bodies each about 30 feet long, 25 feet wide, and as much as 10 feet thick were mined in area D. This ore is locally cut by faults, and oxidized ore extends a short distance along the faults.

Small oxide ore bodies are localized along faults in areas B and C. In area B, ore is stoped discontinuously for a distance of 200 feet along a fault zone striking N. 60° W. and dipping 30° to 50° NE. (fig. 16). The ore is 3 to 10 feet thick and is stoped about 50 feet down the dip. Oxide ore is still exposed on the lower level (fig. 16). Ore at the east end of the open stope in area B terminates against a mineralized fault that strikes N. 30° W. and dips 65° SE. Ore 1 to 12 feet thick was mined 50 feet along strike and 40 feet down dip; ore 2 to 4 feet thick is exposed at the bottom of the stope.

Small, discontinuous ore bodies both parallel to bedding and along faults were mined in area C. The largest ore body is a bedded deposit that strikes east and dips 20° N. It is stoped 40 feet along strike and 30 feet down the dip; it has a thickness of 3 to 6 feet. Other small lenses of ore occur along faults.

The primary ore contains sphalerite, galena, pyrite, and chalcopyrite in order of decreasing abundance in a gangue of calcite, jasper, gypsum, and quartz. Sphalerite is the predominant primary ore mineral. It is brown to yellowish-brown and has a resinous luster. The grain size is ½ to 4 mm in diameter. Galena is only locally abundant. It commonly has a bluish color due to a thin adhered film containing copper. Pyrite and chalcopyrite are present in minor quantities.

Most of the ore that remains in the mine is oxidized zinc ore. It is a crumbly, porous, brownish-colored mass that consists mainly of hemimorphite, hydrozincite, and limonite, and lesser amounts of cerussite, anglesite, smithsonite, and some blue and green secondary copper minerals.

Hemimorphite is the principal supergene mineral, and it must have made up nearly 100 percent of the oxide ore that was mined. The hemimorphite forms crumbly masses of colorless, white, or cream-colored crystals that are admixed with limonite. Locally the crystals are stained pink, red, or deep green. Hydrozincite is concentrated near the borders of oxidized zinc ore bodies, particularly in area C. It forms a white, powdery coating on chalcedony and on vugs and is admixed and banded with clay minerals. Smithsonite is rare. It is in thin veinlets away from the zinc ore bodies and has been transported farther than the other supergene zinc minerals.

Cerussite and anglesite are present in small quantities and where observed are always near relict galena. Anglesite admixed with cerussite is restricted to a dark-gray rim several millimeters thick surrounding galena, while cerussite was not observed more than a few centimeters from galena. Where the ore is completely oxidized, mainly zinc minerals are present.

Supergene copper minerals of various shades of blue and green are on the dump and in the lower adit in area C. Azurite and malachite are the most abundant.

Locally the secondary ore is slightly radioactive. Local radioactivity in a vein of hydrozincite in the lower adit in area C is 0.05 to 0.2 MR/hr, and averages about 0.08 MR/hr compared to a background of 0.02 MR/hr. The surface exposure of the vein has about the same amount of radioactivity. The upper workings in area C also are radioactive and give readings as high as five times the background count. The source of the radioactivity is not known.

Mines and Prospects in the Santa Rosa Hills and Inyo Mountains

Lee Mine (Emigrant Mine)

The Lee mine includes 6 claims in sec. 23 (projected), T. 17 S., R. 40 E., 11.8 miles N. 5° W. of Darwin at an altitude of 5,280 feet. Mrs. Agnes Reid of Panamint Springs owns the mine, and it is leased to Albert F. Glenn. A view of the mine area is shown in photo 7. The mine, formerly known as the Emigrant mine, was one of the early silver producers. Its history has been marked by many small-scale operations by lessees and intermittent periods of inactivity. The main production probably was during the 1870's and early 1880's, but no production records are available for this period. An early description of the mine by Burchard (1884, p. 163) is given below:

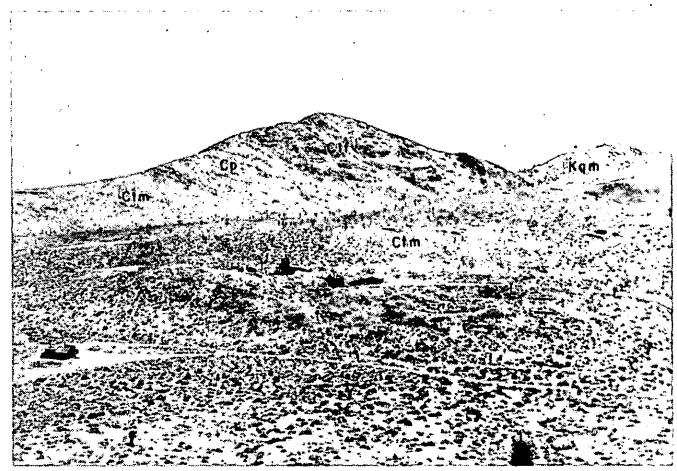


PHOTO 7. View looking south at the Lee mine. The Tin Mountain limestone (Ctm), Perdido formation (Cp), Lee Flat limestone (Clf), and quartz monzonite (Kqm) are in the distance.

"Emigrant mine with a shaft 100 feet in depth and lateral drifts which show a vein 4 feet wide, with a rich streak of gold and silver on both walls. On the hanging wall side the streak is 6 inches and on the footwall side 12 inches. Assay $200 per ton. The ore is sacked and shipped to San Francisco."

This description probably refers to the inaccessible shaft and workings on the major steep northeasterly dipping vein west of the present main shaft. Some of

CERRO GORDO IS IN LOST BURRO FORMATION

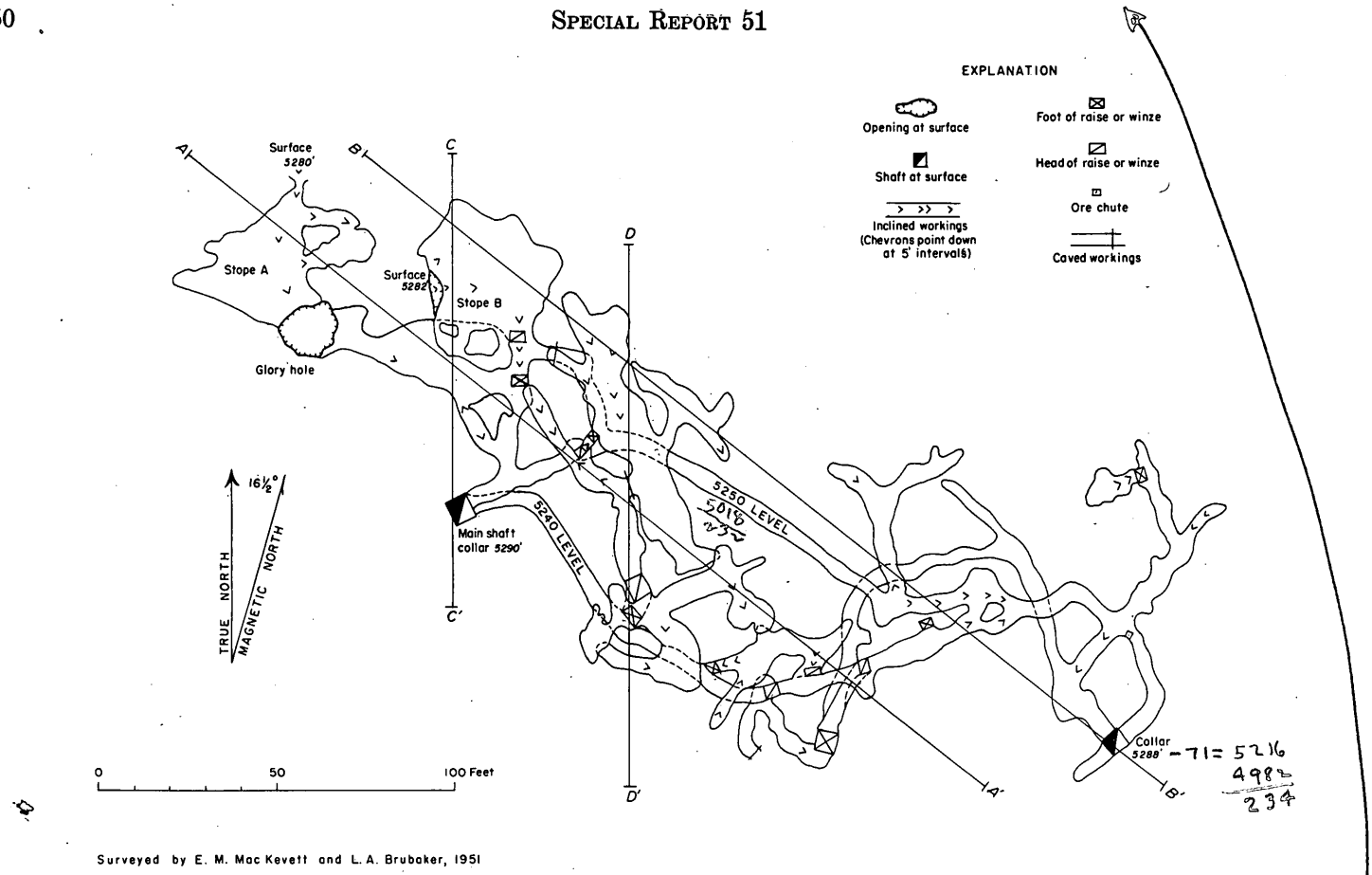


FIGURE 17. Composite map of the underground workings of the Lee mine.

the early Lee mine ore probably was milled in Mill Canyon at the site marked by the ruins of an old mill about 7 miles northeast of the Lee mine. Water was obtained from Lee pump about 8 miles northeast of the mine. DeGroot (1890, p. 213) mentions that the Lee district was waning by 1888.

The available production data probably account for only a minor part of the total output. During 1937, 250 tons of ore was shipped that averaged $49.00 per ton in silver (Tucker and Sampson, 1938, p. 443). Louis Warnken, Jr., shipped 226 tons of dump material in 1938 that contained 750 ounces of silver and 2 ounces of gold (production records of the U. S. Bureau of Mines). Recent production data are summarized below.

*Table 11. Recent ore production from the Lee mine.**

Year	Tons	Copper (percent)	Lead (percent)	Zinc (percent)	Silver (oz/ton)	Gold (oz/ton)
1951	41	0.4	2.4	16.3	61.3	0.025
1951	35	0.25	1.5	17.6	48.0	0.025
1952	44	0.45	1.5	22.75	89.76	0.035
1953	35	0.425	9.85	21.05	93.95	0.037
1953	42	0.24	7.9	17.75	59.6	0.025
1954	49	0.2	4.5	24.0	53.9	--

* Published with the permission of the mine owner.

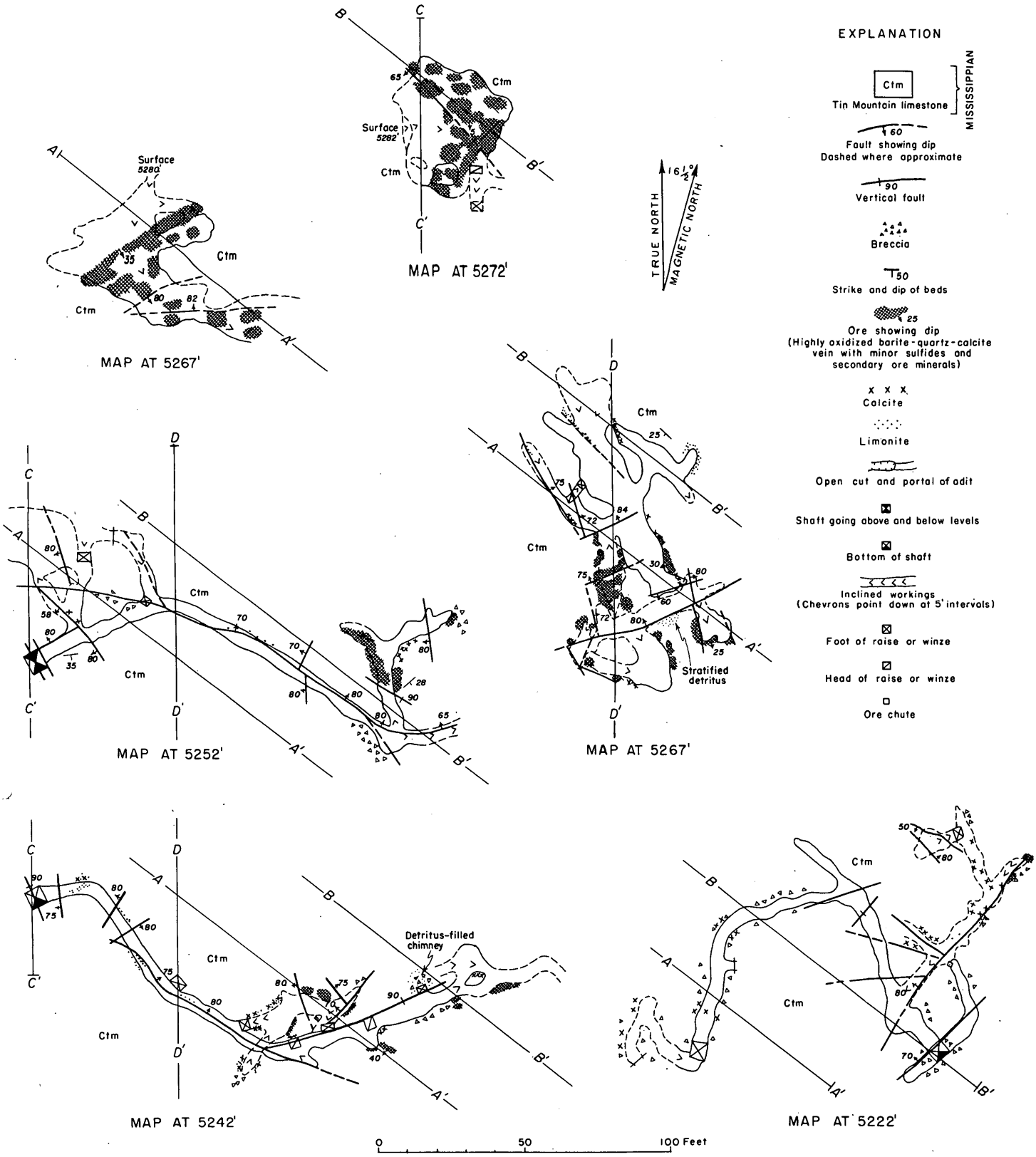
THRU 1961 - 30,000

Accessible workings in the main mine consist of more than 1,000 feet of levels and inclines and several thousand square feet of stopes (fig. 17). In addition, numerous inaccessible shallow workings adjoin the main workings on the northwest. The West Workings consist of two short adits and an inaccessible shaft.

The Lee mine area is underlain predominantly by the Tin Mountain limestone of Mississippian age (pl. 8). The Lost Burro formation of Devonian age is exposed in the northern part of the mine area and conformably underlies the Tin Mountain limestone. The Perdido formation conformably overlies Tin Mountain limestone in the southern part of the mine area and is overlain by a thin flow of olivine basalt.

The Lost Burro formation exposed in the mine is white, medium- to coarse-grained marble with thin bands of dark-gray marble. Some of the marble exposed in the deepest mine workings may be part of the Lost Burro formation, although it is more likely bleached Tin Mountain limestone. The Tin Mountain limestone is a medium-gray, fine-grained limestone in beds half a foot to 2 feet thick. Dark-gray chert nodules and lenses are moderately abundant throughout the formation. The limestone contains sparsely distributed tremolite crystals. All the known ore deposits at the mine are within the lower part of the Tin Mountain limestone. The Perdido formation consists of medium-gray limestone interlayered with beds of dark-gray chert.

The Paleozoic rocks lie in a concordant sequence that strikes generally between N. 70° W. and west and dips predominantly 20° to 40° SW. Most faults in the area strike parallel with bedding; the most conspicuous set dips steeply northeast. Examples are the West fault and the large faults along the 5,240 and 5,250 levels (fig. 18). Where evidence is obtainable, these faults can be shown



Mapped by E. M. MacKevett and L. A. Brubaker, 1951

FIGURE 18. Geologic maps of the underground workings of the Lee mine.

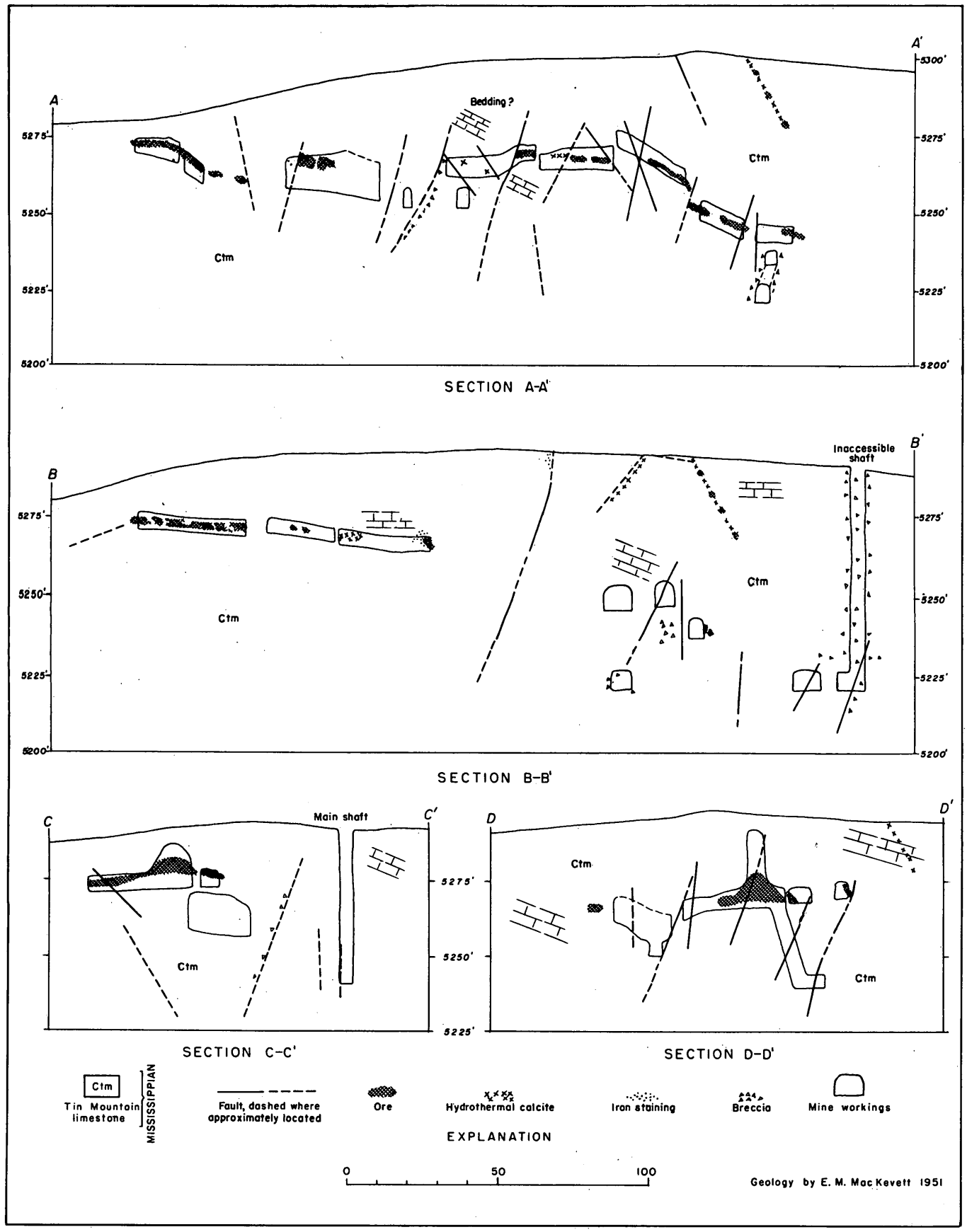


FIGURE 19. Geologic sections of the Lee mine.

to be normal faults. The cumulative dip slip of the West fault and two similar faults south of it is about 50 feet. Another less prominent fault set strikes parallel with bedding and dips steeply southwest. Minor bedding-plane faults are present locally.

The rocks are brecciated and shattered in the vicinity of the main workings. Some of the brecciated rocks are chimneylike and have a long vertical dimension; for example, the breccia at the inaccessible shaft 100 feet S. 70° E. of the main shaft is at least 70 feet long in vertical dimension. Well-stratified subrounded material ranging in size from fine sand to pebbles occurs at two places in the mine in vertical pipelike bodies about 7 feet in diameter circumscribed by near-vertical slickensides. Some ore fragments are in the breccia. Both the chimneylike breccias and the detritus-filled chimneylike bodies are believed to be formed by the solution of limestone during a period of abundant rainfall and the subsequent collapse of the overlying rock. The well-stratified material was deposited in the solution cavities prior to the collapse.

Ore occurs as discontinuous, flat-lying bodies that are in part controlled by bedding or bedding-plane fractures. The size and shape can best be inferred from the dimensions of the old stopes (figs. 18, 19). The largest stopes are about 1,400 square feet in area, about 16 feet in maximum height, and 6 feet in average height. Ore bodies exploited in recent years were considerably smaller, and, in general, yielded between 50 and 100 tons of ore each.

Most of the ore is oxidized and only relicts of the primary minerals remain. Hemimorphite is the most abundant ore mineral. It is in radial and divergent aggregates of light-gray to colorless crystals associated with cerargyrite, which economically is probably the most important mineral. The cerargyrite is in euhedral olive-green crystals that are cubes 0.2 mm on a side modified by octahedral faces. In addition aurichalcite, azurite, bindheimite, cerussite, chrysocolla, and native copper have been identified.

Galena is the most abundant primary ore mineral. It is present as relicts 1 inch to 4 inches in diameter surrounded by oxidized ore minerals. Cerussite and anglesite are found only where relict galena is evident. Minor amounts of sphalerite, pyrite, and tetrahedrite are in the primary ore. The sphalerite is in irregularly shaped fragments as great as an inch in maximum dimension and is a resinous light brown. Barite, quartz, calcite, and chalcedony are the principal gangue minerals and gypsum and clay minerals are in small quantities.

The most important ore bodies are near fault zones where the rocks are in part brecciated and shattered. Although most ore bodies are shallow dipping and generally conform to bedding, locally they steepen and apparently transect bedding. Some of this steepening may be a drag effect of post-ore faulting. The favorable ore zone occupied by the discontinuous ore bodies plunges gently to the southeast (see fig. 19, section A-A′).

Where steep northeast-dipping faults, such as the West fault, are mineralized, they contain abundant quartz, calcite, yellow and brown ocherous iron oxides, and chalcedony, but they contain little ore minerals. Movement on the steep faults was probably instrumental in forming open fractures parallel to bedding that served as locii for ore bodies, but the steep fractures served only as channelways for the ore solutions. Slickensided selvages and local shattering indicate some post-ore movement. The northeast-dipping fractures in places offset the shallow-dipping ore bodies of the main workings.

Santa Rosa Mine

The Santa Rosa mine is in secs. 26 and 35 (projected), T. 17 S., R. 39 E., in the southern part of the Inyo Mountains at an altitude of 6,500 to 7,100 feet. The mine is described in detail by Mackevett (1953), and his report is summarized here.

Workings consist of the 352-foot Hesson inclined shaft, several shallower shafts, about 1,500 feet of drifts and crosscuts, and extensive stopes. In addition, an 1,800-foot westerly trending crosscut adit was driven in 1953 to explore the known veins at greater depth.

The mine is the eighth largest lead producer in the State. From the time of its discovery in 1910 until 1950 the mine produced 36,854 short tons of ore containing 11,990,792 pounds of lead, 487,347 pounds of copper, 4,105 pounds of zinc, 426,543 fine ounces of silver, and 478.7 fine ounces of gold (Mackevett, 1953, p. 4). Lessees have mined some ore from the new deeper workings since 1953.

The mine is within an inlier of the lower limestone member of the Owens Valley formation of Permian age that has been metamorphosed to calc-hornfels. The inlier is approximately 2,000 feet long and 600 feet wide. It is encircled by Tertiary and Quaternary volcanic rocks consisting of olivine basalt, tuff, tuff-breccia, agglomerate, and andesite. The calc-hornfels is a dense, fine-grained rock that is greenish-gray on fresh surfaces and weathers brown. It consists mainly of calcite, quartz, and diopside and minor amounts of zoisite, garnet, epidote, limonite, and opaque minerals. Minor beds of unsilicated bluish-gray limestone that are locally fossiliferous are interbedded with the calc-hornfels.

Andesite porphyry dikes, which were called syenodiorite porphyry by Mackevett (1953), are 2 to 6 feet thick, strike N. 70° W., and dip nearly vertical. These dikes cut the Owens Valley formation of the inlier but do not cut the adjacent volcanic rocks. Northeast-trending, steeply dipping basalt dikes 2 to 16 feet thick cut both limestone and volcanic rocks.

The inlier of calc-hornfels is structurally a horst. The Santa Rosa fault bounds the inlier on the east, and another steep fault forms part of the western boundary of the inlier. The Santa Rosa fault is a north-trending normal fault that dips about 80° E. The east block has been downfaulted probably at least 250 feet. Rocks of the inlier strike N. 10°-20° W. and dip 30°-70° NE. Faults of prevolcanic age within the inlier contain the ore-bearing veins. The most important faults strike parallel with bedding and dip 30° to 60° SW. Some of the ore-bearing faults strike parallel with bedding and dip 55° to 80° NE. or strike about east and dip nearly vertically.

Ore is in veins within prevolcanic faults. At least 12 veins are exposed. They range from less than 100 feet to 700 feet in length and average between 3 and 4 feet in thickness. West-dipping veins are the most abundant and productive. Fissure filling was the dominant process involved in the emplacement of the veins.

"LEE"

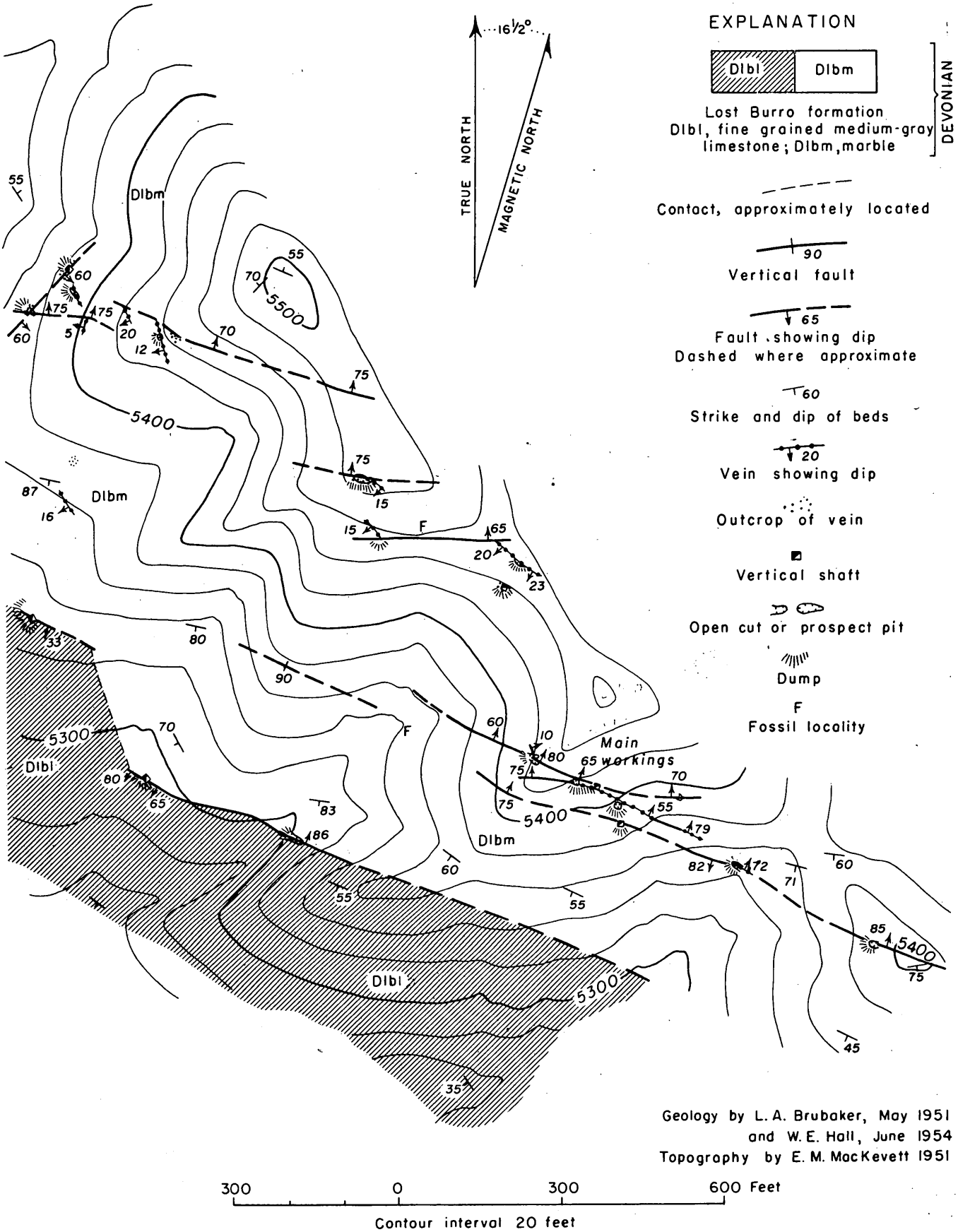


FIGURE 20. Geologic map of the Silver Reid prospect.

The veins are highly oxidized and consist chiefly of cerussite and hemimorphite in an iron-stained silica- and calcite-rich gangue. The primary ore is composed mainly of pyrite, sphalerite, and galena with subordinate arsenopyrite and chalcopyrite. The grade of ore within a vein is erratic, and the richest ore occurs in shoots in the thicker parts of veins. Outlines of workings indicate that most of the production from the Hesson vein, economically the most important vein, was from a shoot that raked gently to the north.

An adit was driven under the mine workings by The Anaconda Company to explore the veins at depth. The adit was driven westerly 1,800 feet at an altitude of about 6,580 feet from the sharp bend in the road at the foot of the tramway from Upper Sanger workings. (See Mackevett, 1953, pl. 2.) The adit is completely in calc-hornfels. The ore showings in the adit are sparse. Most of the veins have pinched out above the level of the adit, but some zinc-rich primary ore was discovered and was being mined in 1955.

Silver Reid Prospect

The Silver Reid prospect is 12.5 miles north of Darwin in the southeastern part of the Santa Rosa Hills in sec. 23 (projected), T. 17 S., R. 40 E. The prospect is accessible by a dirt road that leads from the Saline Valley road 1 mile east to the Lee mine; the property adjoins the Lee mine on the north. The surface geology was mapped by L. A. Brubaker and E. M. Mackevett in May 1951 and additions were made by W. E. Hall in July 1953.

The Silver Reid prospect was staked in 1924 by W. A. Reid, and it is now owned by his widow, Mrs. Agnes Reid of Panamint Springs, Calif. The property has been prospected intermittently since 1924, and by 1951, development work consisted of about 25 shallow pits and shafts and several near-surface stopes. No production has been recorded from the property, but a small production may have been lumped with that of the Lee mine.

The Lost Burro formation of Devonian age crops out in the prospect area (fig. 20). It is conformably overlain by Tin Mountain limestone of Mississippian age south of the prospect at the Lee mine, and it is unconformably overlain by flat-lying basalt of Tertiary or Quaternary age and by alluvium to the west and north of the prospect. A section 1,500 feet thick of the Lost Burro formation is exposed in the area. It consists of white, medium- to coarse-grained marble that is characteristically banded parallel to bedding and contains streaks and thin beds of dark-gray marble less than an inch thick. Quartzite lenses are locally in the white marble. Fine-grained, medium-gray limestone beds as much as 50 feet thick are interbedded with the white marble in the northeast part of the prospect area near the base of the exposed section of Lost Burro. Thin

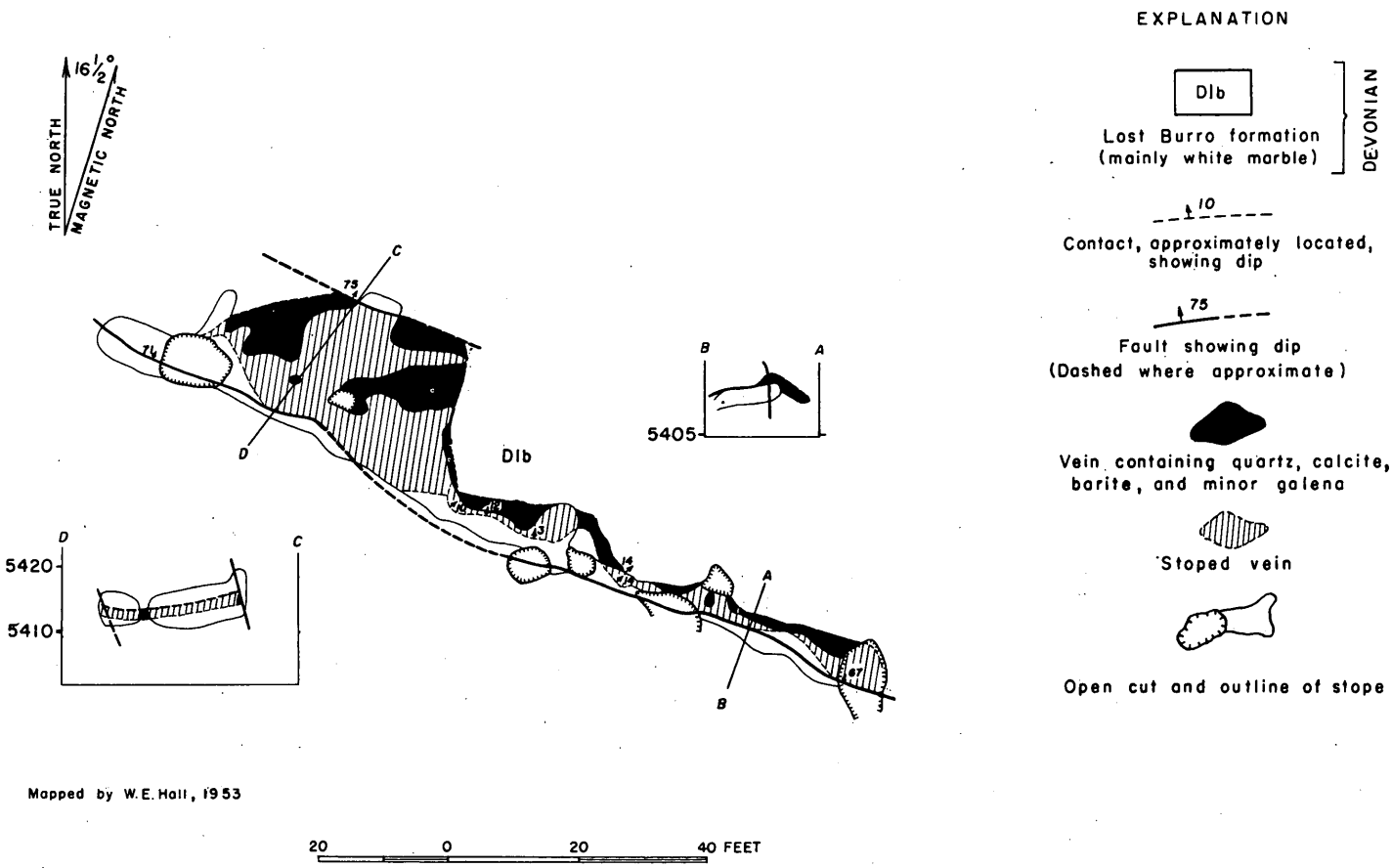


FIGURE 21. Geologic map of the main stope of the Silver Reid prospect.

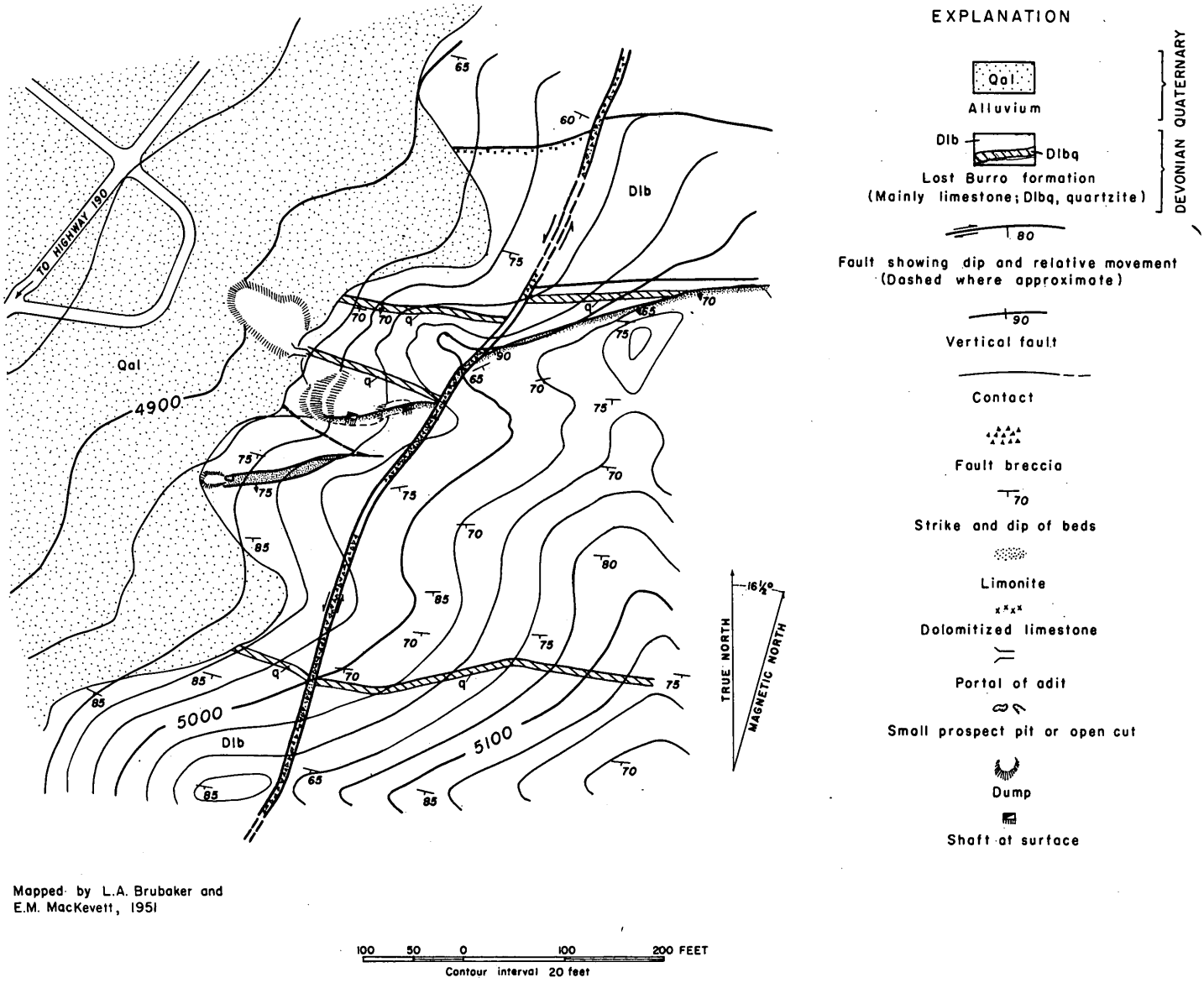


FIGURE 22. Geologic map of the Cactus Owen prospect area.

chert interbeds are abundant in the medium-gray limestone near the base of the exposed section.

Bedding in the Lost Burro formation strikes N. 45° W. to west and dips southwest to south from 35° to 87° except for local steep northeast dips near the crest of the hill. Two sets of faults are evident in the mine area. One set strikes about N. 70° W., approximately parallel to the strike of bedding, and dips steeply either to the north or south. The other set strikes N. 20°-70° W. and dips gently southwest. The flat faults have no appreciable displacement and are probably fractures formed by differential movement along the steep major faults. The major faults strike parallel to bedding, but in general dip more steeply than bedding. They are believed to have mainly a strike-slip displacement.

Ore is localized in small bodies in flat-lying faults near major steeply dipping faults striking N. 60°-80° W. Most of the steep faults are only slightly mineralized. The largest known ore body has been stoped over an area 40 feet long and 20 feet wide, and it has an average thickness of 2 feet (fig. 21). At least five other flat veins are exposed on the surface or in shallow prospect pits (fig. 20) to the northwest of the main stope, but none are extensively developed.

At a few places the steep N. 60°-80° W. faults localize the vein material. At the west side of the Silver Reid prospect an inclined shaft has been driven to a depth of 56 feet on a N. 70° W.-striking fault. At the surface the fault shows little mineralization, but a 30-foot drift at the bottom of the inclined shaft exposes a vein 2 to 3 feet thick, and a winze has been driven on the vein to a depth of 10 feet below the level. The steeply-dipping vein is similar in mineralogy to the flat-lying veins.

The veins consist of minor galena and pyrite in a gangue of quartz, calcite, and barite. Secondary copper minerals and a yellow antimony mineral, probably bindheimite, are present locally. No silver minerals were seen.

Little data are available about the grade of the ore. Albert Glenn (oral communication, 1954), lessee of the adjoining Lee mine, sampled the dump near the Main stope and reports the sample assayed 18 ounces of silver per ton.

Mines and Prospects in the Talc City Hills

Cactus Owen (Midway) Prospect

The Cactus Owen prospect is in sec. 25 (projected), T. 18 S., R. 39 E., on an isolated hill 1½ miles N. 70° W. of the Talc City mine, at an altitude of 5,000 feet. The prospect has no recorded production. Workings consist of inclined shafts 40 and 200 feet deep, a short adit, and about 300 feet of levels.

Limestone and quartzite of the Lost Burro formation of Devonian age crop out in the prospect area (fig. 22). The limestone is a light-gray, bleached rock in beds 1 foot to 4 feet thick. It is recrystallized and shows evidence of intense deformation. Several quartzite beds 1 foot to 12 feet thick are interbedded with the limestone. The quartzite is medium-gray on fresh surfaces and weathers light brown.

The sedimentary rocks strike N. 80° W. to west and dip steeply south. They are cut by a steep fault that strikes N. 20°-30° E. The fault is marked by an iron-stained breccia zone about 10 feet thick. Other faults are parallel or nearly parallel to bedding. They are iron stained and in some places have local pockets of quartz and calcite. Workings have mainly developed the bedding-plane faults.

The only ore minerals observed were found on the dump and consisted of a few scattered galena fragments associated with quartz and minor quantities of pyrite and specular hematite. Calcite commonly coats and veins quartz. Minor gossan is exposed in a few places but appears barren of ore minerals.

Homestake Mine

The Homestake mine is 2,000 feet northwest of the Talc City mine in sec. 30 (projected), T. 18 S., R. 40 E., at an altitude of 5,520 feet. The mine is owned by Edith Lockhart and George Koest. Workings at the Homestake number 1 claim consist of inclined shafts 50 feet and 150 feet deep and workings on the adjacent Homestake number 2 claim include a 45-foot adit trending S. 33° W. and a 100-foot drift trending N. 45° W.

The country rock is thin-bedded bluish-gray limestone of the Lost Burro formation that strikes N. 70° W. and dips 70° SW. The mine workings follow major shear zones. The major structure at the Homestake number 1 claim is a shear zone 2 to 10 feet thick that strikes N. 40° W. and dips 70° SW. The upper workings are on quartz-rich shear zones as much as 6 feet thick that strike N. 45° W. and N. 33° E. and dip steeply south. The sheared limestone is iron stained and is locally replaced by dolomite. In places the shear zones are replaced by pockets of quartz and minor calcite, cerussite, hemimorphite, and oxidized copper minerals.

Silver Dollar (Domingo) Mine

The Silver Dollar mine is 2,600 feet east of the Talc City mine in sec. 29 (projected), T. 18 S., R. 40 E., in the eastern part of the Talc City Hills at an altitude of 5,500 feet. It is owned by Edith Lockhart and George Koest, mailing address Darwin, Calif. Early mining operations were for lead and silver, but in recent years talc deposits have been exploited on some of the claims. Production data from the files of the U. S. Bureau of Mines, San Francisco office, for the metalliferous deposits are given below. These data are given under the name Domingo, a former name of the mine. George Koest provided much of the following historical information.

*Table 12. Ore produced from the Silver Dollar (Domingo) mine.**

Year	Gold (oz)	Silver (oz)	Copper (lbs)	Lead (lbs)
1910	--	5,360	--	107,000
1911	1.79	12,247	-	326,578
1913	1.45	1,117	--	35,374
1915	--	970	229	830

* Production figures furnished by the U. S. Bureau of Mines and published with the permission of the mine owners.

Ore was first discovered on the property in 1910 at the site of the main pit and all the recorded production was made during the ensuing five years. During late 1910 and early 1911 a shaft, sunk to a reported depth of 90 feet, explored a vertical vein on the south side of the main pit. During the next four years, lessees enlarged the main pit and drove short drifts along a vein dipping to the northeast, backfilling the original shaft. This northeast-dipping vein was followed for 100 feet down the dip before work was abandoned in 1915. During the late 1930's the present owners sunk a 130-foot shaft 100 feet east of the main pit. Crosscuts were driven from the bottom of the shaft to points under the main pit, but no ore was found. The main talc workings consist of a 75-foot inclined shaft with several hundred feet of drifts and crosscuts.

The Silver Dollar mine is in a complexly faulted area underlain by the Lost Burro formation of Devonian age and the Keeler Canyon formation of Pennsylvanian and Permian age (fig. 23). Minor Rest Spring shale of Pennsylvanian age crops out in fault zones. The Lost Burro formation consists mainly of massive light-gray dolomite but includes some medium-bedded, light-bluish gray limestone and minor quartzite. The Rest Spring shale is a dark-brown fissile shale that is localized along a thrust plane. Bluish-gray thin-bedded cherty limestone of the Keeler Canyon formation is the host rock for the lead-silver ore.

The Devonian rocks are thrust over the Rest Spring shale and the Keeler Canyon formation. The best exposure of the thrust fault is about 300 feet north of the main pit where the Lost Burro formation overlies the Rest Spring shale. Numerous steeply dipping faults that strike about N. 50° W., approximately parallel to bedding, displace the thrust fault. Some of the northwest-trending faults contain dragged and shattered quartzite. Rocks in the thrust plate are strongly folded. The contact of limestone and dolomite 175 feet southeast of the main pit is parallel to bedding, and the structure is a faulted inverted syncline.

Ore from the main pit probably accounts for almost the entire mine production. The ore is in limestone of Pennsylvanian and Permian age in a fault zone that strikes N. 55° W. and dips steeply northeast. Judging

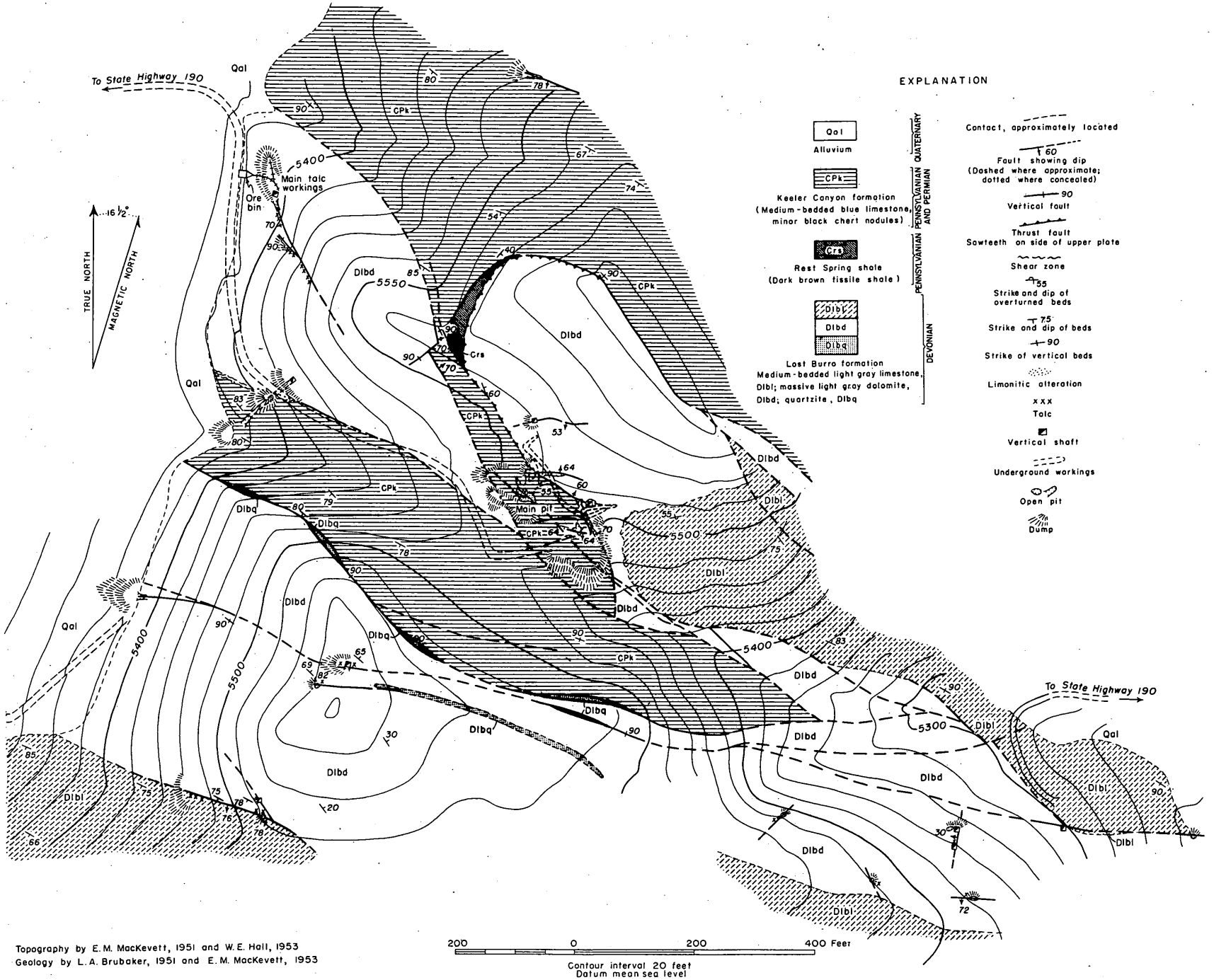


FIGURE 23. Geologic map of the Silver Dollar mine area.

from the size and shape of the main pit, the main ore body was about 35 feet long, 30 feet thick, and extended 90 feet down dip. Little ore remains in any of the workings, but many faults in the mine area are strongly iron stained and contain quartz, calcite, and jasper. A combination of abundant local faulting and shattering and a favorable host rock probably accounts for the localization of ore at the main pit. No data are available regarding the tenor of the ore.

The talc deposits are within dolomite of the Lost Burro formation 650 feet northwest of the lead-silver ore. The talc is in strongly sheared masses in a fault zone that strikes N. 20° W. and dips 70° SW. The deposits were not mapped. The talc is pale green and is finely laminated by shearing. Locally it contains some chlorite. Several of the N. 70° W.-trending faults in the southern part of the map area contain talc and they have been explored by small pits (fig. 23).

Tungsten Deposits

by W. E. Hall, E. M. Mackevett, and D. M. Lemmon *

Distribution

Tungsten in the mineral scheelite has been recovered in the Darwin quadrangle principally from mines in secs. 18 and 19, T. 19 S., R. 41 E., in the east part of the Darwin Hills 1 mile to 1½ miles east and northeast of Darwin. Stolzite has been reported by Tucker and Sampson (1941, p. 567). However, D. M. Lemmon submitted similar material to Jewel Glass of the U. S. Geological Survey as that from which stolzite was reported, and the material was identified as scheelite mixed with other minerals but it contained no stolzite. Some scheelite is present in the Thompson mine of the Darwin group, but it is intimately associated with galena and difficult metallurgical problems have discouraged efforts to recover it except from local high-grade concentrations that were mined selectively and given special metallurgical treatment. A small amount of scheelite has been mined from deposits on the northeast slope of the Coso Range about 8 miles west and southwest of Darwin. All but one of these deposits, the Lone Pinyon, which lies within the quadrangle in sec. 26, T. 19 S., R. 39 E., are south of the Darwin quadrangle (pl. 1).

Some of the deposits in the Darwin district contain both scheelite and lead-silver minerals or scheelite and copper minerals. The Custer, Defiance, Fairbanks, Jackass, Lane, Promontory, Standard, Thompson, and Wonder mines have both lead-silver and tungsten minerals. These properties, which were developed mainly for their lead-silver ore, are described under the heading, "lead-zinc-silver deposits".

History and Production

Although scheelite was recognized in the Darwin silver-lead district during World War I, the deposits remained undeveloped until 1940. At this time Frank Watkins purchased a group of patented claims on the east side of the Darwin Hills at a tax sale, relocated additional claims, and with C. W. Fletcher and others organized the Darwin Consolidated Tungsten Company to develop the tungsten. In 1941 the E. L. Cord interests under the name Pacific Tungsten Company leased 23 mining claims from the Darwin Consolidated Tungsten Company, and during the ensuing twelve months they produced 30,940 tons of ore that averaged about 1 percent WO_3 (Wilson, 1943, p. 544). The ore was treated at a mill near Keeler owned by the West Coast Tungsten Corporation. This production was principally from the Durham, Fernando, St. Charles, and Hayward claims. Possibly 25,000 tons of tungsten ore has been mined in the district from 1944 to 1955.

Howard Miller and Louis Warnken leased the Durham-Fernando and St. Charles groups of claims from 1951 to 1953, and the Hayward and St. Charles group during 1951-1955. They erected a mill in Darwin Wash from which they recovered approximately 2,475 units of WO_3 from 1952 through 1954. The Ajax Tungsten Corporation, C. H. Hall, president, obtained a lease on the Durham and Fernando properties in 1954 and shipped some ore.

The scheelite in the Thompson mine of the Darwin group normally is not recovered except from local concentrations of high-grade ore that are mined selectively. Davis and Peterson (1948, p. 2) report that several hundred tons of high-grade scheelite ore containing 10 to 15 percent WO_3 have been mined, and scheelite was being stockpiled at the Darwin mine in March 1955. This high-grade ore was shipped to Tooele where it was fused with sodium carbonate and then leached with hot water for recovery of WO_3.

Some deposits about 1 mile east and southeast of Darwin were located originally in the 1890's for their copper showings, but they were operated briefly during World War II for tungsten. These include the Alameda and Toga claims. The Alameda claim is mentioned as a copper prospect by Aubury (1908, p. 313) under the name Richardson group, and part of the Toga claim is probably part of the Kingman claim described by Aubury (1902, p. 245).

Acknowledgments and Previous Work

The eastern part of the Darwin Hills, where the tungsten deposits are located, was mapped by Kelley (1938, pl. 7) as part of his study of the Darwin silver-lead district. He identified scheelite on the Bruce claim. A U. S. Geological Survey party under D. M. Lemmon studied the tungsten deposits from Nov. 3, 1941 to March 4, 1942. They mapped the Durham-Fernando-St. Charles area on a scale of 1 inch equals 200 feet and made larger scale maps of the underground workings. Their maps are published in this report, and with additional data supplied by Lemmon serve as the basis for the description of the tungsten deposits. The writers mapped the recent workings in the Fernando and St. Charles mines. The U. S. Geological Survey party under D. M. Lemmon also mapped the tungsten prospects in the Coso Range in Feb. 1942.

L. K. Wilson (1943, p. 543-560), geologist for the Pacific Tungsten Company, described the tungsten deposits in the Darwin district, their genesis, and the operations of the Pacific Tungsten Company from 1941 to 1943. The U. S. Bureau of Mines under D. W. Butner (1949, p. 2), project engineer, trenched and sampled nine properties in the Darwin district in 1941-42. Most of this work was done at the Silver Reef mine, owned by Mickey Summers' estate, at the south end of the

* Geologist, U. S. Geological Survey.

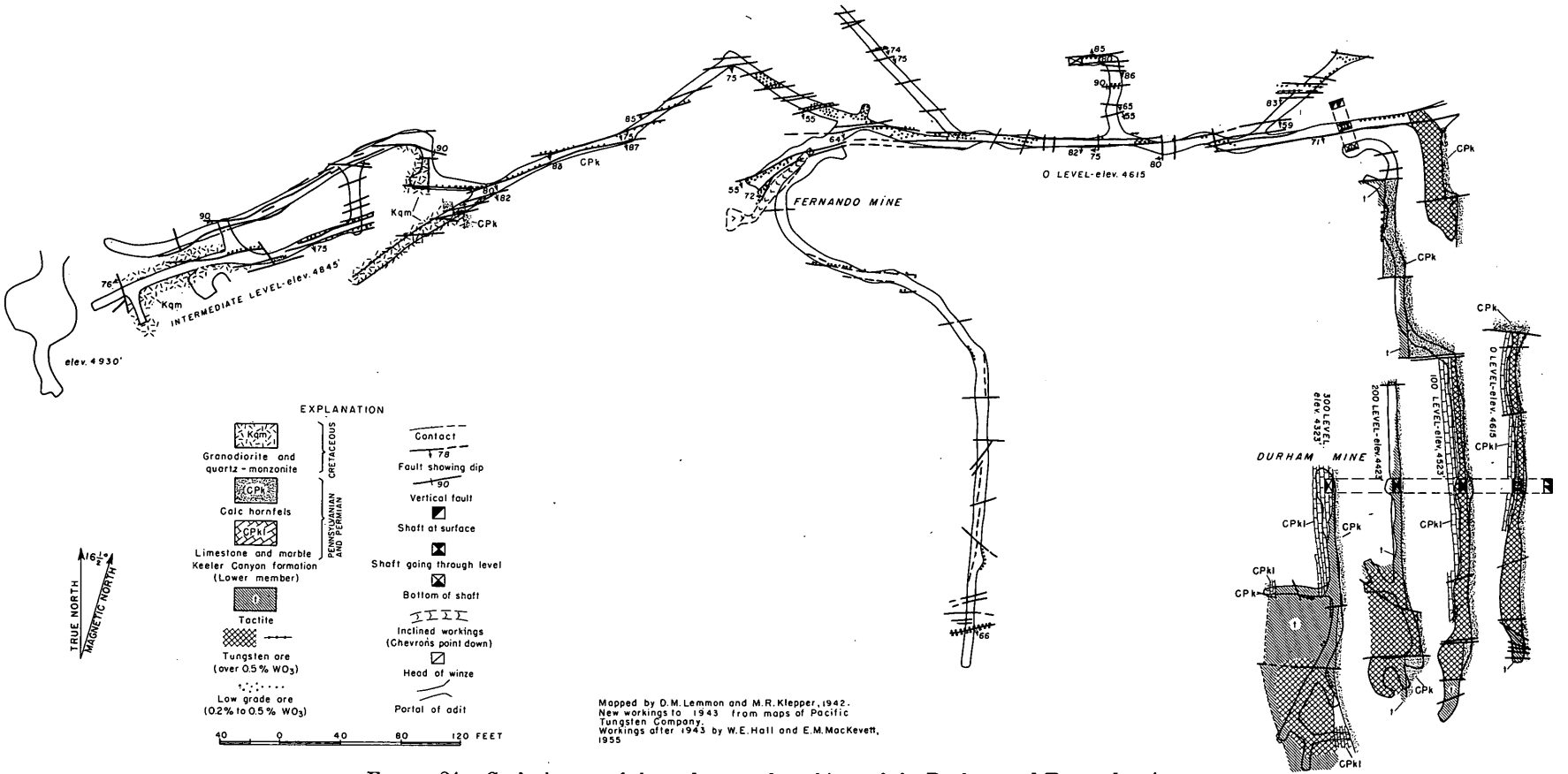


FIGURE 24. Geologic map of the underground workings of the Durham and Fernando mines.

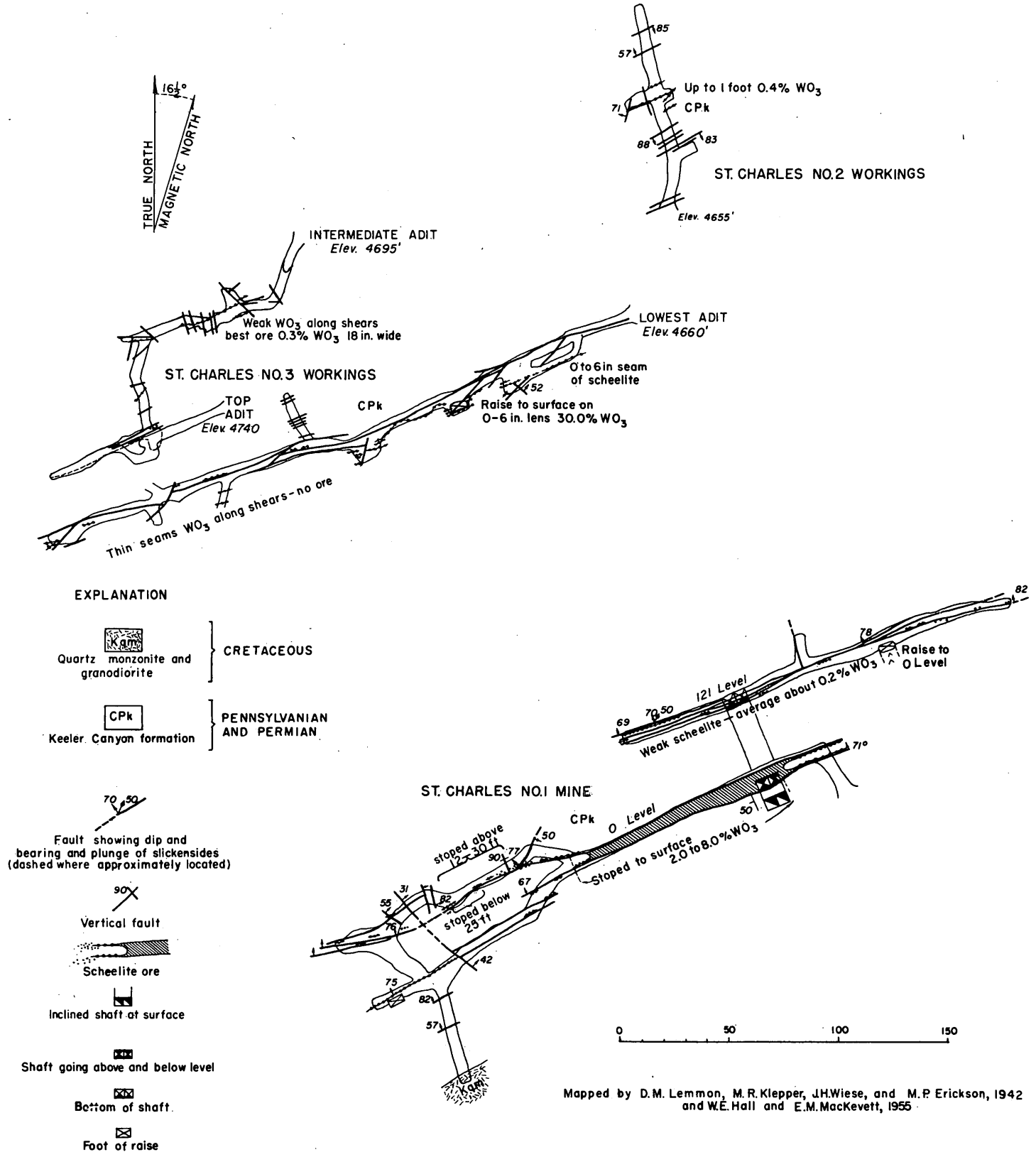


FIGURE 25. Geologic map of the underground workings of the St. Charles mine.

Darwin Hills south of the Darwin quadrangle, but some work was done on all the principal tungsten showings in the Darwin Hills.

Deposits in the Darwin District

Geologic Setting

Most of the tungsten deposits in the Darwin district are within metamorphosed rocks of the upper part of the lower member of the Keeler Canyon formation of Pennsylvanian and Permian age close to the eastern contact of the stock of the Darwin Hills. The rocks consist of calc-hornfels, marble, and tactite that are metamorphosed equivalents of interbedded silty and sandy limestone, limy shale, and pure limestone. The metamorphosed zone extends about 3,000 feet east of the stock. The calc-hornfels is derived from limy shale and silty and sandy limestone. The relatively pure limestone beds are in part unmetamorphosed, but in most places they are recrystallized to marble or altered to tactite.

Calc-hornfels is the predominant rock type. It is a light-gray to greenish-gray dense rock with a wide range in mineralogy depending upon the original composition of the rock. In general, the calc-hornfels is composed of diopside and wollastonite with lesser amounts of garnet, oligoclase, scapolite, tremolite, and relict calcite. The pure limestone beds are partly recrystallized to a gray, medium-grained marble. Locally the marble and limestone are replaced by tactite within a few hundred feet of an intrusive contact close to the intersection of faults. Most of the tactite is a garnet- or idocrase-rich rock, but some contains epidote, diopside, wollastonite, and calcite. The garnet is andradite.

The eastern contact of the stock of the Darwin Hills is very irregular. Many small dikes and sills extend as far as 1,500 feet east of the main intrusive body, and the tungsten deposits are localized close to these offshoots. A group of dikes and small, irregular intrusions extend east of the main stock on the St. Charles claims. A sill of quartz monzonite is 160 feet east of the Durham glory hole, and an irregular intrusion crops out along the ridge between the Durham and Chipmunk mines (pl. 9).

The Paleozoic rocks have been tilted into an overturned section that strikes north and dips 30° to 78° W. as described under the subtopic "Geology" in the section on the Darwin lead-silver-zinc district. Numerous faults that strike N. 60° E. to east and dip steeply either north or south cut the rocks, but the displacement along the faults is small. Slickensides are nearly horizontal, and the displacement is predominantly left lateral.

Ore Bodies

Scheelite ore bodies are found as replacements of pure limestone and tactite beds close to the intersection with N. 70° E.-striking faults and within the N. 70° E. faults mostly where the wall rock is pure limestone or tactite. Most of the ore is found within 3 limestone beds locally known as the Durham, Frisco, and Alameda beds (pl. 9). Only the Durham ore body is known to extend more than 60 feet vertically (fig. 24). The Durham and Alameda ore bodies are replacements of pure limestone and tactite beds close to the intersections with the Fernando shear zone. The Durham ore body is a replacement of the footwall of the Durham limestone bed where it is in contact with calc-hornfels. The ore body is exposed for 350 feet at the surface and has been mined to a depth of 350 feet where the ore body is only 30 feet long (fig. 24). Its thickness ranges from 2½ to 35 feet.

Three ore bodies that are replacements of the Alameda bed near N. 70° E. faults have been mined. Two are at the intersection of the Alameda bed with the Fernando shear zone; the third is 1,000 feet northwest of the Fernando shear at the Alameda shaft. The largest of these ore bodies is at the intersection of the Alameda bed with the Fernando shear 950 feet S. 80° W. of the portal of the Fernando adit. It has been developed by an open cut 50 feet long parallel to the strike of the enclosing limestone, 60 feet wide, and about 20 feet deep. A drift was being driven in 1955 under the pit to develop ore that remained at the bottom.

The ore in the St. Charles-Hayward area is in N. 70° E. faults that dip steeply to the northwest (pl. 9). The largest ore body is developed by the St. Charles No. 1 workings (fig. 25). The ore shoot was 140 feet long, 2 to 10 feet thick, and was mined from the surface to an average depth of about 30 feet. Most of the scheelite exposed in the St. Charles No. 2 and St. Charles No. 3 workings is in thin veins or streaks along N. 70° E. faults, and no scheelite is disseminated in the wall rock between faults (fig. 25). The streaks range from a fraction of an inch to 6 inches thick and can be mined only by highly selective methods or where fractures are sufficiently close that several can be mined together. Some of the streaks contain 10 to 30 percent WO_3, but the grade of ore over a mining width would probably average only about 0.2 to 0.3 percent WO_3.

Grade

The grade of ore mined from the district has averaged about 0.75 percent WO_3. Wilson (1943, p. 558) reports that from 1941 to 1942 approximately 32,000 tons of ore averaging more than 1 percent WO_3 was mined from the Darwin Hills. The ore at the Durham mine averaged 1 percent WO_3 over an average width of 15 feet on the 200-foot and 300-foot levels (Wilson, 1943, p. 558). The grade of ore at the St. Charles No. 1 mine was high and ranged from 2 to 10 percent WO_3. Ore mined since 1951 averaged about 0.5 percent WO_3.

Submarginal ore is present at the Fernando mine and to a lesser extent at the St. Charles No. 3 mine. The submarginal ore at the Fernando mine is exposed in the main Fernando adit along the Fernando shear zone (fig. 24). Scheelite is localized along fractures over a length of 610 feet and a width up to 50 feet; some parts of this area are estimated to contain 0.2 to 0.5 percent WO_3.

Ore Controls

The ore controls for scheelite are both stratigraphic and structural. Pure limestone, and tactite formed as an alteration of it, are more favorable for ore than dense calc-hornfels. However, the dense calc-hornfels cannot be eliminated as a possible host rock as some ore has been mined from it. The bedded replacement body at the Durham mine selectively replaced tactite and pure limestone. Most other occurrences of scheelite in the district are along N. 70° E.-striking faults, and scheelite may be

present whether the wall rock is tactite, limestone, or calc-hornfels. Commonly the scheelite zone is widest where a fault cuts tactite and thins to a narrow stringer where the fault cuts calc-hornfels. In both the St. Charles No. 1 workings and in the Hayward mine, ore has been mined from veins where the wall rock is calc-hornfels. At the Hayward mine the ore is widest where the wall rock is tactite, and the vein thins to a thin stringer to the east where the wall rock is calc-hornfels. The ore body rakes to the west parallel with bedding.

Granitic rocks must be close by in order to form either tactite or scheelite. The most favorable places for ore are where small satellitic intrusive bodies crosscut structure. The tactite and scheelite do not necessarily form adjacent to the intrusive rocks, but are within a few hundred feet of intrusive rocks and commonly are localized by faults.

Mineralogy

The primary tungsten ore contains scheelite in a gangue of andradite, calcite, fluorite, idocrase, and pyrite. Bismuthinite is present at the Fernando mine. Where the wall rock is hornfels, wollastonite and diopside are common. At the Thompson mine the scheelite is associated with galena, sphalerite, pyrite, chalcopyrite, fluorite, and calcite in light-colored calc-hornfels composed of idocrase, garnet, wollastonite, diopside, and epidote.

The scheelite is commonly in euhedral crystals as much as 2 inches in diameter. At the Thompson mine, euhedral to subhedral crystals of scheelite predominantly three-eighths to three-fourths inch in diameter are surrounded and in places veined and slightly corroded by sulfide minerals. Davis and Peterson (1948, p. 2) described euhedral scheelite crystals in a powdery matrix of limonite, jarosite, and clay minerals from the oxidized ore in the Thompson mine. At the Durham, Fernando, and St. Charles mines galena and sphalerite are only in small amounts in tungsten ore bodies, but they occur elsewhere along the same ore controlling structures farther from the stock of the Darwin Hills.

The Durham ore body contains bismuthinite and pyrite near the intersection of the Durham bed with the Fernando shear zone. The bismuthinite is in tabular crystals as much as 2 inches long in calcite veinlets that cut the tactite. It is mostly pseudomorphously replaced by light green powdery bismutite. The tungsten ore mined from the Durham ore body had an average bismuth metal content of approximately 0.05 percent, but no bismuth was recovered.

Most of the ore is oxidized and consists of euhedral to subhedral crystals and grains of scheelite in a crumbly matrix of limonite, calcite, and partially decomposed calc-silicate minerals. Chrysocolla, azurite, malachite, and gypsum coat some of the fractures. Bismuthinite at the Fernando mine is nearly completely altered to bismutite. The scheelite in the upper stopes of the Thompson mine is embedded in a crumbly matrix of limonite, jarosite, cerussite, and clay minerals. The scheelite remained essentially inert to the meteoric waters, although all the other minerals were oxidized or partly leached; thus, the ore has undergone some residual enrichment of tungsten.

Alameda Mine

The Alameda mine is 4,200 feet N. 80° E. of Darwin in sec. 19, T. 19 S., R. 41 E., at an altitude of 5,000 feet. The property was originally developed as a copper prospect by Charles Richardson in the early 1900's and he sunk an inclined shaft 103 feet deep (Aubury, 1908, p. 313). Very little drifting or crosscutting were done.

A pocket of scheelite ore was reported in the shaft at a depth of 95 feet by Wilson (1943, p. 557). This pocket was mined by the Pacific Tungsten Company during World War II, and an additional small tonnage was mined in 1953 by W. E. Schmidt who had a sublease on the property from Howard Miller and Louis Warnken, Jr. The total tonnage of tungsten ore mined is small, because the stope at the bottom of the shaft is only about 25 feet long, 6 to 10 feet wide, and 9 feet high.

The rocks in the mine area are marble, calc-hornfels, and tactite of the Keeler Canyon formation and are intruded 290 feet west of the inclined shaft by the stock of the Darwin Hills. Bedding strikes N. 18° W. and dips 71° SW. The shaft is sunk in marble on a bedding-plane vein 3 feet thick. The vein contains a small amount of secondary copper minerals in a gangue of calcite and limonite. Scheelite has been mined from a small stope at the bottom of the shaft where the N. 18° W. vein is intersected by a small fault that strikes N. 20° E. and dips 77° SE. Only a small amount of scheelite remains along the cross fault.

Bruce Mine

The Bruce mine is 6,000 feet N. 28° E. of Darwin in sec. 18, T. 19 S., R. 41 E., on the north side of Lane Canyon at an altitude of 4,800 feet. A steep dirt road leads to the property from the road in Lane Canyon. The mine is owned by The Anaconda Company and was leased to A. J. Pouch and "Frenchie" Lingsley of Darwin in 1955. The workings consist of 2 adits about 80 and 100 feet long and an open cut 50 feet long, 10 feet wide, and 5 to 15 feet deep.

The rocks in the mine area are calc-hornfels and tactite that are folded into an open anticlinal-shaped fold that is an inverted syncline. The fold axis is approximately 350 feet east of the stock of the Darwin Hills. The rocks are correlated with the upper part of the lower unit of the Keeler Canyon formation of Pennsylvanian and Permian age. The crest of the anticline is mineralized along the surface for a distance of about 400 feet. In the open cut the vein is 2 to 6 feet thick along the crest of the anticline, and ore extends down the west limb of the anticline as a bedding-plane vein that strikes N. 25° W. and dips 67° SW. The vein contains calcite, quartz, limonite, chrysocolla, cuprite, malachite, garnet, and scheelite. The grade or continuity of the deposit down the dip is not known because of insufficient development. Samples cut by D. L. Davis on surface exposures averaged 0.40 percent WO_3 and approximately 1 percent copper; the vein shows only scattered ore minerals where cut by the lower adit.

Chipmunk Claim

The Chipmunk claim, owned by W. E. McCully of Darwin, is 6,000 feet S. 75° E. of Darwin in sec. 19, T. 19 S., R. 41 E., at an altitude of 4,700 feet. The claim is 850 feet S. 15° W. of the Durham open cut. A dirt road

that branches off from the Durham road leads south to the property. Mine workings consist of an adit 115 feet long and several open cuts and short adits.

The rocks in the mine area are calc-hornfels and tactite that are correlated with the top of the lower member of the Keeler Canyon formation. Overturned bedding strikes north and dips 65° to 80° W. A steep fault that strikes N. 70° E. cuts through the portal of the main adit, which trends S. 15° W. along another steep fault.

Scheelite is exposed along the N. 70° E. fault for a distance of 70 feet. Only a few specks of scheelite were seen in the adit along the steep N. 15° E.-striking fault.

Darwin Group

Some of the lead-silver stopes of the Thompson workings have local concentrations of scheelite, although most of the ore contains no scheelite. Davis and Peterson (1948, p. 2) report several hundred tons of lead-silver ore containing 10 to 15 percent WO_3 was mined from oxidized ore. Euhedral crystals of scheelite are found loosely embedded in a matrix of cerussite, limonite, jarosite, gypsum, and wulfenite. Primary ore has also been found in the deeper levels that contain euhedral crystals of scheelite surrounded and slightly embayed by galena (photo 1). Small amounts of scheelite are in fractures in or near the Water Tank fault near the crest of the ridge east of the Darwin mining camp and on the Bernon claim (pl. 5). All are too low grade to be ore.

Durham Mine

The Durham mine is 5,500 feet east of Darwin in sec. 19, T. 19 S., R. 41 E., at an altitude of 4,640 feet. The property is accessible by a hard-surfaced road leading south from Lane mill. Development work consists of an inclined shaft 250 feet deep with 4 levels totaling 1,100 feet of drifts and crosscuts (fig. 24). The 100-foot level connects with the bottom of the Fernando shaft.

The rocks in the mine area consist of limestone, marble, calc-hornfels, and tactite of the Keeler Canyon formation and are intruded by a sill of quartz monzonite 170 feet east of the Durham shaft. Overturned bedding strikes north and dips 50° to 67° W. The rocks are intersected by a series of strike-slip faults that trend east to N. 70° E.

The ore body extends south from the Fernando shear along the footwall of a limestone bed 40 feet thick that is in part recrystallized to marble and altered to an idocrase- and garnet-rich tactite. The tactite is in the basal part of the limestone bed in the upper mine workings and in the central part of the bed below the 200-foot level. Many small cross fractures cut the limestone and tactite.

The ore body is 350 feet long at the surface, and the ore mined by the Pacific Tungsten Company in 1941 to 1943 ranged in thickness from 4 to 20 feet. The lower grade wall rock has been mined by subsequent lessors so that the glory hole now has a maximum width of 44 feet. The ore body extended to a depth of 350 feet (fig. 24). On the 0 and 100 levels, the best grade of ore is on the footwall of the limestone bed where it is altered to tactite. On the 200-foot and 300-foot levels the footwall is barren, and the ore is in the middle of the limestone and tactite bed.

Scheelite occurs irregularly through much of the tactite, but the mineralization is more intense where cross fractures are abundant, and scheelite extends out from the main ore body into tactite along these cross fractures.

Fernando Mine

The Fernando mine consists of two patented claims that lie adjacent to the Durham mine on the north, and both properties are accessible by the same road. The two mines have been worked as a unit through interconnecting workings. The Fernando mine was worked originally for its lead-silver values. The old workings are 500 feet N. 70° E. of the portal of the Fernando adit, and they consist of an inclined shaft 125 feet deep parallel to bedding and several levels driven from the shaft. Kelley (1938, p. 561) reports that on the 100-foot level mineralization along the Fernando shear zone is 30 to 40 feet wide and the ore consists of galena, cerussite, and anglesite in a gangue of limonite, calcite, and jasper. The only recorded production of lead-silver ore was in 1919 and 1920 when the mine was operated by Theo Peterson.

The tungsten ore is along the Fernando shear zone 500 feet S. 70° W. of the old Fernando workings. The shear zone is prospected and developed by three adits. The Fernando or zero level totals 1,850 feet of drifts and crosscuts, and a winze extends 40 feet below this level. The intermediate level, 230 feet above the zero level, and the Alameda glory hole have 310 feet of drifts and crosscuts. An inclined shaft 130 feet deep near the portal of the Fernando adit connects with the 100-foot level of the Durham mine.

Tungsten ore in the Fernando mine is of low grade, and it has been worked successfully only by selective mining and sorting or by screening. Scheelite is erratically distributed along fractures in the Fernando shear zone, which strikes east and dips steeply south, but it is not sufficiently abundant to be ore except at the intersections of the Fernando shear with pure limestone or tactite beds. The largest ore shoot was mined from an open cut at the intersection of the Alameda bed and the Fernando shear zone. The ore shoot was 90 feet long parallel to bedding, 46 feet wide, and was mined to a depth of 50 feet.

Considerable prospecting has been done on the zero level along the Frisco bed, but only a small amount of ore was found. A winze was sunk on ore on the Frisco bed to a depth of 40 feet along a fracture that strikes N. 70° E. and dips 55° SE. On the zero level the ore shoot is 55 feet long and 2 to 10 feet thick, but little scheelite is exposed at the bottom of the winze (see fig. 24). Low-grade ore containing less than half a percent WO_3 is within the Fernando shear zone at its intersection with the Frisco bed (fig. 24). Low-grade scheelite ore is exposed for 200 feet and is a few inches to 15 feet thick. The vertical extent has not been prospected. A thin stringer of scheelite is exposed in the crosscut on the Frisco bed 340 feet south of the Fernando shear. The scheelite stringer is 1 inch to 6 inches thick along a fracture that strikes N. 77° W. and dips 66° SW. No crosscutting has been done along the fracture. Some ore was mined at the portal of the Fernando adit near the intersection with the Durham bed, but no ore was found as a downward extension in the Fernando shaft.

Hayward Mine

The Hayward mine is 1 mile N. 78° E. of Darwin in sec. 19, T. 19 S., R. 41 E., 300 feet east of the portal of the St. Charles No. 1 adit. The mine is accessible by a dirt road down the canyon past the St. Charles mine. Development work consists of an open pit 50 feet long, 15 feet wide, and 20 feet deep. A 50-foot vertical shaft was sunk at the east end of the open pit.

The ore consists of many narrow seams of scheelite along fractures in a shear zone striking N. 65° E. and dipping 72° SE. in dense hornfels. The size of the ore body is outlined by the dimensions of the pit. The fault zone extends northeast onto the Custer claim where it has been prospected by a vertical shaft 50 feet deep that is 140 feet N. 74° E. of the Hayward open pit. Only a narrow seam of scheelite is exposed in the vertical shaft.

Several shallow shafts and open cuts have been dug into a fault zone 200 feet south of the fault through the Hayward open pit. The fault zone is 3 to 4 feet thick and contains minor scheelite and secondary copper minerals. In 1955 an adit was being driven to prospect the fault zone at a depth of about 50 feet.

Lane Mine

Some scheelite is exposed in the Lane mine 700 to 800 feet within the portal of the Lane adit, and a raise was driven 70 feet above the level by the Imperial Metals Company to explore the scheelite-bearing zone. The scheelite is in hornfels along fractures in a fault zone that strikes N. 72° E. The U. S. Bureau of Mines sampled the raise and the adit at 10-foot intervals from 633 to 770 feet from the portal between Nov. 17, 1941, and Jan. 19, 1942 (Butner, 1949, p. 6). Thirteen samples along the adit assayed a trace of WO_3 and one sample assayed 0.09 percent WO_3. Four samples were taken in the raise. Two assayed a trace of WO_3, one assayed 0.49 percent WO_3 over a width of 5.5 feet, and one 0.8 percent WO_3 over a width of 4.7 feet.

St. Charles Mine

The St. Charles mine is 4,500 feet N. 72° E. of Darwin in sec. 19, T. 19 S., R. 41 E., at an altitude of 4,750 feet. The mine is southwest of the Custer mine. Three areas are prospected by separate workings known as the St. Charles No. 1, No. 2, and No. 3 workings (fig. 25). The St. Charles No. 1 area is developed by an inclined shaft 140 feet deep and by 662 feet of drifts and crosscuts. The St. Charles No. 2 workings, which are 280 feet north of the St. Charles shaft, consist of an adit 97 feet long with two short crosscuts; the No. 3 workings 230 feet N. 15° W. of the St. Charles shaft consist of three unconnected adits with several short crosscuts, all of which total 600 feet in length.

The rocks in the mine area are interbedded calc-hornfels and pure limestone beds that are in part recrystallized to marble and altered to tactite. They are correlated with the lower member of the Keeler Canyon formation of Pennsylvanian and Permian age. Overturned bedding in the metasedimentary rocks strikes N. 30° W. and dips 50° SW. Many steep faults that strike N. 60°-70° E. cut the rocks. A granodiorite dike that is an offshoot of the Darwin stock is 100 feet northwest of the St. Charles No. 1 shaft.

The ore body in the St. Charles No. 1 workings is in a vein that strikes N. 65° E. and dips 70° NW (fig. 25). The ore shoot was 140 feet long and 2 to 10 feet thick; it was mined from the surface to an average depth of 30 feet. The ore extended only 10 to 15 feet below the adit level, and the bottom 105 feet of the shaft is in submarginal ore or barren rock. The ore from the stope averaged 2 to 8 percent WO_3. The scheelite was localized in two narrow high-grade veins separated by 5 to 8 feet of low-grade ore. Southwest of the ore shoot the 2 high-grade veins diverged to a horizontal separation of 20 feet, and the amount of scheelite in each vein decreases. Some ore has been mined from the northernmost split for a stope length of 35 feet, a width of 3 to 4 feet, and for a maximum distance of 55 feet down the dip. Work was being done in this part of the mine in March 1955.

At the St. Charles No. 2 workings, scheelite is exposed in the adit 50 feet from the portal, along fractures trending N. 65° E., but the showings are thin and low grade (fig. 25).

At least three veins have been prospected in the St. Charles No. 3 workings, but ore was mined only from the lowest adit. Thin seams of scheelite are exposed in many places in the lowest adit in fractures trending N. 65° E., but only two small shoots have been mined. A high-grade seam of scheelite 40 feet long and a maximum of 6 inches thick was mined between 25 and 65 feet within the adit, and a raise has been driven to the surface on a shoot of ore 10 feet long in the same structure 90 feet within the adit. At 65 feet within the portal 2 thin seams of high-grade scheelite are exposed, but the hornfels between seams is barren, making the average grade over a mining width of 3 feet less than 0.3 percent WO_3. The 2 upper adits exposed only a small amount of scheelite in thin fractures and none is of ore grade.

Toga Mine

The Toga mine is 4,500 feet S. 82° E. of Darwin in sec. 19, T. 19 S., R. 41 E., along the crest of the ridge overlooking Darwin Wash (pl. 9). The property is accessible by a road from Darwin. The C. W. Fletcher estate owns the mine.

The property is developed by several short adits and raises to the crest of the ridge at the end of the road to the Toga mine and by an adit 370 feet long that was driven from the gully 270 feet east of the raises. Some scheelite was mined by Fletcher in 1943 from the workings along the crest of the ridge.

The rocks in the mine area are limestone and calc-hornfels of the lower member of the Keeler Canyon formation and quartz monzonite of the stock of the Darwin Hills. The stock crops out 60 feet southwest of the workings at the crest of the hill and a dike offshoot from the stock is 60 feet to the east. The mine workings intersect a fault that strikes N. 70° E. and dips 80° SE.

A small scheelite ore body was mined from the workings at the crest of the hill. The ore was localized in the N. 70° E. fault at the intersection with one of the Alameda limestone beds. The fault zone is 8 feet thick in the mine area and locally contains scheelite in a highly limonitic groundmass. Scattered scheelite is exposed in the fault zone in the 390-foot adit on the property.

Deposits in the Coso Range

A few small tungsten deposits are on the northeast slope of the Coso Range 8 to 10 miles southwest of Darwin. Most of the deposits are south of the Darwin quadrangle, and only the Lone Pinyon prospect, which is near Black Springs, lies within the quadrangle and is described here. The deposits are within roof pendants or screens of metasedimentary rocks in quartz monzonite of the batholith of the Coso Range. None have proved to be extensive.

Lone Pinyon (Black Rock) Prospect

The Lone Pinyon prospect is in the Coso Range 8 miles S. 80° W. of Darwin and 2,400 feet east of Black Springs in the SW¼ sec. 26, T. 19 S., R. 39 E., at an altitude of 6,200 feet. The prospect is accessible from Darwin by a dirt road that crosses Lower Centennial Flat. Clyde E. Hanbury and associates developed the property in 1941 and 1942. Little or no work has been done since then. The property is opened by an adit 140 feet long bearing S. 31° W. and a few surface pits and trenches. D. M. Lemmon and J. H. Wiese of the U. S. Geological Survey mapped the property in February 1942 and most of the data here are from their investigations.

Quartz monzonite is the predominant rock type in the mine area. It contains many small screens or roof pendants of limestone that are in part altered to tactite and calc-hornfels. The main tungsten showings are in a screen that is 100 feet long in a N. 30° E. direction and 30 feet wide that has been prospected by the adit. Bedding strikes N. 80° E. and dips 50° SE.

Scheelite-bearing tactite crops out at the surface 100 feet S. 30° W. of the adit portal and 60 feet higher at the contact with quartz monzonite over an area 20 feet long and 10 feet wide. The ore did not extend to the adit.

For the first 40 feet the adit is in tactite that contains a small amount of scheelite. The tactite is composed of garnet, epidote, calcite, limonite, and quartz. The remainder of the adit is in hornfels and marble with only a few narrow streaks of scheelite-bearing tactite.

Antimony Deposits

Darwin Antimony Mine

The Darwin Antimony mine is in the Darwin Hills 2 miles north of Darwin in sec. 2, T. 19 S., R. 40 E. The mine is on one of three unpatented claims located in 1942 by F. E. Groover of Balboa, Calif. The production of antimony from the mine is reported by Norman and Stewart (1951, p. 29) as, "50 to 100 tons of ore assaying more than 30 percent antimony." The workings consist of shafts, drifts, and crosscuts totaling 550 feet. The lower shaft, reported by Norman and Stewart (1951, p. 29) to be 100 feet deep with 50 feet of crosscuts east and west from the bottom, is inaccessible. The shaft has an inclination of 65° W. The upper or main shaft, about 350 feet due north and 68 feet higher at the collar, is 150 feet deep and has an inclination of 65° in a S. 78° W. direction. At the 100-foot level, 12-foot drifts extend north and south from the shaft. At the bottom of the shaft, 50-foot drifts extend north and south. From the south end of the south drift, crosscuts extend 50 feet west and 30 feet east. A stope in the east crosscut produced all the antimony ore shipped from the mine.

The Darwin Antimony mine area is underlain by thin-bedded medium-gray limestone of the lower member of the Keeler Canyon formation of Pennsylvanian and Permian age, which is about 1,000 feet thick, in the vicinity of the mine. Bedding in the Keeler Canyon formation is overturned. It strikes north at the main shaft and dips 62° to 65° W. The limestone is sheared and fractured near the main shaft, and limonite and calcite fill many of the fractures. A bedding-plane fault that strikes north and dips 65° W. is exposed in the main shaft. It is cut off by the Darwin tear fault at the position of the lower shaft.

Ore in the Darwin Antimony mine is localized along the bedding-plane fault exposed in the main shaft. The fault is traceable along strike for about 1,000 feet. Stibnite is exposed intermittently at the surface and in the underground workings over a strike length of about 120 feet near the main shaft and probably was in the lower shaft 350 feet farther south. The vein consists of stibnite with minor secondary antimony minerals in sheared limestone. Limonite and calcite are the chief gangue minerals. The vein ranges in thickness from a few inches to about 3 feet. All the ore was mined from a stope in the footwall between the 100- and 150-foot levels about 40 feet south of the main shaft. Small discontinuous seams and pods of stibnite less than an inch thick are exposed in the north drifts on the 100- and 150-foot levels.

Many other bedding-plane faults, also having a north strike, are exposed in the west crosscut, but are not mineralized. Several faults with approximate N. 60° E. strikes and steep northwest dips intersect the main north-trending fault in the east crosscut of the 150-foot level and are mineralized at some of these intersections.

At least three shallow prospect pits were cut into the vein at the surface not more than 100 feet north of the main shaft, but no ore was produced from them.

Copper Deposits

Copper minerals are associated with practically all of the lead-silver-zinc ores and with some of the scheelite deposits. In a few deposits copper minerals are the principal ore mineral, and only these deposits will be described here. The deposits are the Giroux mine and adjacent prospects near Darwin and the Whipperwill prospect near the east border of the quadrangle (pl. 1). Mines of the Darwin group account for most of the copper production in the quadrangle, but the Santa Rosa, Lane, and Custer mines also produced some copper.

Mining activity on the copper prospects was mostly confined to the late 1890's and the first few years of this century. Most of the deposits are described by Aubury (1902, 1908). A blast furnace was built at the Lane mine in 1898, and some copper matte was recovered (Waring and Huguenin, 1919, p. 99).

Geology

Copper minerals are in the lead-silver-zinc deposits and locally along fractures in some tactites. Most of the copper minerals are in oxidized ore. Chrysocolla is the prevalent copper mineral—occurring in almost every copper-bearing deposit. Antlerite, aurichalcite, azurite, brochantite, caledonite, chalcanthite, cuprite, linarite, malachite, and tenorite are the less common secondary

copper minerals found in the quadrangle. The primary copper minerals are chalcopyrite, enargite(?), tetrahedrite, and tennantite. Small amounts of supergene chalcocite and covellite are also present.

Giroux (Jeroo, Rio Tinto) Mine

The Giroux mine, which is owned by the C. W. Fletcher estate, is in sec. 24, T. 19 S., R. 40 E., about half a mile east of the town of Darwin. The main mine workings consist of a lagged two-compartment vertical shaft 203 feet deep with a 95-foot crosscut and a 70-foot deep shaft inclined 42° SE. about 150 feet S. 32° E. of the main shaft. Most of the workings were made prior to 1908 when the mine was owned by Joseph Giroux of Los Angeles (Aubury, 1908, p. 313). No production data are available.

The mine is along a contact between iron stained plutonic rocks of the stock of the Darwin Hills to the northeast and calc-hornfels of the Keeler Canyon formation to the southwest. A garnet-rich tactite zone 1 foot to 6 feet thick is locally along the contact. The workings develop small oxidized veins and irregular iron stained zones. A 2-foot thick vein explored by the inclined shaft strikes N. 55° W. and dips 42° SW. parallel to bedding in the calc-hornfels. Minor cross fractures cut this vein but cause negligible offsets. Another vein is exposed in a cut about 50 feet S. 43° W. of the main shaft. This vein strikes N. 80° W. and dips 40° SW. It is 3 feet thick and can be traced for 30 feet on the surface.

The ore minerals consist of secondary copper minerals, mainly chrysocolla, with minor cuprite, and malachite. The veins are heavily iron stained and limonite pseudomorphous after pyrite pyritohedrons are abundant. Aubury (1902, p. 245) reports chalcopyrite and minor amounts of gold and silver in the ore.

Kingman Prospect

The old Kingman copper prospect is in sec. 19, T. 19 S., R. 41 E., about 1,000 feet S. 66° E. of the Giroux mine. Workings consist of 2 adits each about 100 feet long that trend S. 5° W. and an open pit 40 feet long, a maximum of 20 feet wide, and 20 feet deep. The prospect is in calc-hornfels and tactite of the Keeler Canyon formation near the contact with the stock of the Darwin Hills. Copper minerals are in two iron stained veins 1 foot to 4 feet thick and in smaller quantities as fracture coatings in tactite. One of the veins strikes N. 20° W. and dips 70° NE., and the other strikes N. 85° E. and dips 75° SE. The prevalent copper mineral is chrysocolla with some cuprite, malachite, and aurichalcite(?). Aubury (1902, p. 245) reports chalcopyrite and small amounts of gold and silver.

Whipperwill Prospect

The Whipperwill prospect is in sec. 35 (projected), T. 17 S., R. 41 E., in a canyon near the eastern border of the quadrangle. Workings consist of an inclined shaft about 40 feet deep and short drifts. Copper minerals are localized in a shear zone 6 to 20 feet thick that cuts the calc-hornfels and tactite country rock. The shear zone strikes N. 20° W. and dips 70° SW., approximately parallel to bedding. The shear zone contains chrysocolla in a gangue of sheared, iron-stained calc-silicate minerals.

Gold Prospects

Gold prospects are distributed through the granitic rocks in the southwestern part of the quadrangle, particularly in the low rolling hills west of the Darwin Hills (pl. 1). A few prospects are in the extreme northwestern part of the quadrangle, the southern part of the Santa Rosa Hills, and in the Argus Range. The prospects are all small, and it is doubtful if any produced more than a few tons of ore. Most of them were located during the 1930's and show little indication of recent work.

The numerous prospects in the low hills west of Darwin and those in the northern part of the Coso Range are on iron-stained and local quartz-rich fractures cutting granitic rocks of the batholith of the Coso Range. The fractures strike about N. 30° W. and dip steeply. They can be traced for as much as several hundred feet. Commonly the fractures are tight and locally contain small quartz lenses and veins a maximum of 1 foot thick. Most of the quartz veins and lenses are iron-stained and contain minor amounts of calcite, pyrite, and secondary copper minerals. No gold was seen.

The prospects in the northwest part of the quadrangle are in the shale member of the Owens Valley formation. They explore small gash veins filled with coarsely crystalline quartz. The veins are 10 to 30 feet long and a few inches thick. Shallow workings for gold in the southern part of the Santa Rosa Hills are on northwest-trending, steeply dipping mineralized faults cutting Mississippian limestone. The principal workings are on the West vein at the Lee mine on an iron-stained quartz-calcite vein (pl. 8). At the Granite claim in the Argus Range a short adit follows a steeply dipping fracture in quartz monzonite that locally contains quartz.

Nonmetallic Commodities

Nonmetallic commodities include talc, light-green chlorite which is locally called "pyrophyllite," limestone, dolomite, and quartzite. Only talc and "pyrophyllite" are important commercially at present. The great distance to marketing centers is the chief factor inhibiting the development of the vast quantity of limestone and dolomite.

Talc Deposits

Talc deposits are confined to Devonian and older rocks in the Talc City Hills (pl. 2). Only a brief description of the deposits is given here as the deposits are described by Page (1951) and the reader is referred to his report for detailed mine descriptions. Gay and Wright (1954, map sheet no. 12) mapped the surface geology of the Talc City Hills Mines in the Talc City Hills have been one of the nation's major sources of steatite-grade talc, but in recent years production has been small. The Sierra Talc and Clay Company owns most of the large mines.

The Talc City Hills are underlain by sedimentary rocks of Early Ordovician to Permian age and Cretaceous quartz monzonite. The Silurian and Ordovician sedimentary rocks are predominantly dolomite; the Mississippian and younger rocks are predominantly limestone. The older part of the Devonian rocks is predominantly dolomite and the younger part is limestone and shale.

The Devonian and older rocks are thrust over younger Paleozoic rocks. The Devonian and older rocks in the thrust plate are tightly folded and cut by many steep faults. Overturned bedding and inverted structures are common.

Geology

The talc deposits are replacements of dolomite and quartzite near or within shear zones peripheral to the stock of the Talc City Hills. Dolomite of the Lost Burro formation is the principal host rock for talc, but deposits are also in quartzite and dolomite of pre-Devonian age. Some talc has replaced felsite dikes and sills in the Frisco mine. No deposits are in limestone. Most of the dolomite is normal in the regional stratigraphic section, but some dolomitized limestone is present locally near most of the mines. The dolomite is recrystallized and nearly all evidence of original bedding has been obliterated so that original dolomite does not look like its analogue in unaltered equivalent sections. The prevalent talc-controlling shears strike northwesterly and dip nearly vertically.

The steatite is grayish green, pale green, or dull white. It commonly is highly sheared. The larger steatite deposits are irregular elongate pods as much as 600 feet long and 50 feet thick. Most of the deposits are small irregularly shaped bodies a few inches to a few feet thick and are exposed for 10 to 20 feet along shear zones. Some of the deposits contain large residual masses of the host rock.

Except for a few thin dikes and sills of felsite the nearest intrusive rock is quartz monzonite of the stock which crops out in the southern part of the Talc City Hills. The deposits near the stock are larger than those farther away from the stock.

Alliance Mine

The Alliance mine is in secs. 29 and 30 (projected), T. 18 S., R. 40 E., at an altitude of 5,400 feet. Edith Lockhart and George Koest, mailing address Darwin, Calif., own the mine. The main workings consist of a northeast-trending glory hole about 200 feet long, 50 feet in maximum width, and 30 feet in maximum depth, an inclined shaft 70 feet deep that connects with about 500 feet of level underground workings and stopes, and several minor adits and pits. Page (1951, p. 12) reports a total production between 5,000 and 10,000 tons.

The talc deposits are in or near shear zones in dolomite and quartzite of Ordovician and Silurian age. The dolomite and quartzite are thrust over limestone of Pennsylvanian and Permian age; the thrust contact is exposed at the south end of the mine (photo 8). Locally the contact is steep on the Irish lease. Here, the thrust is apparently displaced a small amount by a later steep fault. The main workings are on a N. 70° E.-trending shear that dips about 47° NW. Eureka quartzite is in the footwall of the shear and Hidden Valley dolomite in the hanging wall. Talc is in an alteration zone as much as 30 feet thick that can be traced about 200 feet. Much of the material of this zone is a dark-gray chloritic rock, but talc is in irregularly shaped bodies in gradational contact with the chlorite. According to Page (1951, p. 22) two types of talc were mined—a white to gray, commonly mottled talc and a dark-gray to black talc.

The easternmost workings are on a shear zone 4 feet thick that strikes N. 48° E. and dips 75° NW. The host rock is dark-gray Ely Springs dolomite. Talc is mainly on the hanging wall of the shear zone.

Apex Prospect

The Apex talc prospect is in sec. 29 (projected), T. 18 S., R. 40 E., bordering the Talc City mine on the northeast. Talc occurs locally along a N. 80° E.-striking vertical shear zone and along a north-striking vertical shear zone, which is developed by a 40-foot shaft and an adit 100 feet long. The country rock is light-gray dolomite and minor bluish-gray limestone of the Lost Burro formation.

Bobcat Claims

The Bobcat claims are in secs. 29 and 32 (projected), T. 18 S., R. 40 E., in the eastern part of the Talc City Hills. Talc is along two near-vertical shear zones. The major zone strikes N. 75° W. and the other N. 25° E. Page (1951, p. 30) reports the ore body, which is now mined out, was more than 100 feet long and was 5 to 15 feet thick. The host rock is light-gray dolomite of the Lost Burro formation. Blue-gray limestone of the Lost Burro formation crops out south of the northwest-trending shear zone.

Frisco Mine

The Frisco mine is 4,000 feet southwest of the Talc City mine in sec. 31 (projected), T. 18 S., R. 40 E. The mine is owned by the Sierra Talc and Clay Company. The deposit is developed by two inclined shafts 60 and 65 feet deep and three pits, the largest approximately 350 feet long, 100 feet wide, and 50 feet deep. Light medium gray dolomite of the Pogonip group is the principal host rock. Gray limestone of the Pogonip is exposed in parts of the mine area but does not serve as a host for the talc. Some sills and dikes of chloritized felsite are exposed in one of the pits. Slivers of quartzite locally distributed in the shear zones are believed to be Eureka quartzite fault-dragged into the Pogonip. Although the mine produced significant quantities of steatite, a large part of the production consisted of massive green chlorite, locally called "pyrophyllite."

The easternmost inclined shaft and two of the large open pits are on a chlorite-rich shear zone that strikes N. 20° E. and dips 70° NW. Chlorite is abundantly exposed in the largest pit along near-vertical shear zones 2 to 15 feet thick striking N. 70° W. and N. 20° E. Page (1951, p. 30) gives the chemical analysis of the chlorite as follows:

	Percent
SiO_2	36.24
Fe_2O_3	1.19
Al_2O_3	23.56
MgO	23.39
Alkalies	0.35
CaO	1.47
Ig. loss	12.19
CO_2	0.86
Moisture	0.18
	99.43

The identification of chlorite was confirmed by an x-ray defraction pattern.

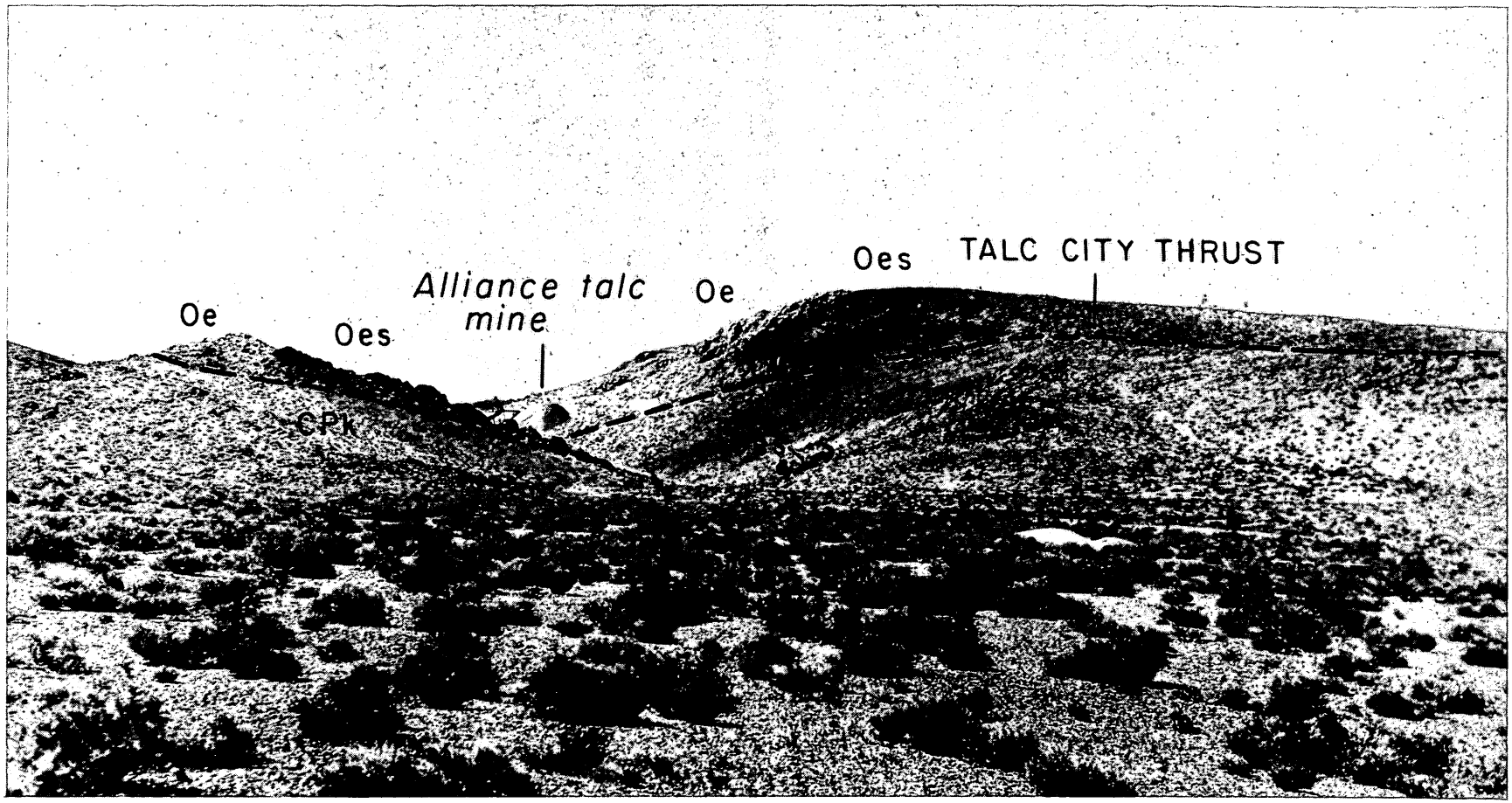


PHOTO 8. View looking north at the Alliance talc mine showing the Talc City thrust with the Eureka quartzite (Oe) and Ely Springs dolomite (Oes) of Ordovician age thrust over the Keeler Canyon formation of Pennsylvanian and Permian age (CPk).

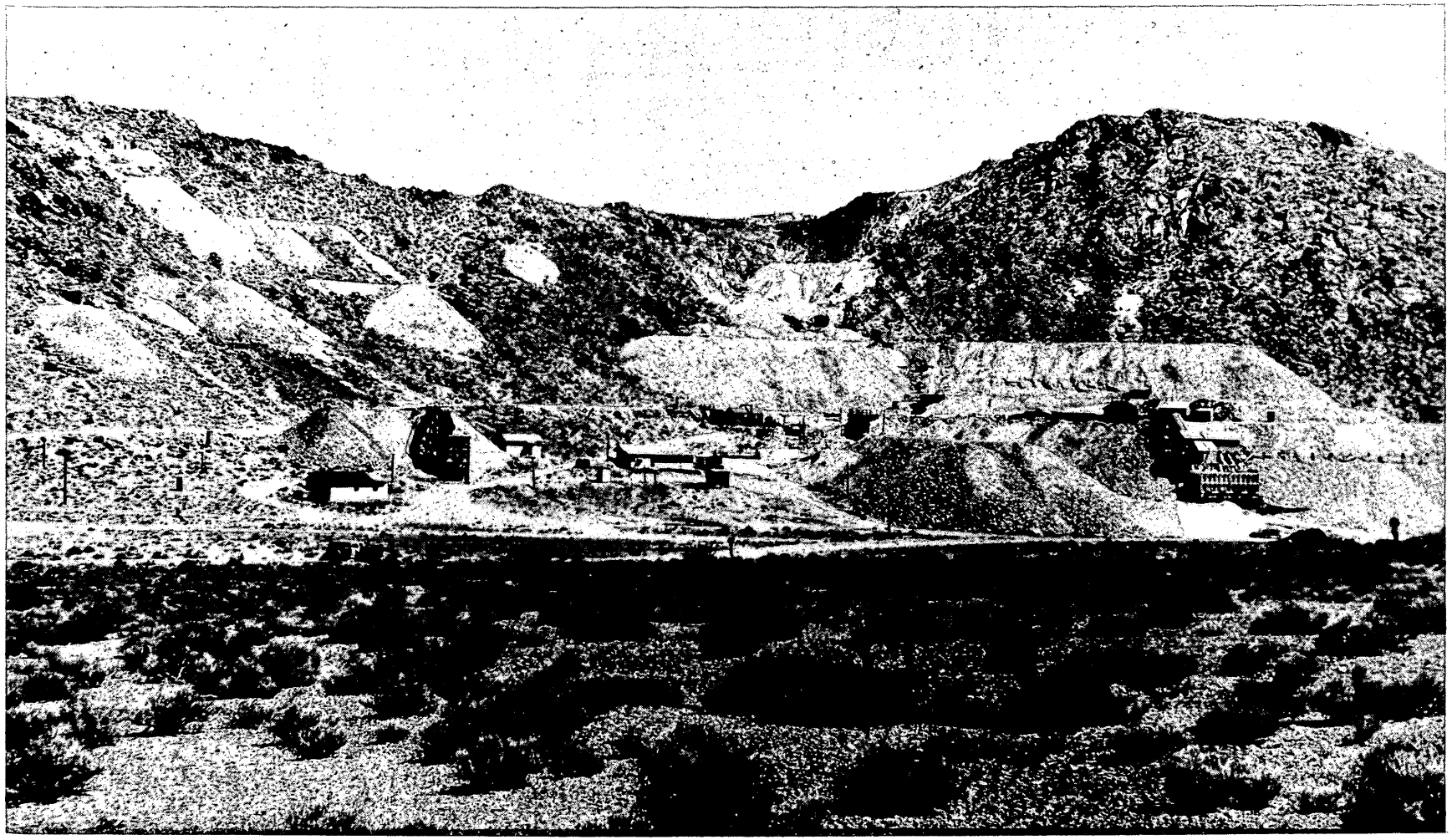


PHOTO 9. Talc City mine. Talc is in shear zones in massive dolomite of the Lost Burro formation of Devonian age.

The westernmost shaft and smaller pits are on a N. 70° E.-trending shear zone that dips 70° NW. Talc bodies 5 to 15 feet thick are distributed locally along this shear. The adit north of the western-most shaft is along a shear zone 6 to 8 feet thick striking N. 75° W. and dipping 70° SW. that contains a zone of chlorite 2 feet thick.

Hard Scramble Prospect

The Hard Scramble prospect is in sec. 13 (projected), T. 18 S., R. 39 E. Talc is sporadically distributed along a shear zone that strikes N. 10° W. and dips 70° NE. The shear is developed by an inclined shaft about 60 feet deep and by some short adits. The country rock is mainly Eureka quartzite and the talc formed as a replacement of quartzite adjacent to Ely Springs dolomite.

Irish Lease

The Irish lease is in secs. 29 and 30 (projected), T. 18 S., R. 40 E., adjoining the southern boundary of the Alliance mine. Workings consisting of a short adit and an inclined shaft about 65 feet deep are on a shear zone striking N. 63° W. and dipping to the north. The shear zone ranges from 4 to 30 feet thick and separates Eureka quartzite to the north from silty limestone of the Keeler Canyon formation to the south. Talc is in irregular masses within the sheared and altered rock. Page (1951, p. 22) reports the talc-bearing zone is at least 250 feet long and that the talc replaced a quartzose rock—the Eureka quartzite.

Talc City Mine

The Talc City mine is in secs. 29 and 32 (projected), T. 18 S., R. 40 E. (pl. 2). The mine is owned by the Sierra Talc and Clay Company and has been the largest single source of steatite-grade talc in the United States. Talc production from the Talc City mine from 1915 to 1947 is shown below. This table, which may include some production from the Trinity mine, was compiled by the California State Division of Mines.

The extensive mine workings consist of three large glory holes, several thousand feet of underground level workings, stopes, several shafts, inclined underground workings, and numerous shallow surface workings (photo 9). Many of the underground workings are caved, and large open fractures are visible at many places on the surface.

*Table 13. Talc produced from the Talc City mine.**

Year	Short tons	Year	Short tons
1915	300	1932	4,398 (est.)
1916	428	1933	3,402
1917	620	1934	3,640
1918	2,000	1935	3,766
1919	3,398	1936	6,667
1920	7,087	1937	9,829
1921	4,300	1938	8,800
1922	5,325	1939	7,640
1923	5,685	1940	9,691
1924	5,202	1941	5,890
1925	4,517	1942	12,600
1926	5,462	1943	15,526
1927	5,273	1944	13,325
1928	6,195	1945	14,908
1929	6,370	1946	11,113
1930	5,561	1947	15,169
1931	4,398		

* Production figures furnished by California State Division of Mines and published with the permission of the Sierra Talc and Clay Company.

The mine area is in highly folded Devonian rocks consisting mainly of light-gray faintly mottled massive dolomite, with lesser silty, brown-weathering limestone, and light-gray quartzite. A quartz porphyry dike 2 feet thick that strikes generally northwest and dips gently northeast is exposed in the central part of the mine area. This dike is highly altered and consists mainly of quartz, sericite, and calcite, with subordinate iron oxides and pyrite. Quartz appears to be the chief primary mineral both as phenocrysts and in the groundmass. Most of the other primary minerals are completely altered.

The major talc deposits are in four large shear zones that strike about N. 20°-30° W. and dip southwest. The main ore bodies are the West ore body, Central body, East ore body, and Evening Star ore body (Page, 1951, p. 16). Numerous smaller exposures of talc are in the mine area, commonly localized in N. 70°-80° W.-trending steep shear zones.

The West and Central ore bodies accounted for most of the production. The West ore body is 550 feet long on the surface and 5 to 60 feet thick. It thins with depth and about 100 feet below the surface it is manifested by two salientlike prolongations. The Central ore body is 680 feet long on the surface and 70 feet thick. It has been mined for a vertical distance of almost 400 feet below the surface, but its downward extensions are apparently discontinuous along strike.

The East End ore body is 2 to 15 feet thick and developed for more than 180 feet along strike and 100 feet down dip. Workings in the adjacent hills southeast of the East End shaft and access road are probably on the same ore-controlling structure as the East End ore body. The Evening Star ore body is irregularly shaped and crops out for almost 200 feet in length and has a maximum thickness of 50 feet.

Most of the talc deposits are within massive light-gray dolomite. Many are in the proximity of quartzite, and a few are near brown-weathering silty limestone. Characteristically the talc is fine grained and pale greenish gray. In places it is strongly sheared and foliated. Most of the talc is of steatite grade, and some of it is of exceptional purity.

Trinity Mine

The Trinity mine is 4,000 feet west of the Talc City mine in sec. 30 (projected), T. 18 S., R. 40 E. It is owned by the Sierra Talc and Clay Company. Talc was mined mainly from a northwest-trending glory hole 150 feet long, 50 feet wide, and 50 feet deep. Other workings include an inclined shaft about 100 feet deep, several adits, a vertical shaft, and numerous drifts, crosscuts, and stopes. Many of the underground workings are caved and inaccessible.

The country rock is light-gray dolomite of the upper part of the Ely Springs dolomite. Dolomite of the Pogonip group is in fault contact with Ely Springs dolomite in the southern part of the mine area and Eureka quartzite is present locally along this fault. Talc is mainly in a N. 72° W.-trending, gentle southwest-dipping shear zone. The talc is fine-grained, pale green variety of steatite grade.

Victory Mine

The Victory mine is in sec. 19 (projected), T. 18 S., R. 40 E. (pl. 1). The mine is owned by Edith Lockhart and George Koest. The main workings consist of a northeast-trending adit 170 feet long and a shallow shaft. Talc is irregularly distributed in an altered shear zone within Hidden Valley dolomite near the contact with Ely Springs dolomite. The shear zone strikes N. 44° E., dips 60° NW., and has a maximum thickness of 8 feet.

Viking Mine

The Viking mine is in secs. 23 and 24 (projected), T. 18 S., R. 39 E. (pl. 1). The mine is owned by Edith Lockhart, Ida Nelson, and George and Helen Knight. Production was from the Viking number 1 and Viking number 4 claims. The Viking number 1, the easternmost of the claims, is developed by a shaft less than 100 feet deep, two drifts, and minor trenches. Talc is mainly along a N. 33° E.-trending minor shear zone cutting Eureka quartzite and Ely Springs dolomite.

The Viking number 4 claim is on a shear zone striking N. 75° W. and dipping 80° SW. The mine is worked by two shafts and two adits. Ely Springs dolomite is south of the shear zone and Eureka quartzite to the north. The Eureka quartzite forms a wedge-shaped, fault-bounded outcrop.

White Swan Mine

The White Swan mine includes several claims in sec. 23 (projected), T. 18 S., R. 39 E., at the northwest end of the Talc City Hills. The mine is owned by Mrs. Edna M. Towers. Workings, which for descriptive purposes are grouped as the North workings and the South workings, are on many shear zones in the mine area. The North workings include an adit about 100 feet long and a pit about 50 feet long, 30 feet wide, and 20 feet deep, on a N. 83° W.-trending shear zone in Ely Springs dolomite. Talc surrounds fragments of brecciated dolomite within the shear zone. Another shear zone, about 50 feet to the south in Ely Springs dolomite, strikes N. 60° E. and dips 74° SE. The shear zone is 8 feet thick and contains a talc-bearing border zone about 6 inches thick on the footwall. Other smaller workings expose small lenses of talc.

The South workings consist of 2 adits, a shaft, and surface cuts on a N. 80° W.-striking shear zone that dips 80° NE. Dolomite of the Pogonip group is north of the shear zone and dolomite and limestone of the Lost Burro formation are to the south. Talc is irregularly distributed in small pods in the thick shear zone.

Iceland Spar

Coarse calcite crystals are a common accessory mineral in many of the lead-zinc-silver deposits in the quadrangle, but they are generally discolored by iron oxides and other impurities. Only one deposit has been developed for iceland spar. This is the Iceland prospect in sec. 3, T. 19 S., R. 40 E., in the northern part of the Darwin Hills. The property is owned by the estate of W. R. Wallace. Workings consist of an open cut 60 feet long, with small irregular underground workings near its northwest end, a vertical shaft 40 feet deep, and minor surface cuts. Calcite occurs as cavity fillings between coarse limestone fragments in a N. 45° W.-trending, vertical fault zone. The coarse calcite rhombohedrons are a maximum of 4 inches across cleavage fragments. The quality of the iceland spar is impaired by imperfect transparency due to iron oxide discoloration and local fracturing. No production is recorded from the property.

Limestone and Dolomite

The Darwin quadrangle is a large potential source of limestone and dolomite, but their development is hampered by distances from markets. Limestone of the Devonian and younger Paleozoic rocks probably could be used in the manufacture of cement. The Tin Mountain limestone and the upper part of the Lost Burro formation are the most likely sources. Minor shallow drilling was done a few hundred feet north of the Lee Flat road in the Santa Rosa Hills by operators who contemplated quarrying Tin Mountain limestone for ornamental or building stone, but no limestone was mined.

Massive dolomite in the Devonian and older rocks is abundant in the Talc City Hills. The massive light-gray Hidden Valley dolomite probably would be the most suitable formation for commercial exploitation.

Quartzite

The upper part of the Eureka quartzite is exceptionally pure and is a potential source of silica for refractory silica brick. The Eureka quartzite crops out at the north end of the Talc City Hills at the Hard Scramble mine and north of the White Swan mine.

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Extra

WALTER M. HOOVER

764 LORAINE

GROSSE POINTE, MICHIGAN 48230

General Delivery
Lone Pine, Calif.

Feb. 8, 1967

Office of Mineral Exploration
345 Middlefield Road
Menlo Park, Calif. 94025

Attention Mr. Stager
Re: OME-6234

Gentlemen:

We have found high grade float spread over an area about 2200 X 2000; West of the location of our diamond drilling. under the above contract, and would like to have some new claims included in the contract. They are recorded as the Hoover-Greenwood claims numbers 1 through 23. They have all been surveyed and staked and location work is proceeding and expected to be completed by next week. Claims 1, 2, 3 & 4 are recorded in Book 101, page 733; claims 5 thru 16, Book 101, page 741; claims 17 thru 23 Book 102, pages 317-324., Inyo County Court House.

Enclosed is a sketch of their location.

Respectfully submitted

W. M. Hoover

WMH:tg
Encl.

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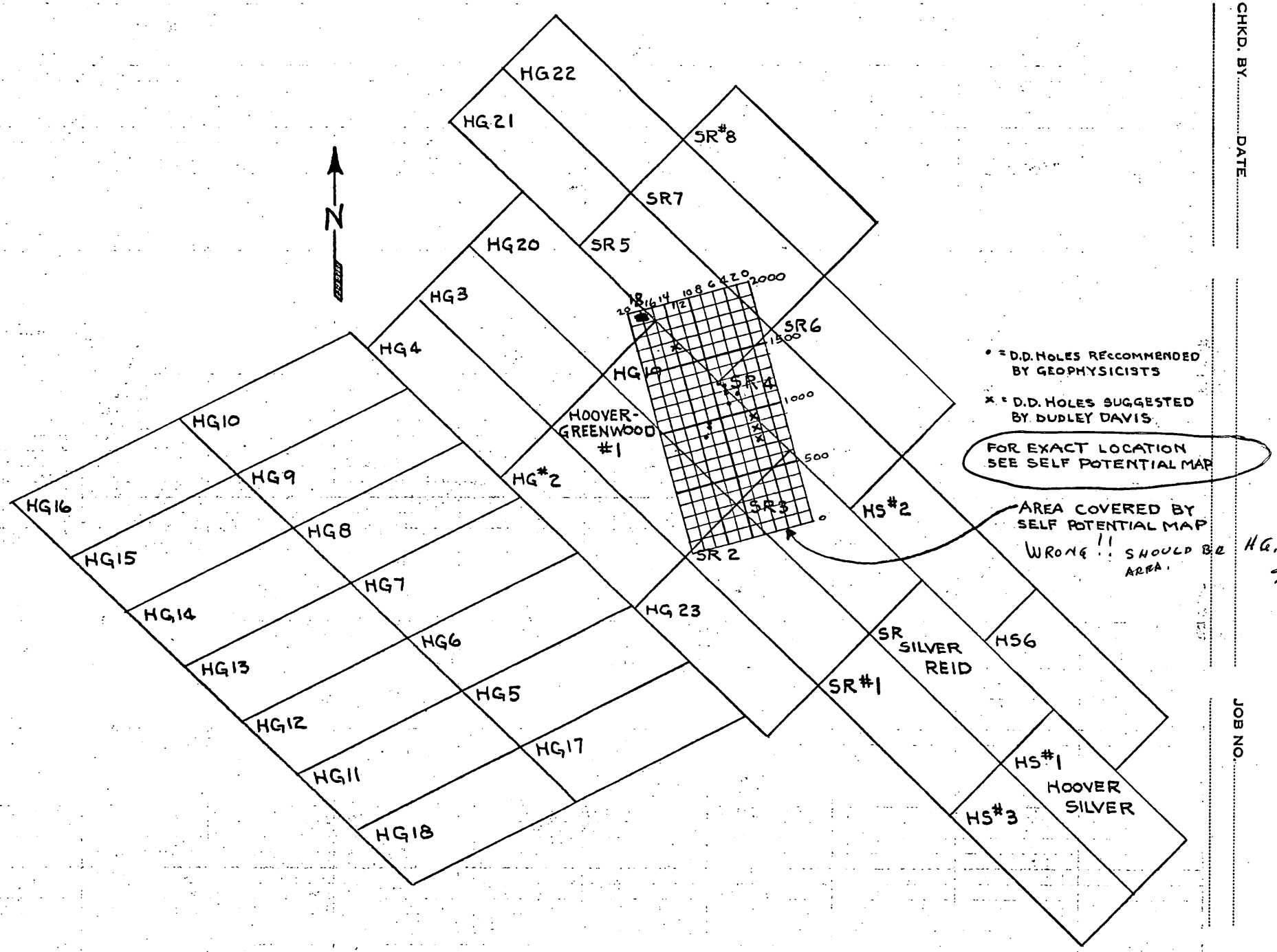
FEB 9 1967

OFFICE OF MINERALS EXPLORATION
U.S. GEOLOGICAL SURVEY
MENLO PARK, CALIF.

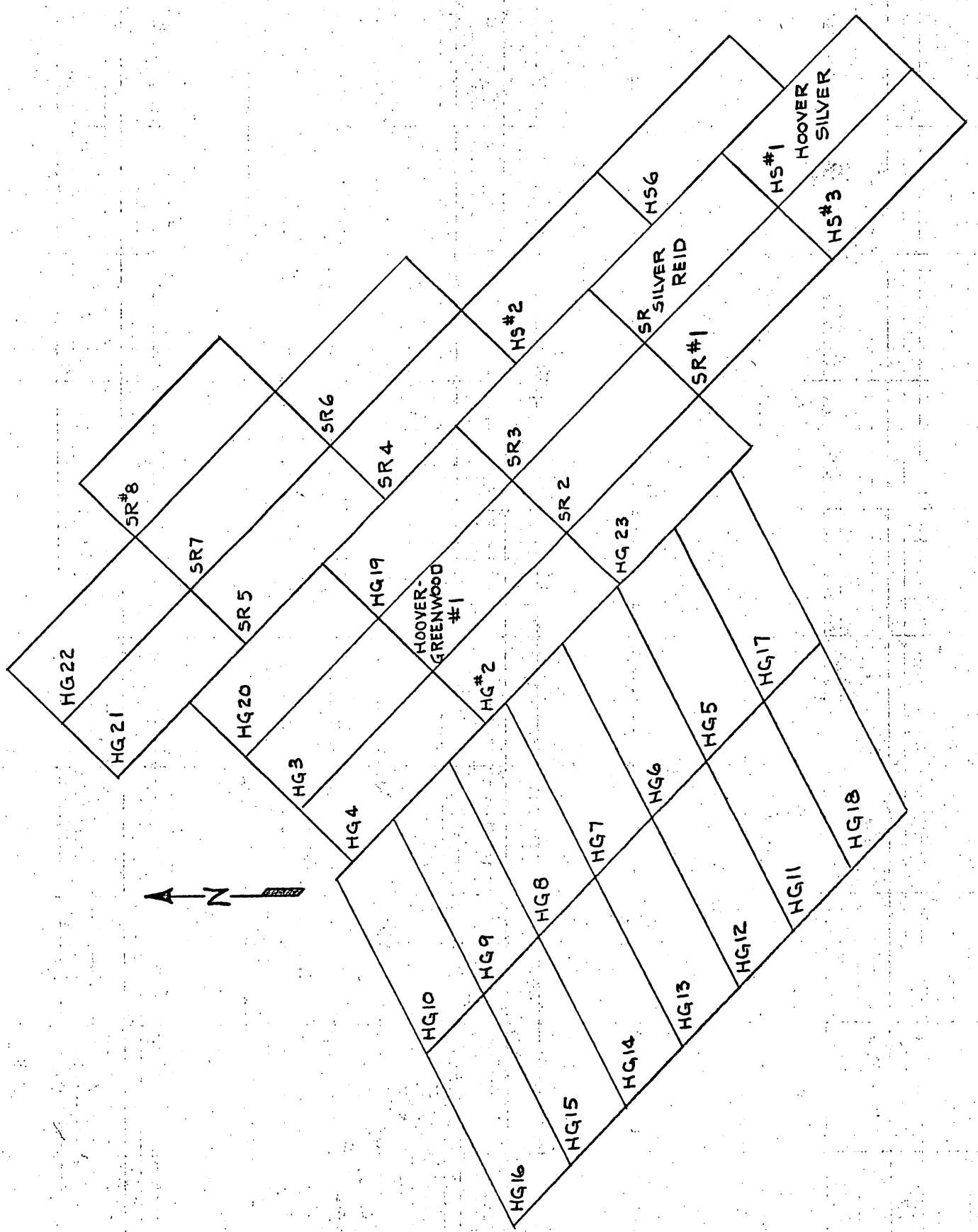


CHKD. BY..... DATE.....

JOB NO.....

BY Hoover DATE 2-7-'67 SUBJECT "LEE" MINE CLAIMS SHEET NO. ..... OF .....

CHKD. BY ..... DATE ..... JOB NO. .....



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WALTER M. HOOVER

764 LORAINE

GROSSE POINTE, MICHIGAN 48230

RECEIVED

FEB 9 1967

OFFICE OF MINERALS EXPLORATION
U.S. GEOLOGICAL SURVEY
MENLO PARK, CALIF.

General Delivery
Lone Pine, Calif.
Feb. 8, 1967

Office of Mineral Exploration
345 Middlefield Road
Menlo Park, Calif. 94025

Attention: Mr. Stager
Re: OME-6234

Gentlemen:

We respectfully request a change of location of the balance of the drilling under the above contract.

The drilling to date of holes #1, #7, & #5(620') did not show ore. We would like to have the balance of the 2000' allocated to the new area.

During the drilling last fall I discovered considerable high grade float West of the Lee Mine as indicated on the attached sketch. We first tried to uncover the source with a D4 bulldozer. Only a foot or two was loose enough to remove. We then tried jack-hammer holes to 10' & 12" without hitting bed rock. Next we drilled about 20-40' to 70' holes with an air track and found bed rock at an average of 45'-50' in depth. Overburden was mostly post-mineral basalt, typically 40' to 45' with 5' to 10' of coliche (or hard pan) beneath.

Assuming the cover to average 50' and using a hand level from the areas of the floatc we "guestimate" the source to be in the vicinity of 800'-1000' North and 300-400' West using the coordinates of the self-potential map.

We have had a professional self-potential survey made of the eastern half of the area in which we have found

high grade float. A sketch is enclosed showing the claims involved and the area covered by the survey. Also enclosed is the report of the geophysicists. I have noted on their map in pencil the additional four holes reccommended by Mr. Davis.

If the program suggesed (2400') must be curtailed to stay within the limits of the original contract, we suggest the following sequence of the drill holes:-1, 4, 5, 6, 9,10, 11, 12.

If we slope #9 hole S.E. about 60° it will bottom out close to proposed hole #3.

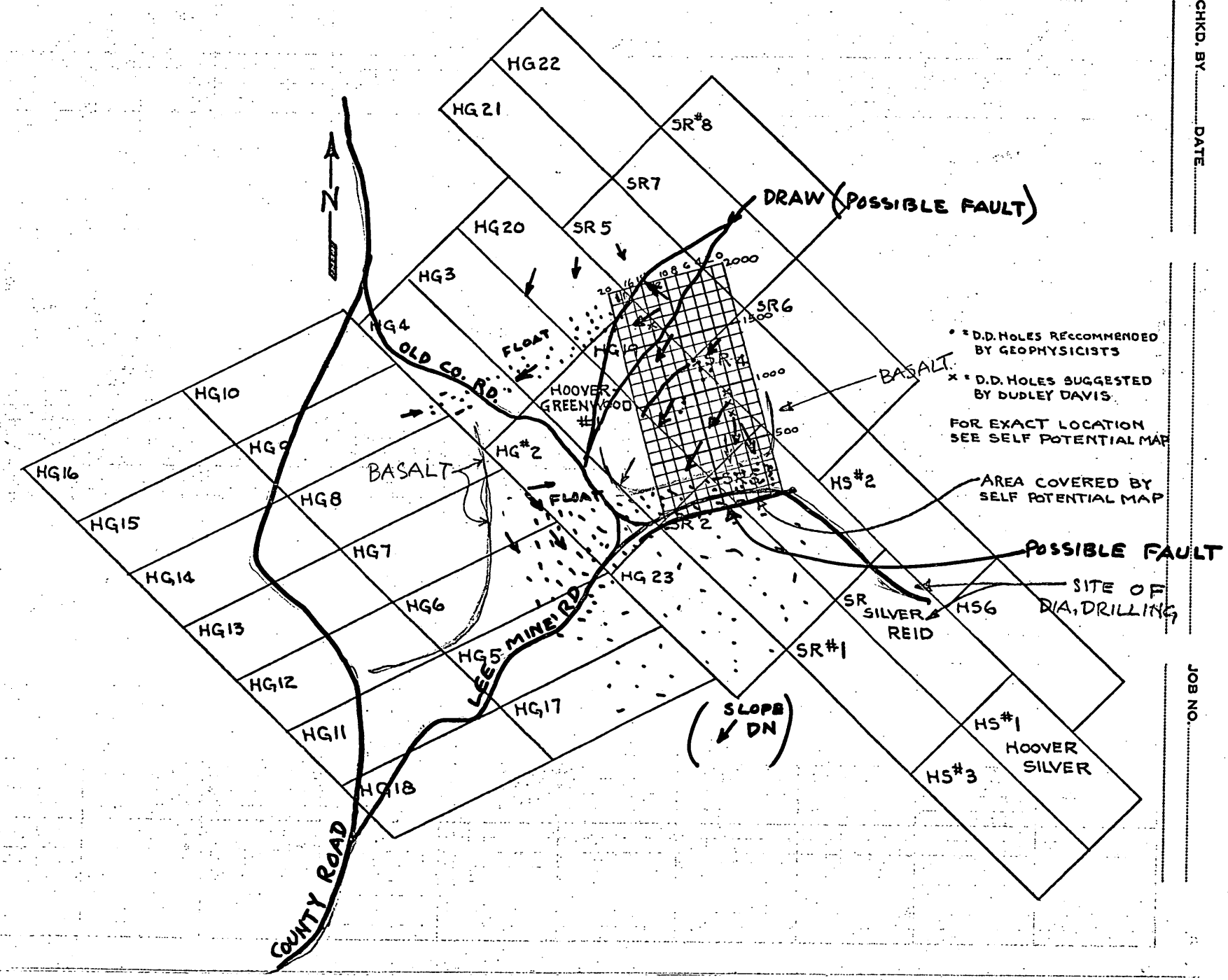
Also, if we space holes 4,5, & 6 slightly differently and slope them North at 60° we may well intercept the ledge believed to be the source of the float and thus obviate the drilling of #10, 11, & 12.

However, we believe, the anomolies indicate bedded deposits and our primary aim is to cut these beddings, therefore all holes are planned for depth. Nevertheless, the sources of the float should not be ignored as the size and value indicate a sizeable ledge of commercial ore.

We trust and hope that the above ideas will meet with your approval.

Respectfully submitted
Hoover & Greenwood

By W.M. Hoover



CHKD. BY_____ DATE_____

JOB NO._____

Geophysical Report 67-3
January 24, 1967

To: W. M. Hoover
Lone Pine, California

From: Brian L. Krogseng
Donald P. Williams

Subject: Final report of self potential (SP) and geochemical surveys conducted on the Hoover and Greenwood claims, Lee mines, Darwin quadrangle, California on January 14,15,21,22, 1967.

INTRODUCTION

Approximately seven miles of SP lines were surveyed in the area on 50 foot spacing with lines 50 or 100 feet apart. A contour map was made of the results and several interesting anomalies defined. In addition to the SP survey, 45 soil samples were obtained and analyzed for silver content by atomic absorption methods.

DISCUSSION OF RESULTS

Self Potential Survey

The SP measurements were made by implanting a porus pot containing a $CuSO_4$ solution and a copper electrode near the south end of line 7. A similar electrode was used for the moveable electrode and a bridge type SP unit used so that maximum accuracy was obtained during the survey with a minimum disturbance of the natural earth potentials. The results of the SP survey are presented in the form of a contour map in figure 1.

The results of the survey indicate that a strong local source of current is present in the area giving rise to strong local SP anomalies. Several major lows and highs can be noted. The lows generally trend in north-south directions near the center of the map with highs to the east. An increasing trend is also indicated to the west.

It is of interest to compare SP profiles across the major lows and extended to the east with a theoretical profile of partially oxidized sulfide ore bodies. A theoretical profile for an ore body dipping to the east is shown in figure 2. It can be noted that the negative upper end of the body gives rise to a rather sharp negative anomaly while the deeper positive end gives rise to a rather broad positive anomaly.

Five SP profiles trending in an east-west direction are shown in figures 3 through 7. These profiles bear a remarkable similarity to the theoretical curves for a sulfide ore body dipping to the east with the upper end more highly oxidized than the lower portion. This is the interpretation that has been given to the SP anomalies. If these profiles are considered in sections there is a strong indication that there are two or more zones of mineralization. For example, in figure 3 the westernmost 300 feet of the profile fits the theoretical curve and the remainder of the profile also has the same general shape.

During the survey the base line was extended 400 feet to the east and 200 feet to the west of the mapped area. Similar lines were run south from line 8 and the 1000N line was extended to the west. These data could not be contoured, but the data indicated a general leveling of the contours at plus 20 to 30 millivolts to the east, south and west. To the north and northwest this trend is not indicated, but the map would have to be extended before a reasonable interpretation could be made. The high located on line 14(1650N) is also difficult to interpret, but may be associated with a contact, possibly a fault, or with the low to the northwest. A small anomalous area is also seen at the southeast corner of the mapped area, but cannot be properly interpreted until the map is extended.

Geochemical Sampling

Geochemical samples were collected in the area to determine levels of concentration of silver and its distribution in the residual soils. All samples were screened to minus 100 mesh and analyzed for silver, utilizing atomic absorption spectrophotometry. The samples that were analyzed were collected generally around the edges of the basalt flow at 200 foot intervals. On lines 9, 11, and 13, samples were collected at 100 foot intervals between 1000N and 1600N. This area contained some apparently anomalous self potential readings and also some old diggings.

The analyses results indicated a background level of around 100 parts per billion with several samples containing anomalous concentrations of silver. Of interest in terms of silver values are the three samples located at the southeast corner of the map. However, these values do not correlate directly to the geophysical data nor to obvious exposures in the area. There is a steep self potential gradient present here, but additional data would be required to provide an interpretation. It should be noted that these silver values fall in or near an outcrop area and are probably little affected by dilution.

The concentrations shown on line 15 from 0 to 600N may be significant in relation to the self potential anomaly to the northeast. Because of the thickness of colluvial material

here, a high dilution factor must be considered. Considering the terrain and dilution, the observed values could well have been derived from a source buried under the basalt to the northeast.

The sample collected at 9(1200N) provided the highest silver concentration in the area. This location lies in an interesting position on the self potential map and also is situated just above the head of a gully that may be related to structure and/or alteration. However, from cursory inspection the sample site is underlain by solid basalt and therefore the silver value cannot be related to pre-volcanic mineralization if the sample was residual, untransported material.

Thirteen shallow drillhole samples were also analyzed for silver concentration. These locations are plotted on the map (figure 1) in the south end of the area. Although none of the values were extremely high all ran somewhat higher than the published normal background levels for silver of 100-200 parts per billion. Values such as those for holes 6 and 12 could indicate close proximity to a mineralized zone. However, without depth figures and close control of sampling no conclusions can be drawn except that this is a high background area.

CONCLUSIONS AND RECOMMENDATIONS

As a result of the SP survey, it is concluded that the SP anomalies are due to one or more mineralized zones dipping slightly to the east and striking in a general north-south direction. The sharpness of the negative lows indicate that the zones are quite shallow, probably not more than 200 feet near the west end of the bodies.

Analyses of the anomalous areas indicate three locations where near-surface mineralization is most probable. These locations are:

1. Line 6 (1250N)
2. Line 8 (1400N)
3. Line 12-13 (700N-1000N)

It is recommended that the following drilling program be initiated to investigate the potential mineralization indicated by the self potential survey. Sites to be drilled are listed in the recommended drilling sequence, but core analyses, to be performed during drilling operations, may dictate modifications in both depth and location.

1. Midway between lines 6 and 7 at 1250N
2. Line 8 at 1350N
3. Midway between 8 and 9 at 1475N
4. Midway between lines 12 and 13 at 775N
5. Line 12 at 950N
6. Line 12 at 875N
7. Line 8 at 1175N
8. Line 8 at 1425N

The holes should be drilled to a minimum depth of 200 feet. It is recommended that samples collected at 10 foot intervals be analyzed for silver by atomic absorption methods to determine trace concentrations that may indicate proximity to a mineralized zone. The results of these analyses may determine modification of the drilling program. For example if high silver concentrations are observed at a depth of 200 feet the hole should be deepened. If this occurs, and a footage limitation exists in the program, elimination of recommended drill sites should begin with number 8 above.

Brian L. Krogseng

Brian L. Krogseng

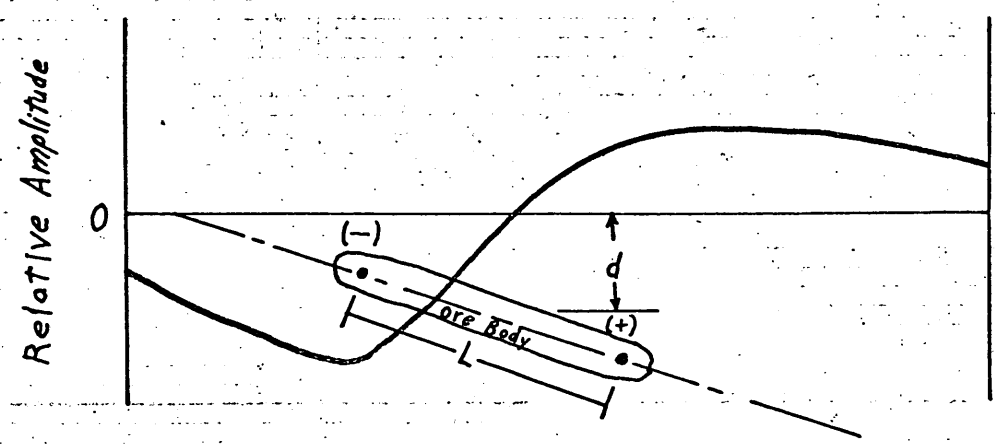


Figure 2. Theoretical SP Anomaly For a Partially Oxidized Sulfide Ore Body With $d = L/3$

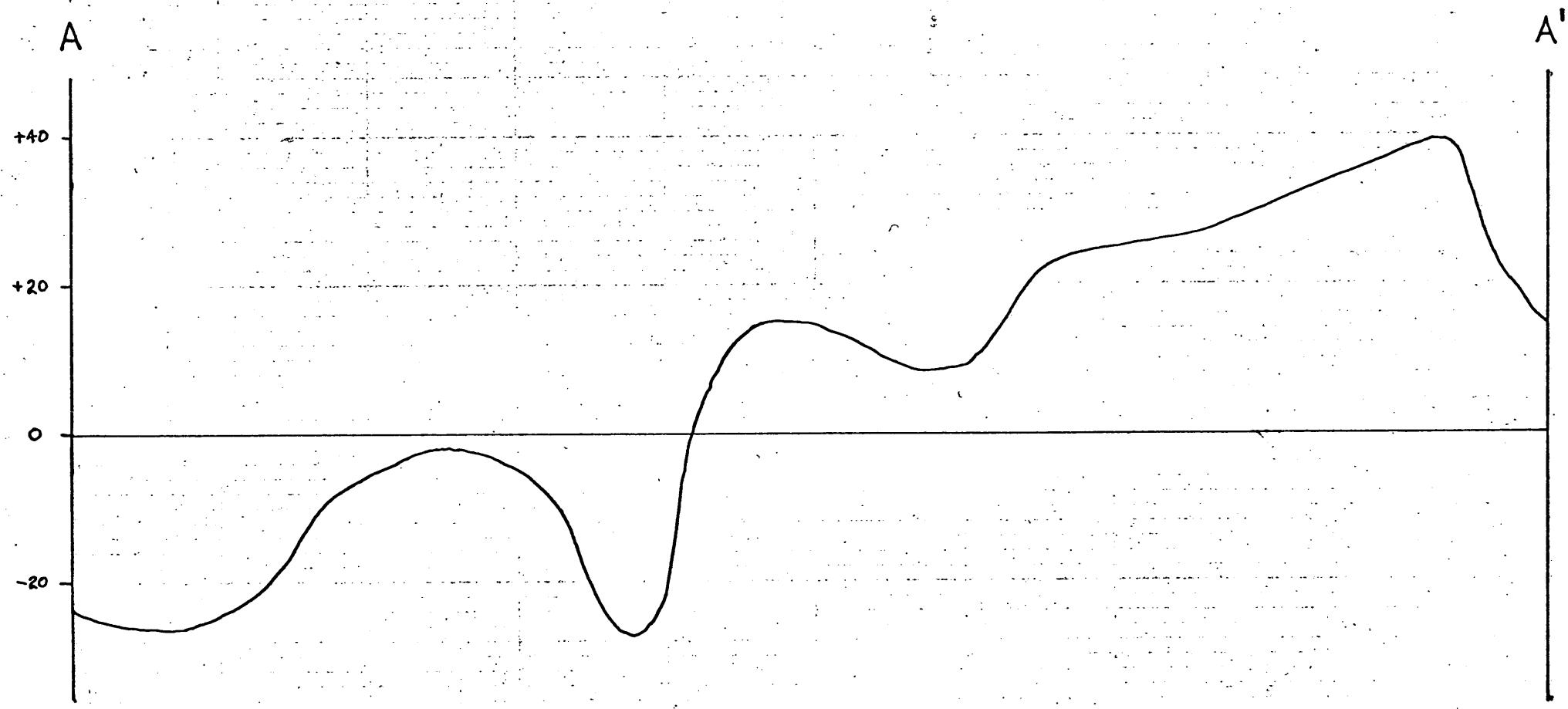


Figure 3. Section A-A'

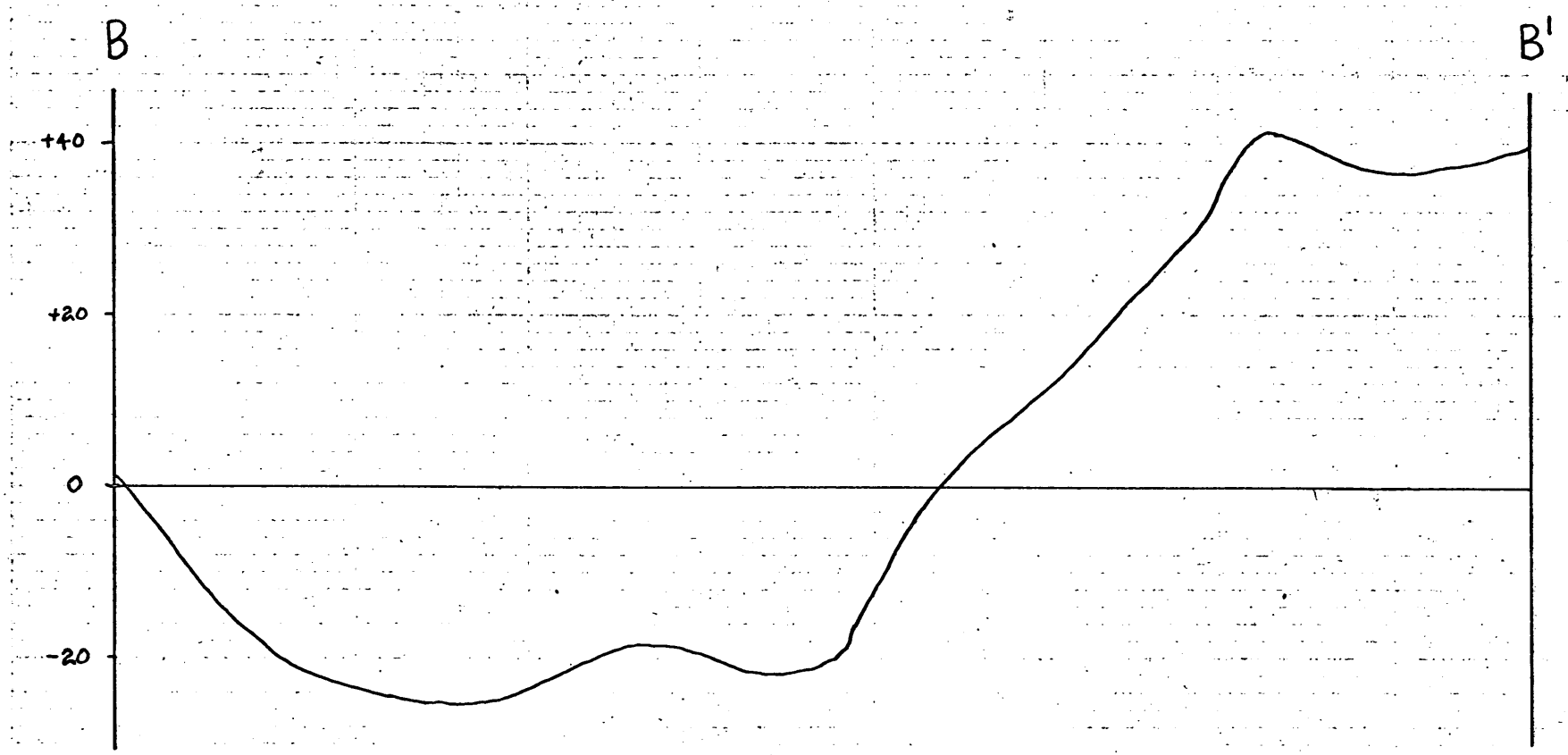


Figure 4. Section B-B'

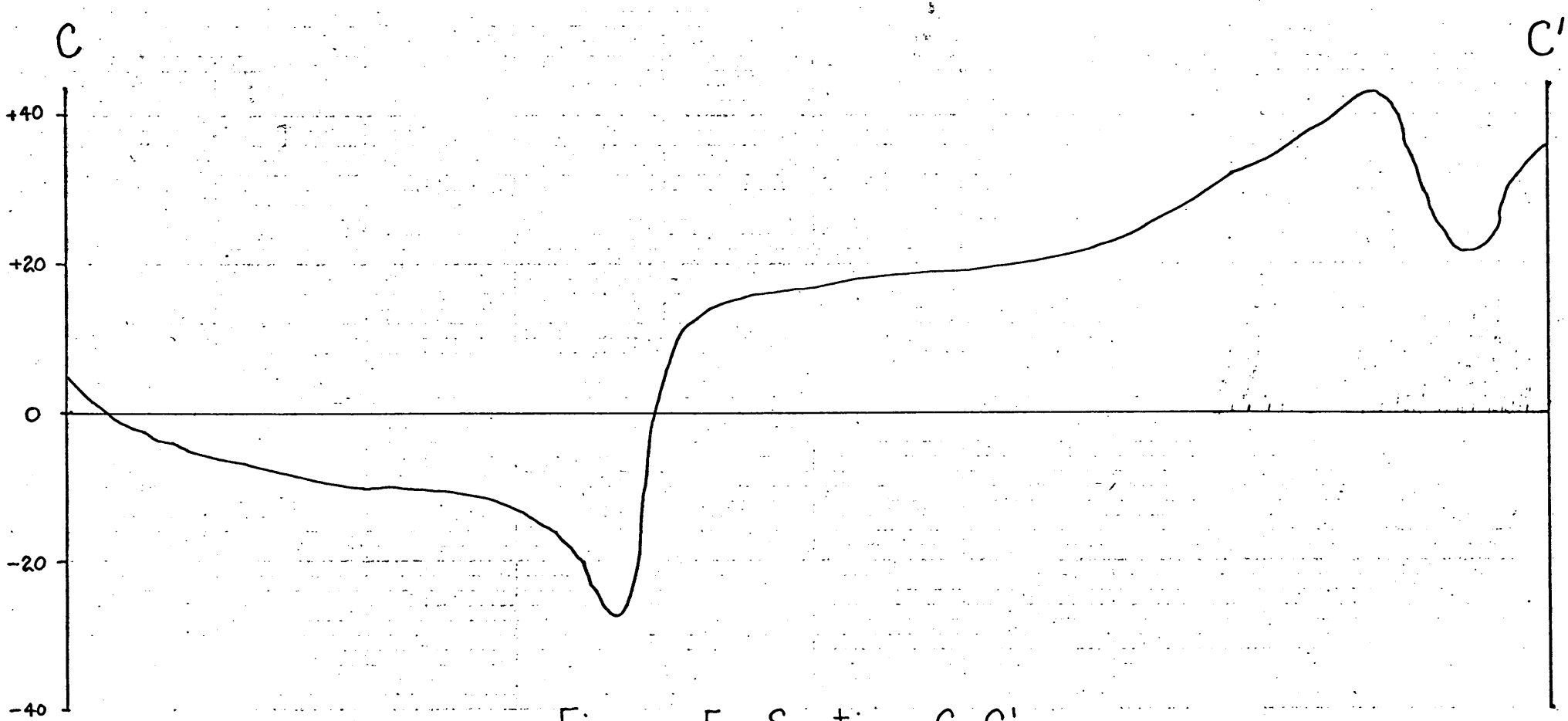


Figure 5. Section C-C'

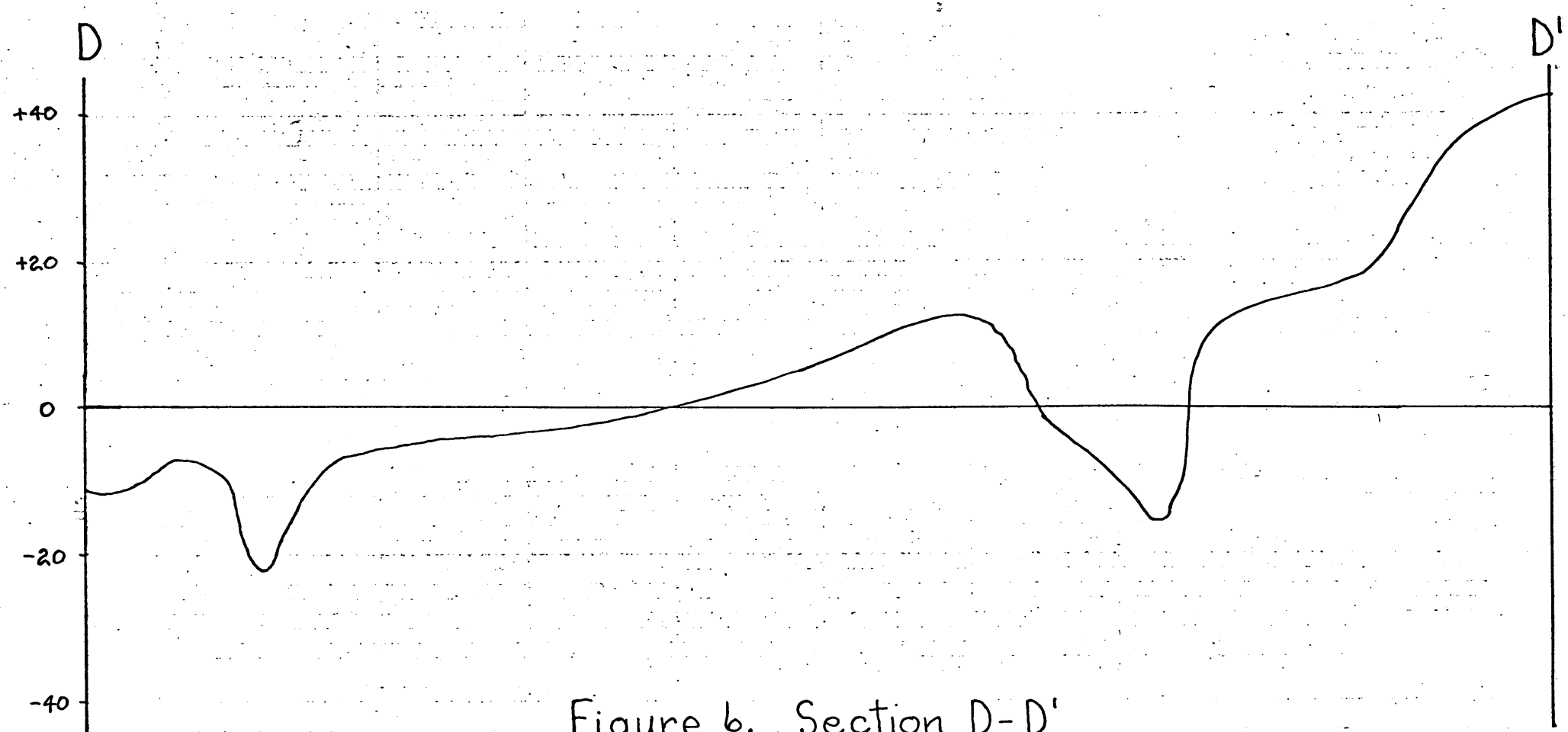
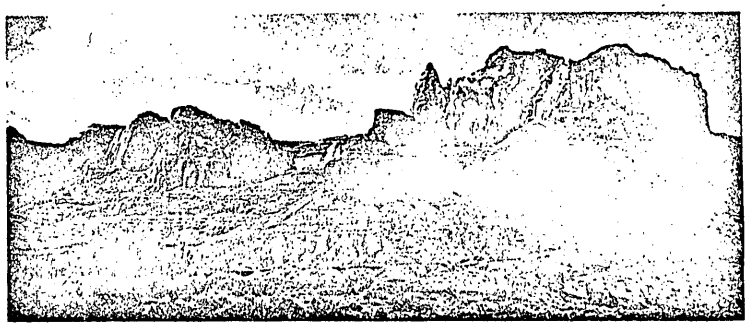


Figure 6. Section D-D'

Figure 7. Section E-E'

DL DAVIS
Room 22

APACHE MOTEL
166 S. 4th E. • MOAB, UTAH • PH. 253-3771



"Heart of the Canyonlands"

Feb. 5, 1967

Mr. Walter Hoover
Gen. Del.
Lone Pine, California

Dear Walter:

A review of Brian Krogseng's recommendations for drilling the Hoover-Greenwood claims raises a question regarding the exploration for a steeply inclined high-grade vein-float from which is abundant in the area. Krogseng's program is designed to explore for bedded replacement ore indicated by S.P. survey.

I would like to have you make application for three inclined diamond drill holes - exact location to be spotted after the vertical holes have been drilled - in order to prospect for the presumably steep-dipping fissure-feeder near the best replacement ore found.

We should discuss this with Harold Stager.

Very truly yours,

Dudley L. Davis

APACHE MOTEL
MOAB, UTAH

February 2, 1967

Mr. Walter Hoover
Gen. Del.
Lone Pine, Calif.

Dear Walter:

Enclosed is the map of the Hoover-Greenwood claims staked about a month ago. Please tie Krogseng's S.P. survey to these claims for your application for amendment of the OME loan. Also, you will need to show specific locations of the proposed drill holes on this claim map before prints are made.

I think it would be well to include an angle hole or two to check that fault zone we looked at where evidently a good vein structure has been covered by basalt on the Silver Reid No. 7(?) claim. This area is high on the hill near the northeastern basalt-limestone contact.

Please let me know when Hal wants to check the amended proposal.

Best regards to Mrs. Hoover and Bill Skinner.

Very truly yours,
Dudley L. Davis

WALTER M. HOOVER
764 LORAINE
GROSSE POINTE 30, MICHIGAN

extra copy

March 25, 1966

Office of Mineral Exploration
Department of the Interior
Washington 25, D.C.

Re: Re-application for Loan.
"Lee" Mine. OME-6234

Gentlemen:

Since our application #6234 for a loan to explore the "Lee" Mine was denied in 1962, we have done approximately $20,800.00 worth of additional work. We ran a geophysical survey with Sharpe 300 E.M. instruments. Several Anomolies were found, and a sketch, Plate #HL-2 covering them is enclosed. Also, in 1963, '64 and '65, diamond drill cores were taken from holes #(2), #(3) & #(11), 181', 224', and 456' respectively. A 312' hole #(1) was drilled in 1961. These cores are stored at the Anaconda mine in Darwin.

Holes #(2) & #(3) cut through a 12' granitic sill similar to those associated with the ore at Darwin, 10 miles south of the "Lee". This is the first time these sills have been encountered in the "Lee" area. Some ore was cored from Hole #(2). Hole #(11), about 600' S.E. of the old diggings was drilled because the limestone "country rock" from a 20' shaft showed alteration and assayed approximately 2% Zn and 2oz. Ag. The mineralization continued for about 350' when these trace assays faded out. The first 80' ± of this hole was highly silicified and very hard drilling.

1400' S.E. of the mine is an old gold prospect that has a 1/2" to 1" seam of Garnierite that assays $512.00 in Gold. It is part of a ledge of gouge which assayed .20 Zn, .10 Pb, .68 Ag & .10 Au. None of the gold seam was included in the sample which was across a width of 35". We believe the trace assays of Pb, Zn & Ag may be significant. A claim covering this ground has been located as well as three others. A subordination agreement for these new claims is

enclosed. These Hoover-Silver claims #1,2,3,-6 are recorded in Volume 98 page 125 at The Inyo County Recorders office at Independence, California.

The new report of Mr. Dudley Davis geologist, is enclosed. I wish to stick closely to his recommendations; however, there are other holes that I feel are justified in our drilling program.

Specifically:

1. Hole #7 suggested by L.J. McCarthy, geologist, in the area of the anamolies.
2. Holes #4,#5, & #6 to further investigate the granitic sill or sills and to penetrate a likely area near the junction of a quartz ledge and the shear zone south of the main diggings. This fault had some ore in place and some dragged ore, and it seems to me that the possible intersection of a vein leading to the old diggings and this fault might carry ore.

I have, therefore, included these holes in the list of work to be done. If you do not concur, of course we will eliminate them from our program.

A summary of the costs is as follows:

Recondition shaft etc as stated in the original application	$ 2,842.00
Item #5 original application	3,658.00
Phase II " "	11,700.00
Consulting geologist additional 10 Visits @ $250.00	2,500.00
Supervision & Expense $750,00 Mo. X 10	7,500.00
Assays approximate 1 per 100' of core @ $11.00	450.00
4,050' of Dia. Drilling @ $10.50	42,525.00
	$71,175.00
O.M.E. Loan 75%	$53,381.50

Since the first application, Mr. Alden Johnson has discontinued his association with the venture and Mr. Alfred Greenwood has undertaken the financing. A quit claim deed executed by Mr. Johnson, and an agreement with Mr. Greenwood are enclosed.

Diamond drilling bids are enclosed. A tabulation of the bids and a conservative estimate of the extras show costs exceeding $11.00 per foot. Mr. John Madison has verbally agreed to drill the ground for a flat $10.50 (No extras).

In the event that you wish to re-examine the property, Mr. Davis will be available. He can be reached at 1528 Michigan Ave., Salt Lake City 5, Utah, telephone 801-322-4263 or at Box 1481, Grand Junction, Colorado. If his presence is not required, Mr. John Kinneberg, Anaconda Mine, Darwin California will provide you with a guide to the Lee mine.

Five coppies each are enclosed of the following:

(a) Mrs. Reids new subordination agreement.
(b) Hoover's subordination of 4 Hoover-Silver claims.
(c) Johnson's quit claim deed.
(d) Greenwoods agreement.
(e) Geologists new report.
(f) Mine map. Plate HL-1
(g) Map showing anomolies and proposed drill holes. Plate HL-2
(h) New assays
(i) New bank loan refusals
(j) Drill bids
(k) Drill bid recap
(l) Drilling schedule upon which bids were based.

If Mr. Greenwood's signature is necessary on the application, time could be saved by sending it to him directly at 4737 Stamp Road., S.E. Washington, D.C. 20031.

Mr. Madison, the diamond driller, is now available and work could start within ten days of approval. I would be on the job myself to supervise the work, take care of cores, assays etc.

If it would help, I could see your West Coast representative for instructions, on the way out to the mine.

Thank you for your consideration and past courtesies.

Respectfully submitted,

W. M. Hoover, Mgr.

MME Form 40
Dec. 1958

Budget Bureau No. 42-R1368
Approval expires Dec. 31, 1963

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF MINERALS EXPLORATION

APPLICATION FOR FINANCIAL ASSISTANCE IN MINERALS EXPLORATION

Pursuant to Public Law 85-701 (72 Stat. 700; 30 U.S.C. 641)

NAME OF APPLICANT *(Full legal name and mailing address as they should appear on contract if one is executed.)*

WALTER M. HOOVER
764 LORAINE,
GROSSE POINTE, MICH. 48230

APPLICANT DO NOT USE THIS BLOCK

DOCKET NUMBER

DATE RECEIVED

REGION

DIVISION CODE

BUSINESS ORGANIZATION *(Check one)*

INDIVIDUAL ☐
CORPORATION ☐
PARTNERSHIP ☐
OTHER *(Specify)* ☑
JOINT VENTURE

STATE IN WHICH FIRM IS ORGANIZED

LIST CORPORATE OFFICERS OR PARTNERS HERE, IF APPLICABLE

NAME	ADDRESS	TITLE
W. M. HOOVER	764 LORAINE, GROSSE POINTE, MICH.	MANAGER
ALFRED GREENWOOD	4737 STAMP ROAD, S.E. WASHINGTON, D.C.	

MINERAL(S) FOR WHICH YOU WISH TO EXPLORE
SILVER WITH LEAD & ZINC SOME AU.

ESTIMATED COST OF PROJECT
$ 71,175

PROPERTY NAME: LEE MINE (SILVER REID CLAIMS & HOOVER SILVER "")

LOCATION — COUNTY: INYO — STATE: CALIF.

GENERAL INSTRUCTIONS

Before filling out this application, please read the *OME Regulations for Obtaining Federal Assistance in Financing Explorations for Mineral Reserves* (30 CFR Chap. III). To assure prompt action, your application must provide all applicable material and information specified on the back of this application form. Avoid unnecessary correspondence and delays by submitting complete and accurate information. *Please submit four copies of this application and all accompanying papers* except as otherwise noted. Place your name and address on each sheet. Each item of information, maps, and reports required as a part of this application is described on the back of this form. Identify each attached statement by the item number to which it applies. If an item does not apply to your application, show the item number on your statement and after it write "not applicable." Maps or sketches should be used to supplement narrative descriptions of the property location and boundaries in item 2, existing mine workings and geology in item 3, and the proposed exploration work in item 5. When this information is not too complex, all of it may be shown on one map or sketch. All documents and other attachments submitted as a part of this application, except those in item 3(g) which you mark to be returned, become the property of the Government and will not be returned to the applicant. Send true copies, *not originals*, of leases, contracts, and other documents which are an essential part of your business records. *File this application with the Office of Minerals Exploration, Department of the Interior, Washington 25, D. C., or with the nearest OME Field Office.*

CERTIFICATION

The undersigned, whether as an individual, corporate officer, partner, or otherwise, both in his own behalf and acting for the applicant, certifies that the information set forth in this form and accompanying papers is correct and complete, to the best of his knowledge and belief, and that he would not ordinarily undertake the proposed exploration under current conditions and circumstances at his sole expense.

MARCH 25, 1966
DATED

W M Hoover
BY *(Signature)*

MANAGER
TITLE

A wilfully false statement or certification to any Department or Agency of the United States Government is a criminal offense. U. S. Code, Title 18, Sec. 1001.

Supplementary Report
Silver Reid Mine
Inyo County, California

February, 1966

Dudley L. Davis

INTRODUCTION

This report will bring up-to-date one written in 1962 which became a part of O.M.E. application No. 6234. It is presumed that the reader has access to this prior report, hence the location, accessibility, ownership, history, and record of production are not reiterated.

In the interim, a geophysical survey has been run and three diamond drill holes have been drilled. No production has been made from the mine nor has any underground development work been accomplished.

A summary of results of geophysical survey is presented on Plate HL-2, and Plate HL-1 shows diamond drill holes Hoover No. 1, No. 2, and No. 3 as well as holes previously recommended. A discussion of this work and recommendations for additional exploration is presented below.

DIAMOND DRILL RESULTS

Hoover's No. 1 drill hole followed Davis' recommendation No. 3 (February, 1962 report) and cut silver ore assaying 21.8 oz. per ton at the projected position of the ore bed exploited by mine workings.

Hoover's No. 2 hole extended this ore zone 100' further to the east where it cut ore averaging $33.00 (25.58 oz. per ton) at a depth of 120 feet below the surface. This ore lies above a granite sill twelve feet in thickness.

The granite sill may be important genetically since much of the ore mined by Anaconda at Darwin (about ten miles to the south) was found near similar sills.

Hoover's No. 3 hole was drilled about 220 feet N. 52°E. from No. 2 and was run to prospect the geophysical anomaly shown by McCarthy's E.M. survey. The hole cut the 12-foot granite sill but found no silver ore.

Hoover's No. "11" hole, drilled at a point S. 51°E., 445 feet from No. 2 hole, cut 3 ounce silver mineralization at 148 feet. Traces were found at 313 feet which represents the ore bed as projected but appears off the ore shoot.

GEOPHYSICAL DATA

Plate HL-2 shows the interpretation of an electromagnetic dip-angle survey ~~run~~ INTERPRETATION by L. J. McCarthy with an additional interpretation by Charles E. Melbye.

The principal anomaly lies parallel with known ore structure but approximately 100 feet to the northeast. Depths correspond roughly to a zone 100 feet deeper than the known horizon.

RECOMMENDATIONS

In view of the ore found by drill holes Hoover No. 1 and No. 2, it seems likely that a substantial silver ore deposit may be found at the Silver Reid (Lee Flat) mine. Also, the anomaly map shows the possibility of a new ore horizon at 100 feet below the one mined and generally 100 to 300 feet to the northeast.

Hoover's hole No. 11 showed two ore horizons but was weakly mineralized so additional offset drilling in that area is justified. Likewise, the three-foot shear zone near point 19 just south of the Hoover-Silver No. 3 north side line should be prospected.

Diamond drilling and underground exploration is recommended as shown below.

1. Drill holes 1, 3, 7, 13, 14, 15 and 16 as shown on Plate HL-2. These seven holes will aggregate 1500 feet of "BX" hole if No. 3 is drilled 300 feet deep as geologic structure would indicate rather than 100 feet as shown. These holes will evaluate the geophysical anomaly.

2. Drill holes #4 and #5 as recommended by Davis in 1962. This amounts to 300 linear feet of drilling and will check the deeper zone (indicated by the E.M. survey) under the mine area.

3. Drill two vertical holes 350 feet deep, the first 150 feet N. 45° E. of Hoover No. 11 and the second 150 feet north of No. 11.

4. Drill three inclined holes to prospect the gold-bearing shear zone at 100, 200 and 300 feet below the surface. These holes should be from point 19: drill S. 50° W. for 125 feet at minus 60°, S. 20° W. for 250 feet at minus 70°, and S. 80° W. 350 feet at minus 80°.

5. Rehabilitate mine workings as recommended in the O.M.E. application and sink an inclined winze to ore cut in Hoover's No. 1 hole. This amounts to fifty feet of new winze plus repair of existing shaft and surface facility.

Respectfully submitted,

Dudley L. Davis

DUDLEY L. DAVIS

8 pt. type or larger

RECORDING REQUESTED BY

AND WHEN RECORDED MAIL TO

Name
Street Address
City & State

SPACE ABOVE THIS LINE FOR RECORDER'S USE

QUITCLAIM DEED

FOR A VALUABLE CONSIDERATION, receipt of which is hereby acknowledged

I, ALDEN P. JOHNSON
#4 PAUL REVERE ROAD
WORCESTER, MASS.

do hereby

REMISE, RELEASE AND FOREVER QUITCLAIM to

WALTER M. HOOVER
764 LORAINE GROSSE POINTE, MICH. 48230

the real property in the County of INYO
State of California, described as:

1/4 INTEREST IN A LEASE AND OPTION ON THE "SILVER REID" MINING CLAIMS, MORE COMMONLY KNOWN AS THE LEE MINE, LOCATED 6 MILES NORTH OF STATE HIGHWAY #190 AND 1 MILE EAST OF THE SALINE VALLEY ROAD, IN THE LEE MINING DISTRICT, INYO COUNTY, CALIFORNIA.

Dated:

State of ~~California~~, Mass.
County of Worcester } ss

On 3/9/66, before me, the undersigned, a Notary Public in and for said County and State, personally appeared Alden P Johnson

known to me to be the person whose name subscribed to the within Instrument and acknowledged that he executed the same.

Witness my hand and official seal.

(Seal) Frank M. Heath Jr.

My Commission Expires Dec. 23, 197 FRANK M. HEATH, JR.
NAME (TYPED OR PRINTED)
Notary Public in and for said County and State.

Title Order No. Escrow or Loan No.

DEED—QUITCLAIM—WOLCOTTS FORM 790
REVISED 11-60

This standard form covers most usual problems in the field indicated. Before you sign, read it, fill in all blanks, and make changes proper to your transaction. Consult a lawyer if you doubt the form's fitness for your purpose.

MEMORANDUM OF AGREEMENT

THIS AGREEMENT, made and entered into this 28th day of April, 1965, by and between WALTER M. HOOVER, whose address is 764 Loraine, Grosse Pointe, Michigan, party of the first part, and ALFRED GREENWOOD, who resides at Great Falls, Virginia, second party,

W I T N E S S E T H :

WHEREAS, first party is the lessee of those certain unpatented mining claims situate in the County of Inyo, State of California, described as follows:

SILVER REID Mining Claim
SILVER REID No. 1 Mining Claim,
SILVER REID No. 2 Mining Claim,
SILVER REID No. 3 Mining Claim,
SILVER REID No. 4 Mining Claim,
SILVER REID No. 5 Mining Claim,
SILVER REID No. 7 Mining Claim, and
SILVER REID No. 8 Mining Claim,

and

WHEREAS, first party is engaged in the business of developing and mining said unpatented mining claims, and desires to associate second party with himself to provide and furnish certain necessary capital for the development and mining of said properties to the best possible advantage and for the mutual benefit of the parties hereto;

NOW, THEREFORE, it is hereby mutually agreed and convenanted by the parties hereto, on the conditions and considerations herein recited, that the second party provide and furnish the sum of Five thousand dollars ($5,000.00) for the development and/or mining of said properties, and such further sums as may be justified and required for the development of the property, and receive as consideration therefore, a sum or sums equal to fifty per cent (50%) of the net proceeds realized from mining operations conducted on said mining premises.

Original

All sums paid by second party unto first party pursuant to the terms and provisions of this agreement shall be used solely for the development of said mining properties and the expenses of mining, processing and shipping ores and materials from said mining claims to market. First party shall keep accurate accounts showing all sums received and all sums expended in connection with the development and operation of said mining properties, and furnish unto second party accurate accounting showing all such funds received and expended at such times as second party may request the same.

From the net proceeds realized from the development and mining of said mining property first party shall pay unto second party a sum or sums equal to fifty per cent (50%) of such net proceeds. Settlement shall be made at such times as may be mutually agreed upon between the parties, and no funds shall be withdrawn from the venture that might in any way prevent its continuance on a profitable basis.

First party shall have the right and responsibility of the management of the venture, provided, however, that he shall at all times and in all things exercise the utmost good faith toward second party in the conduct, mamagement and operation thereof.

It is understood, stipulated and agreed by and between the parties hereto that second party shall not be liable for any indebtedness created by the venture or for damages to others resulting from the conduct of the business of the venture, or otherwise, except to the extent of his contribution in the amount of Five thousand dollars ($5,000.00).

Upon demand of second party a partnership shall be created between the parties hereto for continuance of the business of the venture, but until the creation of such partnership the relationship hereby created shall be deemed and considered that of a joint venture and not co-partnership.

This agreement shall inure to the benefit of and be binding upon the parties hereto, their heirs, executors, administrators and assigns.

IN WITNESS WHEREOF, the parties have executed this agreement in triplicate the day and year first above written.

Walter M. Hoover
FIRST PARTY

Alfred Greenwood
SECOND PARTY

DETROIT
BANK
& TRUST

DETROIT, MICHIGAN 48231

Fisher Building Office

JOSEPH W. CLARK
ASSISTANT VICE PRESIDENT

January 13, 1966

Mr. Walter M. Hoover
764 Loraine
Grosse Pointe, Michigan 48230

Mr. Hoover - we are not in a position to extend you a loan of $60,000 which you requested to finance your drilling program on the "Lee" Mine, Inyo County, California.

This is a very highly speculative venture and the financial information and other data available to us would not justify a loan of this sort.

We wish you success in your undertaking.

Joseph W. Clark

Cable Address — BANKAMERICA

Bank of America
NATIONAL TRUST AND SAVINGS ASSOCIATION

LONE PINE BRANCH • 400 NORTH MAIN STREET
LONE PINE, CALIFORNIA 93545

January 12, 1966

Mr. Walter M. Hoover
764 Loraine
Grosse Pointe 30, Michigan

Dear Mr. Hoover:

We are not in a position to grant a loan as requested for exploratory work on the Lee Mine.

Sincerely,

W. W. Hastings
Manager

WWH:ab

E. J. LONGYEAR COMPANY
General Offices, 76 South 8th St.
Minneapolis 2, Minnesota, U. S. A.
TELEPHONE: FEDERAL 9-7631 • CABLE LONGCO

308 East Pima Street
Phoenix, Arizona 85004
February 28, 1966

Mr. W. M. Hoover
764 Loraine
Grosse Point 30, Michigan

SUBJECT: PROPOSAL COVERING CORE DRILLING ACTIVITY, LEE MINE, INYO COUNTY, CALIFORNIA, VICINITY DARWIN, CALIFORNIA

Dear Mr. Hoover:

1. In response to your request for a proposal covering core drilling operations at your Lee Mine location in Inyo County, California, we are pleased to submit our proposal as outlined below.

2. Our understanding of your program is as follows:

The program will consist of drilling approximately 21 holes ranging in depth from a minimum of 100 feet to a maximum of 400 feet for an approximate total drilling of 4,965 feet. The inclination of the holes will vary from a minus 60 degrees to a minus 75 degrees as measured from the horizontal. Water for drilling purposes is obtainable from the town of Darwin, 20 miles distance one way or Panamint Springs, 21 miles one way. The formation to be penetrated consists generally of medium hard limestone of which the first 100 feet or so is expected to be highly silicified and very hard. Furthermore, the formation can be expected to be highly fractured involving loss of water and requiring frequent grouting to stabilize the hole or to retain water circulation.

It is understood that you will provide suitable access roads and will prepare, if required, suitable drill sites.

Housing for crew is non-existent in the area. It would be necessary for them to live either in Olancha or possibly as far away as Lone Pine, California.

For the most part, the drilling will be carried out with BX and AX size wireline tools.

3. For the work as outlined above, we propose to furnish one complete core drilling machine together with all the required accessory equipment including service and water truck. We would expect to operate the rig on a one shift basis, six days per week.

4. We will carry public liability insurance covering personal injury and property damage, and Workmen's Compensation insurance and also all-risk

insurance on the drilling equipment protecting against loss by theft, fire, flood, landslides and other similar hazards. Certificates showing the coverage referred to will be furnished upon request.

5. Based upon the conditions anticipated in this work, we would expect the following prices and conditions to prevail.

a) Mobilization and demobilization of personnel and drilling equipment.....$695.00 Lump Sum

b) Overburden drilling, where required in alluvial material or eroded ledge rock, including setting casing to ledge.....$6.50 per foot

c) Diamond core drilling, vertical or angle holes with inclination of 60 degrees or steeper -

	AX WL	BX WL
Ledge to 500 feet in depth.....	$6.95/ft.	$7.45/ft.

d) Reaming, if required and where applicable -
AX hole to receive AX casing.....$3.00 per foot
BX hole to receive BX casing.....$3.35 per foot

NOTE: In computing the prices that will prevail under the diamond core drilling section, item c, and the reaming, item d, we assumed a diamond bit cost of $1.25 per foot. In the event actual costs incurred in performing this work exceed the $1.25 per foot allowed, such overage of allowable cost will be invoiced to you. The basis for determining the cost per foot on our diamond bits would be computed using $11.25 per carat diamonds for the diamond loss, plus applicable setting charges divided by the number of feet drilled per bit.

e) Delays or standby time requested by you or for which you are responsible.....$12.25 per hour with 2-man drill crew.

f) Time spent by crews cementing, waiting for cement to set and drilling out cement or other time consumed in hole stabilizing or hole plugging operations will be invoiced at.....$13.50 per hour with 2-man drill crew.

g) Cement, drill mud, additives or other stabilizing or hole plugging material consumed will be invoiced to you at our cost, F.O.B. job site basis.

h) Casing or pipe lost or left in holes at your request will be invoiced at our cost, F.O.B. job site basis.

i) Water truck service will be provided on the following basis:

(1) Water truck rental charge.....$200.00 per month plus 15¢ per mile traveled while engaged in water hauling activity.

(2) We would expect to utilize the drill helper for the purpose of driving the water truck. As long as this arrangement can be maintained without subjecting the drilling operation to excessive delays as a result of waiting for water or the helper, no charge will be made for his service. However, in the event it should become necessary to hire a full time, separate employee for the purpose of driving the water truck, it is understood and agreed that we would invoice to you $3.50 per hour for his time to offset the resultant additional wages, payroll taxes and other related expenses.

(3) Any charges arising from the purchase of water at its source will be invoiced to you.

j) Tractor or other service, if required for the preparation and maintenance of drill access roads and the preparation of proper drill sites, if not performed by you, will be obtained locally and invoiced to you at our cost, plus a 10% handling fee.

k) Core boxes, cardboard type, capacity ten feet of core will be supplied by the Longyear Company, if requested, in either BX or AX size for.....$1.00 each

6. It is understood if we are awarded this work that the starting date of drilling operations will be contingent upon the availability of equipment and personnel. At the present time, we would expect a minimum of 30 days would be required before mobilizing operations could commence.

7. Due to a lack of necessary financial information, it is understood that if we are awarded this work that you will make suitable financial arrangements with the Longyear Company for payment of the work prior to the time that mobilizing operations commence.

8. Statements would be submitted promptly after the end of each month covering work performed during the month and payment will become due twenty days from date of statement.

9. We appreciate the opportunity to submit this proposal to you and apologize for the time that it has taken us to accumulate the necessary information. Because of the high activity in core drilling operations at this time of the year, we would appreciate learning of your decision concerning the award of this work at the earliest possible date.

If the above proposal is acceptable to you, please sign in the space provided, retain two copies for your files and return the original signed copy to us in Phoenix.

Sincerely,

J.R.Miller:jag

E. J. LONGYEAR COMPANY

ACCEPTED:

Company_____

J. R. Miller

By_____

Manager, Southwestern Zone
Contract Drilling Division

Date_____

HIMES DRILLING COMPANY
CONTRACT DRILLING
2390 HIGHWAY 6 & 50
GRAND JUNCTION, COLORADO

PHONE 242-8893

March 9, 1966

Via Air Mail

Mr. Walter M. Hoover
764 Loraine
Grosse Point 30, Michigan

Dear Mr. Hoover:

I talked with Mr. Dudley Davis as you suggested in your recent reply. He furnished me with the details on your proposed drilling in Inyo County, California. I respectfully submit the following prices and conditions as my bid on this drilling project:

AX CORE

0-100 feet	$ 7.50 per ft.
101-200 feet	10.00 per ft.
201-300 feet	12.50 per ft.
301-400 feet	15.00 per ft.

The prices quoted are with the understanding we will drill approximately 4,965 feet before moving from the drill location.

Reaming and setting casing and/or cementing and redrilling--
$ 4.00 per ft.

Transporting of water for drilling operation is included in the footage price.

Mobilization of equipment to the drilling location and demobilization of equipment at the completion of the job--Total $2,000.00.

Thank you, Mr. Hoover, for your consideration.

Sincerely,

HIMES DRILLING COMPANY

Bud Himes

Bud Himes

BH/ph

DIAMOND CORE DRILLING
DIAMOND DRILLING EQUIPMENT
GROUTING
FOUNDATION TESTING
MINING
QUARRYING
SHAFT SINKING
TUNNEL DRIVING
MINE PLANT DESIGN
AND FABRICATION

Boyles Bros.
DRILLING COMPANY
CONTRACTORS - ENGINEERS - GEOLOGISTS
600 Industrial Way
SPARKS, NEVADA
Phone: 355-3233

General Offices and Plant
1624 Pioneer Road P. O. Box 58
SALT LAKE CITY 10, UTAH
HUnter 7-7595

BRANCH OFFICES
PHOENIX
RENO
SPOKANE
DENVER
SACRAMENTO
ST. LOUIS

January 25, 1966

Mr. Walter M. Hoover
764 Loraine
Grosse Pointe 30, Michigan

Dear Mr. Hoover:

Your letter of January 10th to Boyles Bros. Drilling Company of Vancouver, B.C. has been referred to us. This is the Nevada and Southern California branch of Boyles Bros Inc. of Salt Lake City, Utah. We are familiar with the area you mention and would like to submit the following prices for your consideration.

1. Mobilization $750.00

2. Drilling rates for holes up to 500 feet in depth—NX Size $8.00 per foot.
   BX Size $7.50 per foot.

3. All bit cost in excess of $1.50 per foot will be to your account.

4. Moving and setting up between holes and including first set up—$12.50 an hour.

5. Cleaning and casing previously drilled holes—$15.00 an hour.

6. Casing lost in a hole or left at customer's request will be charged at list price f.o.b. the job.

7. Cementing, if necessary, will be charged at $12.50 per hour plus cement or cement substitutes, which include drilling mud and additives. These will be charged at list price f.o.b. the job or customer may furnish them to our specifications if he desires.

8. Water to be charged at cost, based on truck rental of $225.00 per month plus 12 cents per mile and drivers wages including payroll taxes and insurance. Customer may supply the water if he prefers.

9. Delays caused through no fault of Boyles Bros will be charged for at $12.50 per hour.

If these prices meet with your approval we would appreciate an early notification in order toschedule crews and equipment. A formal contract will be sent to you at this time for your signature.

Thank you for the opportunity of bidding on your work.

Yours truly,
Joe D. Fetterhoff
Joe D. Fetterhoff
District Manager

L.J. PRICE & COMPANY

9949 BARIUM LANE
SANDY, UTAH -84070

March 15, 1966

Walter M. Hoover
764 Loraine
Grosse Point, 30 Michigan

Gentlemen;

We present our bid for drilling at the Lee Mine property, near Darwin Cal. We understand that water must be hauled to the drill site, and at our expence, and the distance to haul water is around 21 miles.

Drill site preparation is to be completed by your Company, and any road necessary to bring drilling equipment to the mine is at your expence.

The price we show below for drilling is for Non-silicifed rock a $2.00 pr. foot extra charge will be added to the below prices for all formations penetrated that is silicifed.

Stand pipe or "NX" hole at the collor to 20 feet depth----------$10.50 pr.ft.

" BX " to a depth of 100 ft. ---- ---- ---- ---- ---- ---- $10.00 " "

"AX" from 0 ft. to 250ft.---- ---- ---- ---- ---- ---- ---- 9.50 " "

"AX from 250 ft. to 400 ft. ---- ---- ---- ---- ---- -0 $10.00 " "

Reaming AX to BX ---- ---- ---- .... $ 2.50 " "

Casing lost in a completed hole to be replaced by the owner at his expence.
Cement placed in the hole and redrilled .... $2.00 " "
Standby time for any reason requested by the project engineer.....
.... or time lost for setting up of cement so it can be drilled out... $20.00 " Hr.

Owner will supply core boxes and care for the same.

Very Truly Yours,

L. J. Price & Company

L.J.Price

DRILLING
BLASTING

QUARRYING
TUNNELING

METLER BROTHERS DRILLING CO.

Core Drilling Contractors

Route 7, Box 945 4001 E. Illinois Street ★ ★ ★ Phone 327-4268 Tucson, Arizona 85714

21 March, 1966

Mr. Walter M. Hoover
764 Lorain
Grosse Point 30, Michigan

Dear Mr. Hoover:

After looking at your proposed drilling program at the Lee Mine near Darwin, California, we are pleased to submit the following prices:

	(NX)	(BX)
a. Drilling (wireline)		
0 to 500'	8.00 per ft.	7.75 per ft.
500 to 1000'	8.50 " "	8.25 " "

b. Cementing and redrilling cement if required, are to be charged at the rate of #12.50 per hour plus the cost of cement.
c. Drilling mud hauled to jobsite and mixed @2.50 per 50# bag. Other mud additives used will be billed to your company at cost.
d. Reaming if required, will be charged at the rate of $4.00 ft.
e. Casing left in hole due to ground conditions or ordered left in place will be charged at contractor's cost.
f. Water Haul- We will furnish a water truck and haul water for $30.00 per shift plus driver's wages and cost of water if any.
g. Core boxes are to be furnished by your company, however, we will furnish them at $1.00 per box if requested.
h. Mobilization and demobilization -$500.00

Access roads and drill sites are to be prepared by your company in advance.

We intend to put a Joy 22 Truck mounted drill rig. This rig cannot drill angle holes.

Thank you for giving us the opportunity to quote prices on this project.

Very truly yours,

METLER BROS. DRILLING CO.

E. R. Metler

E. R. Metler

ERM/dr

COMPANY	MOBIL-IZE	OVERBURDEN SETTING UP ETC.	DELAYS	GROUTING & DRILL GROUT	MAT'L	WATER	ROAD WORK	MISC.	TOTAL	PER FOOT
									34,506.75	
LONGYEAR		$6.50	12.25 SETTING UP BTW HOLES 16x12.25x 21 HOLES	13.50 HR. MIN. 100x 8' x 13.50	CORE BOXES 480x$1.00 480 CEMENT 250	$200 Mo 15¢ MILE 10Mo 2000 2700		4965 $695	695 1040 4116 10,800 730 4700 100	
PHOENIX BRANCH	695.00	6.50x8'x20								
	695.00	1,040	4,116	10,800	$730	4,700	100		56,687.75	11.41
BOYLES BROS. SALT LAKE	750	SETTING UP 12.50 HR 16HRS x 21		12.50 HR. 100x8x12.50	480 250 CEMENT CORE BXS	$225 MO. 12¢ MILE 10 Mo AV. 1½ TRIPS/DAY 60x12x300 2160		4965 7.50 37,237.50	750 108 4200 10000 730 4410 37,237.50	
	$750	$4,200		10,000	730	4410	100		57,427.50	11.57
HIMES GRAND JUNCTION COLO.	2000			$4.00 FT. 100x8x$4.00	2100@ 1635@ 880@ 350@	7.50 = 15,750 10.00 = 16,350 12.50 = 11,000 15.00 = 5,250			2000 3200 48350 53550	
	2000			3200		48,350				10.79
L.J. PRICE SANDY, UTAH		20' @ 10.50 = 21x20x10.50 20 - 250' @ 9.50 = 250 - 400 @ 10.00 = $2.00 EXTRA SILICIFIED GROUT CORE BOXES $480 + LOST TIME		21x50'	= CEMENT 2000	4410 35,957.50 7,600 4,200 1,600 2,480	100		55,947.50	11.27
METLER BROS. TUCSON ARIZ.	500 500		DRILL MUD	$12.50 HR. 100x8x12.50	CEMENT CORE BOXES	$30.00 SHIFT $30x250	100	DRILL MUD 4965 7.75 38,478.75	38,478.75 100 7,500 730 10,000 1,000 57,808.75	
	1000			10,000	730	7500	100			11.64
JOHN MADISON PALMDALE						$10.50 PER FT.			52,132.50	$10.50

DATE ____ BY ____ CH'K'D BY ____ JOB ____ NO. SHEETS ____ SHEET NO. ____

WAYNE COUNTY ROAD COMMISSIONERS BOARD OF DETROIT, MICH.

LEE MINE

LOCATED 11 MILES NORTH OF DARWIN. 1 MILE EAST OF SALINE VALLEY ROAD.

INYO COUNTY CALIFORNIA

HOOVER 1-10-65

HOLES DRILLED	HOLES TO BE DRILLED	DEPTH	REMARKS
1		312'	DRILLED 75° TO CUT FAULT AT 600'-. NOT COMPLETED. SMALL ORE AT 62'
2		181'	CUT 13' GRANODIORITE SILL AT 118'-131'. SMALL ORE ABOVE.
3		224'	" " " " " 44-57'.
11		456'	TRACE MINERALS, Pb, Zn, AG. TO 350'± . HARD SILICIFIED LIME TO 90'±.
	1	100'	EXTEND HOLE 3 IN MINERALIZED AREA BELOW SILL.
	2	100'	TO CUT GRANODIORITE SILL TO DETERMINE ITS ATTITUDE.
	3	170'	" " " " " " " "
	4	175'	" " " " " " " "
	5	220'	TO CUT AREA OF 60° FAULT & QUARTZ LEDGE.
	6	300'	" " " " " " " " "
	7	350'	RECCOMMENDED BY GEOLOGIST McCARTHY. (IN ANOMOLY)
	8	350'	TO CUT AREA AROUND MINERALIZED HOLE 11.
	9	350'	" " " " " " "
	10	300'	" " " " " " "
	11	400'	" " " " " " "
	12	350'	" " " NORTH OF " " "
	13	260'	TO CUT AREA NEAR MINE & No. OF FAULT.
	14	200'	" " " " " " " " "
	15	140'	" " " " " " " " "
	16	100'	" " " " " " " " "
	17	350'	AREA OF EAST ANOMOLY
	18	200'	" " So. EAST "
	19	200'	60°-75° HOLE TO CUT 3' LEDGE AT DEPTH.
	20	150'	TO CUT AREA OF ARAGONITE & $200 FLOAT
	21	200'	AREA OF NORTH ANOMOLY.
		4965'	TOTAL - NEW DRILLING.

COMMENTS:~ GROUND, GENERALLY, IS MEDIUM-HARD LIMESTONE. FIRST 100' IN AREA OF HOLE 11 IS VERY HARD, HIGHLY SILICIFIED LIMESTONE. ALL GROUND IS FRACTURED & FREQUENT GROUTING IS NECESSARY. WATER IS AVAILABLE AT DARWIN (20 MILES) OR PANAMINT SPRINGS (21 M.) TRUCK & 600 GAL. TANK TRAILER IS AVAILABLE WITH DRIVER AT $30.00/DAY ALL HOLES CAN BE REACHED BY TRUCK.

THE EISENHAUER LABORATORIES
316-322 South San Pedro Street
Los Angeles 13, California

ASSAY CERTIFICATE

PHONE MADISON 2-9328

Los Angeles, Calif. Nov. 4/65 19

I hereby Certify that the samples described below, received from

W. M. Hoover

assay as follows:

Mark and Sample	GOLD		SILVER		TOTAL VALUE PER TON	PERCENTAGE OF		
	OZS. PER TON	VALUE PER TON	OZS. PER TON	VALUE PER TON		COPPER	LEAD	ZINC
Core 3-core at 222'			.64	$ .83	$ .83			
Bouge-35' gold ledge	.10	$ 3.50	.68	$ .88	$ 4.38		.10	.20
35'								
HOLE #3 & "GOLD PROSPECT" 1400' S.E.								

oz.

THE EISENHAUER LABORATORIES
316-322 South San Pedro Street
Los Angeles, California 90013

ASSAY CERTIFICATE

PHONE MADISON 2-9328

Los Angeles, Calif. Sept. 3/65 19

I hereby Certify that the samples described below, received from W. M. Hoover assay as follows:

Owner's Mark and Sample	GOLD		SILVER		TOTAL VALUE PER TON	PERCENTAGE OF		
	OZS. PER TON	VALUE PER TON	OZS. PER TON	VALUE PER TON		COPPER	LEAD	ZINC
40'	-----		.14	$ .18	$ .18			
13' to 360' -picked pcs.			.16	$ .20	$ .20			.11
15-344' sludge			.18	$ .23	$ .23			trac

GOLD @ $ 35 PER OZ.
SILVER @ $ 1.29 PER OZ.
LEAD @ ____ c.
COPPER @ ____ c.

Ed Eisenhauer Jr.
ASSAYER

CHARGES $ 14.00

Paid C.E.P.
9/3/65

Established 1916

THE EISENHAUER LABORATORIES
316-322 South San Pedro Street
Los Angeles, California 90013

ASSAY CERTIFICATE

PHONE MADISON 2-9328

Los Angeles, Calif. Oct. 29/65 19

I hereby Certify that the samples described below, received from

W. M. Hoover assay as follows:

Owner's Mark and Sample	GOLD		SILVER		TOTAL VALUE PER TON	PERCENTAGE OF		
	OZS. PER TON	VALUE PER TON	OZS. PER TON	VALUE PER TON		COPPER	LEAD	
#1-core 2-Hole 108	.09	$ 3.15	5.72	$ 7.38	$ 13.83			1.
#2-sludge #2-hole	.12	$ 4.20	30.46	$ 39.29	$ 73.19			9.
#3-core 2-Hole 119'	.08	$ 2.80	10.32	$ 13.31	$ 23.91			2.
#4-Hole 3-185'	.02	$ .70	.20	$ .26	$ .96			

1.10
9.90
2.60

GOLD @$ 35 PER OZ.
SILVER @$ 1.29 PER OZ.

E. Eisenhauer
ASSAYER

EISENHAUER LABORATORIES
316-322 South San Pedro Street
Los Angeles 13, California

ASSAY CERTIFICATE

PHONE MADISON 2-0328

Los Angeles, Calif. Nov. 4/65 19

I hereby Certify that the samples described below, received from

W. M. Hoover

assay as follows:

Mark and Sample	GOLD OZS. PER TON	GOLD VALUE PER TON	SILVER OZS. PER TON	SILVER VALUE PER TON	TOTAL VALUE PER TON	PERCENTAGE OF COPPER	PERCENTAGE OF LEAD	PERCENTAGE OF ZINC
3-core at 222'			.64	$ .83	$ .83			
-35' gold ledge	.10	$ 3.50	.68	$ .88	$ 4.38		.10	.20

35'

HOLE #3 &

"GOLD PROSPECT" 1400' S.E. OF MINE

oz.

THE EISENHAUER LABORATORIES
316-322 South San Pedro Street
Los Angeles, California 90013

ASSAY CERTIFICATE

PHONE MADISON 2-9326

Los Angeles, Calif. Sept. 3/65 19

I hereby Certify that the samples described below, received from W. M. Hoover assay as follows:

Owner's Mark and Sample	GOLD		SILVER		TOTAL VALUE PER TON	PERCENTAGE OF		
	OZS. PER TON	VALUE PER TON	OZS. PER TON	VALUE PER TON		COPPER	LEAD	ZINC
40'	----		.14	$ .18	$ .18			
13' to 360' -picked pcs.			.16	$ .20	$ .20			.11
15-344' sludge			.18	$ .23	$ .23			trac

GOLD @ $ 35 PER OZ.
SILVER @ $ 1.29 PER OZ.
LEAD @ ____ c.
COPPER @ ____ c.

CHARGES $ 14.00

Paid C.E.P.
9/3/65

Ed Eisenhauer Jr.
ASSAYER

Established 1916

THE EISENHAUER LABORATORIES
316-322 South San Pedro Street
Los Angeles, California 90013

ASSAY CERTIFICATE

PHONE MADISON 2-9321

Los Angeles, Calif. Oct. 29/65 19

I hereby Certify that the samples described below, received from

W. M. Hoover assay as follows:

Owner's Mark and Sample	GOLD OZS. PER TON	GOLD VALUE PER TON	SILVER OZS. PER TON	SILVER VALUE PER TON	TOTAL VALUE PER TON	PERCENTAGE COPPER	PERCENTAGE LEAD
#1-core 2-Hole 108	.09	$ 3.15	5.72	$ 7.38	$ 13.83		1
#2-sludge #2-hole	.12	$ 4.20	30.46	$ 39.29	$ 73.19		9
#3-core 2-Hole 119'	.08	$ 2.80	10.32	$ 13.31	$ 23.91		2
#4-Hole 3-135'	.02	$ .70	.20	$ .26	$ .96		

1.10
9.90
2.60

GOLD @ $ ___ PER OZ.
SILVER @ $ ~~1.29~~ 35 PER OZ.
LEAD @ ___ c.
COPPER @ ___ Zinc @ 15¢

CHARGES Paid

E. Eisenhauer
ASSAYER

Established 1916

PAUL SKINNER

ASSAYER

ONE PINE, CALIFORNIA — NOVEMBER 15, 1965

I HEREBY CERTIFY THAT THE SAMPLES DESCRIBED BELOW
CEIVED FROM W.M. HOOVER — ASSAY AS FOLLOWS:

			AU	AG	ZN
ORE HOLE	#11-	186'-6"		TRACE	
" "	"	29'-30'		0.5 OZ	
" "	"	79'		TRACE	
" "	"	193' SOFT WHITE		0.5 OZ	
LUDGE	"	174'-180'		TRACE	
ORE "	"	190' - DARK QUARTZ		2.0 OZ	
" "	"	200' - 7" and LM. PC.		1.0 OZ	
" "	"	230 - 234'		TRACE	
" "	"	148'	TRACE	2.5	0.55

THE EISENHAUER LABORATORIES
316-322 South San Pedro Street
Los Angeles, California 90013

ASSAY CERTIFICATE

PHONE MADISON 2-9328

Los Angeles, Calif. Sept. 3/65 19

I hereby Certify that the samples described below, received from W. M. Hoover assay as follows:

Owner's Mark and Sample	GOLD		SILVER		TOTAL VALUE PER TON	PERCENTAGE OF		
	OZS. PER TON	VALUE PER TON	OZS. PER TON	VALUE PER TON		COPPER	LEAD	ZINC
40'	-----		.14	$ .18	$ .18			
13' to 360' -picked pcs.			.16	$ .20	$ .20			.11
15-344' sludge			.18	$ .23	$ .23			trac

GOLD @$ 35 PER OZ.
SILVER @ $ 1.29 PER OZ.
LEAD @ ____ c.
COPPER @ ____ c.

CHARGES $ 14.00

Paid E.E.P.
9/3/65

Established 1916

E. Eisenhauer Jr.
ASSAYER

THE EISENHAUER LABORATORIES
316-322 South San Pedro Street
Los Angeles, California 90013

ASSAY CERTIFICATE

PHONE MADISON 2-0328

Los Angeles, Calif. Oct. 29/65 19

I hereby Certify that the samples described below, received from

W. M. Hoover assay as follows:

Owner's Mark and Sample	GOLD		SILVER		TOTAL VALUE PER TON	PERCENTAGE OF		
	OZS. PER TON	VALUE PER TON	OZS. PER TON	VALUE PER TON		COPPER	LEAD	
#1-core 2-Hole 108	.09	$ 3.15	5.72	$ 7.38	$ 13.83			1.
#2-sludge #2-hole	.12	$ 4.20	30.46	$ 39.29	$ 73.19			9.
#3-core 2-Hole 119'	.08	$ 2.80	10.32	$ 13.31	$ 23.91			2.
#4-Hole 3-185'	.02	$ .70	.20	$ .26	$ .96			
					1.10			
					9.90			
					2.60			

GOLD @ $ 35 PER OZ.

SILVER @ $ 1.29 PER OZ.

E. Eisenhauer

ASSAYER

Paul St. was did not sign these assays. Perhaps because he is not licensed. However, he is qualified. He is a graduate of the Mackay School of Mines & has been employed as an assayer. [illegible]

Hole #11

PAUL SKINNER

ASSAYER

LONE PINE, CALIFORNIA

NOVEMBER 15, 1965

I HEREBY CERTIFY THAT THE SAMPLES DESCRIBED BELOW RECEIVED FROM W.M. HOOVER

ASSAY AS FOLLOWS:

				AU	AG	ZN
CORE HOLE	#11-	186'-6"			TRACE	
" "	"	29'-30'			0.5 OZ	
" "	"	79'			TRACE	
" "	"	193'	SOFT WHITE		0.5 OZ	
SLUDGE	"	174'-180'			TRACE	
CORE "	"	190'	- DARK QUARTZ		2.0 OZ	
" "	"	200'	- 7" and LM. PC.		1.0 OZ	
" "	"	230 - 234'			TRACE	
" "	"	148'		TRACE	2.5	0.55

EISENHAUER LABORATORIES
316-322 South San Pedro Street
Los Angeles 13, California

ASSAY CERTIFICATE

PHONE MADISON 2-0328

Los Angeles, Calif. Nov. 4/65 19

I hereby Certify that the samples described below, received from

W. M. Hoover

assay as follows:

Mark and Sample	GOLD		SILVER		TOTAL VALUE PER TON	PERCENTAGE OF		
	OZS. PER TON	VALUE PER TON	OZS. PER TON	VALUE PER TON		COPPER	LEAD	ZINC
3-core at 222'			.64	$ .83	$ .83			
-35' gold ledge	.10	$ 3.50	.68	$ .88	$ 4.38		.10	.20

35'

HOLE #3 &

"GOLD PROSPECT" (400' S.E. OF MINE

oz.

Extra Copy

WALTER M. HOOVER
764 LORAINE
GROSSE POINTE 30, MICHIGAN

March 25, 1966

Office of Mineral Exploration
Department of the Interior
Washington 25, D.C.

Re: Re-application for Loan.
"Lee" Mine. OME-6234

Gentlemen:

Since our application #6234 for a loan to explore the "Lee" Mine was denied in 1962, we have done approximately $20,800.00 worth of additional work. We ran a geophysical survey with Sharpe 300 E.M. instruments. Several Anomolies were found, and a sketch, Plate #HL-2 covering them is enclosed. Also, in 1963, '64 and '65, diamond drill cores were taken from holes #(2), #(3) & #(11), 181', 224', and 456' respectively. A 312' hole #(1) was drilled in 1961. These cores are stored at the Anaconda mine in Darwin.

Holes #(2) & #(3) cut through a 12' granitic sill similar to those associated with the ore at Darwin, 10 miles south of the "Lee". This is the first time these sills have been encountered in the "Lee" area. Some ore was cored from Hole #(2). Hole #(11), about 600' S.E. of the old diggings was drilled because the limestone "country rock" from a 20' shaft showed alteration and assayed approximately 2% Zn and 2oz. Ag. The mineralization continued for about 350' when these trace assays faded out. The first 80' ± of this hole was highly silicified and very hard drilling.

1400' S.E. of the mine is an old gold prospect that has a 1/2" to 1" seam of Garnierite that assays $512.00 in Gold. It is part of a ledge of gouge which assayed .20 Zn, .10 Pb, .68 Ag & .10 Au. None of the gold seam was included in the sample which was across a width of 35". We believe the trace assays of Pb, Zn & Ag may be significant. A claim covering this ground has been located as well as three others. A subordination agreement for these new claims is

enclosed. These Hoover-Silver claims #1,2,3,-6 are recorded in Volume 98 page 125 at The Inyo County Recorders office at Independence, California.

The new report of Mr. Dudley Davis geologist, is enclosed. I wish to stick closely to his recommendations; however, there are other holes that I feel are justified in our drilling program.

Specifically:

1. Hole #7 suggested by L.J. McCarthy, geologist, in the area of the anamolies.
2. Holes #4,#5, & #6 to further investigate the granitic sill or sills and to penetrate a likely area near the junction of a quartz ledge and the shear zone south of the main diggings. This fault had some ore in place and some dragged ore, and it seems to me that the possible intersection of a vein leading to the old diggings and this fault might carry ore.

I have, therefore, included these holes in the list of work to be done. If you do not concur, of course we will eliminate them from our program.

A summary of the costs is as follows:

Recondition shaft etc as stated in the original application	$ 2,842.00
Item #5 original application	3,658.00
Phase II " "	11,700.00
Consulting geologist additional 10 Visits @ $250.00	2,500.00
Supervision & Expense $750,00 Mo. X 10	7,500.00
Assays approximate 1 per 100' of core @ $11.00	450.00
4,050' of Dia. Drilling @ $10.50	42,525.00
	$71,175.00
O.M.E. Loan 75%	$53,381.50

Since the first application, Mr. Alden Johnson has discontinued his association with the venture and Mr. Alfred Greenwood has undertaken the financing. A quit claim deed executed by Mr. Johnson, and an agreement with Mr. Greenwood are enclosed.

Diamond drilling bids are enclosed. A tabulation of the bids and a conservative estimate of the extras show costs exceeding $11.00 per foot. Mr. John Madison has verbally agreed to drill the ground for a flat $10.50 (No extras).

In the event that you wish to re-examine the property, Mr. Davis will be available. He can be reached at 1528 Michigan Ave., Salt Lake City 5, Utah, telephone 801-322-4263 or at Box 1481, Grand Junction, Colorado. If his presence is not required, Mr. John Kinneberg, Anaconda Mine, Darwin California will provide you with a guide to the Lee mine.

Five coppies each are enclosed of the following:

(a) Mrs. Reids new subordination agreement.
(b) Hoover's subordination of 4 Hoover-Silver claims.
(c) Johnson's quit claim deed.
(d) Greenwoods agreement.
(e) Geologists new report.
(f) Mine map. Plate HL-1
(g) Map showing anomolies and proposed drill holes. Plate HL-2
(h) New assays
(i) New bank loan refusals
(j) Drill bids
(k) Drill bid recap
(l) Drilling schedule upon which bids were based.

If Mr. Greenwood's signature is necessary on the application, time could be saved by sending it to him directly at 4737 Stamp Road., S.E. Washington, D.C. 20031.

Mr. Madison, the diamond driller, is now available and work could start within ten days of approval. I would be on the job myself to supervise the work, take care of cores, assays etc.

If it would help, I could see your West Coast representative for instructions, on the way out to the mine.

Thank you for your consideration and past courtesies.

Respectfully submitted,

W. M. Hoover, Mgr.

MME Form 40
Dec. 1958

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF MINERALS EXPLORATION

Budget Bureau No. 42-R1368
Approval expires Dec. 31, 1963

APPLICATION FOR FINANCIAL ASSISTANCE IN MINERALS EXPLORATION

Pursuant to Public Law 85-701 (72 Stat. 700; 30 U.S.C. 641)

NAME OF APPLICANT *(Full legal name and mailing address as they should appear on contract if one is executed.)*

WALTER M. HOOVER
764 LORAINE,
GROSSE POINTE, MICH. 48230

APPLICANT DO NOT USE THIS BLOCK

DOCKET NUMBER

DATE RECEIVED

REGION

DIVISION CODE

BUSINESS ORGANIZATION *(Check one)*

- INDIVIDUAL ☐
- CORPORATION ☐
- PARTNERSHIP ☐
- OTHER *(Specify)* ☑ JOINT VENTURE

STATE IN WHICH FIRM IS ORGANIZED

LIST CORPORATE OFFICERS OR PARTNERS HERE, IF APPLICABLE

NAME	ADDRESS	TITLE
W. M. HOOVER	764 LORAINE, GROSSE POINTE, MICH.	MANAGER
ALFRED GREENWOOD	4737 STAMP ROAD, S.E. WASHINGTON, D.C.	

MINERAL(S) FOR WHICH YOU WISH TO EXPLORE: SILVER WITH LEAD & ZINC SOME AU.

ESTIMATED COST OF PROJECT: $ 71,175

PROPERTY NAME: LEE MINE (SILVER REID CLAIMS & HOOVER SILVER "")

LOCATION — COUNTY: INYO — STATE: CALIF.

GENERAL INSTRUCTIONS

Before filling out this application, please read the *OME Regulations for Obtaining Federal Assistance in Financing Explorations for Mineral Reserves* (30 CFR Chap. III). To assure prompt action, your application must provide all applicable material and information specified on the back of this application form. Avoid unnecessary correspondence and delays by submitting complete and accurate information. *Please submit four copies of this application and all accompanying papers* except as otherwise noted. Place your name and address on each sheet. Each item of information, maps, and reports required as a part of this application is described on the back of this form. Identify each attached statement by the item number to which it applies. If an item does not apply to your application, show the item number on your statement and after it write "not applicable." Maps or sketches should be used to supplement narrative descriptions of the property location and boundaries in item 2, existing mine workings and geology in item 3, and the proposed exploration work in item 5. When this information is not too complex, all of it may be shown on one map or sketch. All documents and other attachments submitted as a part of this application, except those in item 3(g) which you mark to be returned, become the property of the Government and will not be returned to the applicant. Send true copies, *not originals*, of leases, contracts, and other documents which are an essential part of your business records. *File this application with the Office of Minerals Exploration, Department of the Interior, Washington 25, D. C., or with the nearest OME Field Office.*

CERTIFICATION

The undersigned, whether as an individual, corporate officer, partner, or otherwise, both in his own behalf and acting for the applicant, certifies that the information set forth in this form and accompanying papers is correct and complete, to the best of his knowledge and belief, and that he would not ordinarily undertake the proposed exploration under current conditions and circumstances at his sole expense.

MARCH 25, 1966
DATED

W M Hoover
BY *(Signature)*

MANAGER
TITLE

A wilfully false statement or certification to any Department or Agency of the United States Government is a criminal offense. U. S. Code, Title 18, Sec. 1001.

Supplementary Report
Silver Reid Mine
Inyo County, California

February, 1966 Dudley L. Davis

INTRODUCTION

This report will bring up-to-date one written in 1962 which became a part of O.M.E. application No. 6234. It is presumed that the reader has access to this prior report, hence the location, accessibility, ownership, history, and record of production are not reiterated.

In the interim, a geophysical survey has been run and three diamond drill holes have been drilled. No production has been made from the mine nor has any underground development work been accomplished.

A summary of results of geophysical survey is presented on Plate HL-2, and Plate HL-1 shows diamond drill holes Hoover No. 1, No. 2, and No. 3 as well as holes previously recommended. A discussion of this work and recommendations for additional exploration is presented below.

DIAMOND DRILL RESULTS

Hoover's No. 1 drill hole followed Davis' recommendation No. 3 (February, 1962 report) and cut silver ore assaying 21.8 oz. per ton at the projected position of the ore bed exploited by mine workings.

Hoover's No. 2 hole extended this ore zone 100' further to the east where it cut ore averaging $33.00 (25.58 oz. per ton) at a depth of 120 feet below the surface. This ore lies above a granite sill twelve feet in thickness.

The granite sill may be important genetically since much of the ore mined by Anaconda at Darwin (about ten miles to the south) was found near similar sills.

Hoover's No. 3 hole was drilled about 220 feet N. 52°E. from No. 2 and was run to prospect the geophysical anomaly shown by McCarthy's E.M. survey. The hole cut the 12-foot granite sill but found no silver ore.

Hoover's No. "11" hole, drilled at a point S. 51°E., 445 feet from No. 2 hole, cut 3 ounce silver mineralization at 148 feet. Traces were found at 313 feet which represents the ore bed as projected but appears off the ore shoot.

GEOPHYSICAL DATA

Plate HL-2 shows the interpretation of an electromagnetic dip-angle survey ~~run~~ INTERPRETATION by L. J. McCarthy with an additional interpretation by Charles E. Melbye.

The principal anomaly lies parallel with known ore structure but approximately 100 feet to the northeast. Depths correspond roughly to a zone 100 feet deeper than the known horizon.

RECOMMENDATIONS

In view of the ore found by drill holes Hoover No. 1 and No. 2, it seems likely that a substantial silver ore deposit may be found at the Silver Reid (Lee Flat) mine. Also, the anomaly map shows the possibility of a new ore horizon at 100 feet below the one mined and generally 100 to 300 feet to the northeast.

Hoover's hole No. 11 showed two ore horizons but was weakly mineralized so additional offset drilling in that area is justified. Likewise, the three-foot shear zone near point 19 just south of the Hoover-Silver No. 3 north side line should be prospected.

Diamond drilling and underground exploration is recommended as shown below.

1. Drill holes 1, 3, 7, 13, 14, 15 and 16 as shown on Plate HL-2. These seven holes will aggregate 1500 feet of "BX" hole if No. 3 is drilled 300 feet deep as geologic structure would indicate rather than 100 feet as shown. These holes will evaluate the geophysical anomaly.

2. Drill holes #4 and #5 as recommended by Davis in 1962. This amounts to 300 linear feet of drilling and will check the deeper zone (indicated by the E.M. survey) under the mine area.

3. Drill two vertical holes 350 feet deep, the first 150 feet N. 45° E. of Hoover No. 11 and the second 150 feet north of No. 11.

4. Drill three inclined holes to prospect the gold-bearing shear zone at 100, 200 and 300 feet below the surface. These holes should be from point 19: drill S. 50° W. for 125 feet at minus 60°, S. 20° W. for 250 feet at minus 70°, and S. 80° W. 350 feet at minus 80°.

5. Rehabilitate mine workings as recommended in the O.M.E. application and sink an inclined winze to ore cut in Hoover's No. 1 hole. This amounts to fifty feet of new winze plus repair of existing shaft and surface facility.

Respectfully submitted,

Dudley L. Davis

DUDLEY L. DAVIS

8 pt. type or larger

RECORDING REQUESTED BY

AND WHEN RECORDED MAIL TO

Name
Street Address
City & State

SPACE ABOVE THIS LINE FOR RECORDER'S USE

QUITCLAIM DEED

FOR A VALUABLE CONSIDERATION, receipt of which is hereby acknowledged

I, ALDEN P. JOHNSON
#4 PAUL REVERE ROAD
WORCESTER, MASS.

do hereby

REMISE, RELEASE AND FOREVER QUITCLAIM to

WALTER M. HOOVER
764 LORAINE GROSSE POINTE, MICH. 48230

the real property in the County of INYO
State of California, described as:

1/4 INTEREST IN A LEASE AND OPTION ON THE "SILVER REID" MINING CLAIMS, MORE COMMONLY KNOWN AS THE LEE MINE, LOCATED 6 MILES NORTH OF STATE HIGHWAY #190 AND 1 MILE EAST OF THE SALINE VALLEY ROAD, IN THE LEE MINING DISTRICT, INYO COUNTY, CALIFORNIA.

Dated: _____

State of ~~California~~, Mass.
County of Worcester } ss

On 3/9/66, before me, the undersigned, a Notary Public in and for said County and State, personally appeared Alden P Johnson

known to me to be the person whose name subscribed to the within Instrument and acknowledged that he executed the same.

Witness my hand and official seal.

(Seal) Frank M. Heath Jr.

My Commission Expires Dec. 23, 1971 FRANK M. HEATH, JR.
NAME (TYPED OR PRINTED)
Notary Public in and for said County and State.

Title Order No. _____ Escrow or Loan No. _____

This standard form covers most usual problems in the field indicated. Before you sign, read it, fill in all blanks, and make changes proper to your transaction. Consult a lawyer if you doubt the form's fitness for your purpose.

MEMORANDUM OF AGREEMENT

THIS AGREEMENT, made and entered into this 28th day of April, 1965, by and between WALTER M. HOOVER, whose address is 764 Loraine, Grosse Pointe, Michigan, party of the first part, and ALFRED GREENWOOD, who resides at Great Falls, Virginia, second party,

W I T N E S S E T H :

WHEREAS, first party is the lessee of those certain unpatented mining claims situate in the County of Inyo, State of California, described as follows:

SILVER REID Mining Claim
SILVER REID No. 1 Mining Claim,
SILVER REID No. 2 Mining Claim,
SILVER REID No. 3 Mining Claim,
SILVER REID No. 4 Mining Claim,
SILVER REID No. 5 Mining Claim,
SILVER REID No. 7 Mining Claim, and
SILVER REID No. 8 Mining Claim,

and

WHEREAS, first party is engaged in the business of developing and mining said unpatented mining claims, and desires to associate second party with himself to provide and furnish certain necessary capital for the development and mining of said properties to the best possible advantage and for the mutual benefit of the parties hereto;

NOW, THEREFORE, it is hereby mutually agreed and convenanted by the parties hereto, on the conditions and considerations herein recited, that the second party provide and furnish the sum of Five thousand dollars ($5,000.00) for the development and/or mining of said properties, and such further sums as may be justified and required for the development of the property, and receive as consideration therefore, a sum or sums equal to fifty per cent (50%) of the net proceeds realized from mining operations conducted on said mining premises.

(original)

All sums paid by second party unto first party pursuant to the terms and provisions of this agreement shall be used solely for the development of said mining properties and the expenses of mining, processing and shipping ores and materials from said mining claims to market. First party shall keep accurate accounts showing all sums received and all sums expended in connection with the development and operation of said mining properties, and furnish unto second party accurate accounting showing all such funds received and expended at such times as second party may request the same.

From the net proceeds realized from the development and mining of said mining property first party shall pay unto second party a sum or sums equal to fifty per cent (50%) of such net proceeds. Settlement shall be made at such times as may be mutually agreed upon between the parties, and no funds shall be withdrawn from the venture that might in any way prevent its continuance on a profitable basis.

First party shall have the right and responsibility of the management of the venture, provided, however, that he shall at all times and in all things exercise the utmost good faith toward second party in the conduct, mamagement and operation thereof.

It is understood, stipulated and agreed by and between the parties hereto that second party shall not be liable for any indebtedness created by the venture or for damages to others resulting from the conduct of the business of the venture, or otherwise, except to the extent of his contribution in the amount of Five thousand dollars ($5,000.00).

Upon demand of second party a partnership shall be created between the parties hereto for continuance of the business of the venture, but until the creation of such partnership the relationship hereby created shall be deemed and considered that of a joint venture and not co-partnership.

This agreement shall inure to the benefit of and be binding upon the parties hereto, their heirs, executors, administrators and assigns.

IN WITNESS WHEREOF, the parties have executed this agreement in triplicate the day and year first above written.

Walter M. Hoover
FIRST PARTY

Alfred Greenwood
SECOND PARTY

January 10, 1966

Bank of America
Lone Pine, California

Attn: Mr. Hastings

Gentlemen:

Enclosed is an application for a loan to be used for the exploration of the "Lee Mine" for additional deposits of Silver, Lead and Zinc, This property has produced about $250,000 in high grade silver ore. It is situated near three large producers, Anaconda's Darwin Lead, the Santa Rosa Lead Mine and the Cerro Gordo Silver Mine. We believe the prospects are excellent.

If your bank will consider such a loan, geological and other detailed reports and maps as well as financial statements will be submitted for your consideration.

Thanking you for past services and courtesies, I am,

Sincerely,

W.M. Hoover, Mgr.

DETROIT
BANK
& TRUST

DETROIT, MICHIGAN 48231

Fisher Building Office

JOSEPH W. CLARK
ASSISTANT VICE PRESIDENT

January 13, 1966

Mr. Walter M. Hoover
764 Loraine
Grosse Pointe, Michigan 48230

Mr. Hoover - we are not in a position to extend you a loan of $60,000 which you requested to finance your drilling program on the "Lee" Mine, Inyo County, California.

This is a very highly speculative venture and the financial information and other data available to us would not justify a loan of this sort.

We wish you success in your undertaking.

Joseph W. Clark

Cable Address — BANKAMERICA

Bank of America
NATIONAL TRUST AND SAVINGS ASSOCIATION

LONE PINE BRANCH • 400 NORTH MAIN STREET
LONE PINE, CALIFORNIA 93545

January 12, 1966

Mr. Walter M. Hoover
764 Loraine
Grosse Pointe 30, Michigan

Dear Mr. Hoover:

We are not in a position to grant a loan as requested for exploratory work on the Lee Mine.

Sincerely,

W. W. Hastings
Manager

WWH:ab

Longyear

E. J. LONGYEAR COMPANY
General Offices, 76 South 8th St.
Minneapolis 2, Minnesota, U. S. A.
TELEPHONE: FEDERAL 9-7631 • CABLE LONGCO

308 East Pima Street
Phoenix, Arizona 85004
February 28, 1966

Mr. W. M. Hoover
764 Loraine
Grosse Point 30, Michigan

SUBJECT: PROPOSAL COVERING CORE DRILLING ACTIVITY, LEE MINE, INYO COUNTY, CALIFORNIA, VICINITY DARWIN, CALIFORNIA

Dear Mr. Hoover:

1. In response to your request for a proposal covering core drilling operations at your Lee Mine location in Inyo County, California, we are pleased to submit our proposal as outlined below.

2. Our understanding of your program is as follows:

The program will consist of drilling approximately 21 holes ranging in depth from a minimum of 100 feet to a maximum of 400 feet for an approximate total drilling of 4,965 feet. The inclination of the holes will vary from a minus 60 degrees to a minus 75 degrees as measured from the horizontal. Water for drilling purposes is obtainable from the town of Darwin, 20 miles distance one way or Panamint Springs, 21 miles one way. The formation to be penetrated consists generally of medium hard limestone of which the first 100 feet or so is expected to be highly silicified and very hard. Furthermore, the formation can be expected to be highly fractured involving loss of water and requiring frequent grouting to stabilize the hole or to retain water circulation.

It is understood that you will provide suitable access roads and will prepare, if required, suitable drill sites.

Housing for crew is non-existent in the area. It would be necessary for them to live either in Olancha or possibly as far away as Lone Pine, California.

For the most part, the drilling will be carried out with BX and AX size wireline tools.

3. For the work as outlined above, we propose to furnish one complete core drilling machine together with all the required accessory equipment including service and water truck. We would expect to operate the rig on a one shift basis, six days per week.

4. We will carry public liability insurance covering personal injury and property damage, and Workmen's Compensation insurance and also all-risk

insurance on the drilling equipment protecting against loss by theft, fire, flood, landslides and other similar hazards. Certificates showing the coverage referred to will be furnished upon request.

5. Based upon the conditions anticipated in this work, we would expect the following prices and conditions to prevail.

a) Mobilization and demobilization of personnel and drilling equipment.....$695.00 Lump Sum

b) Overburden drilling, where required in alluvial material or eroded ledge rock, including setting casing to ledge.....$6.50 per foot

c) Diamond core drilling, vertical or angle holes with inclination of 60 degrees or steeper -

	AX WL	BX WL
Ledge to 500 feet in depth.....	$6.95/ft.	$7.45/ft.

d) Reaming, if required and where applicable -
AX hole to receive AX casing.....$3.00 per foot
BX hole to receive BX casing.....$3.35 per foot

NOTE: In computing the prices that will prevail under the diamond core drilling section, item c, and the reaming, item d, we assumed a diamond bit cost of $1.25 per foot. In the event actual costs incurred in performing this work exceed the $1.25 per foot allowed, such overage of allowable cost will be invoiced to you. The basis for determining the cost per foot on our diamond bits would be computed using $11.25 per carat diamonds for the diamond loss, plus applicable setting charges divided by the number of feet drilled per bit.

e) Delays or standby time requested by you or for which you are responsible.....$12.25 per hour with 2-man drill crew.

f) Time spent by crews cementing, waiting for cement to set and drilling out cement or other time consumed in hole stabilizing or hole plugging operations will be invoiced at.....$13.50 per hour with 2-man drill crew.

g) Cement, drill mud, additives or other stabilizing or hole plugging material consumed will be invoiced to you at our cost, F.O.B. job site basis.

h) Casing or pipe lost or left in holes at your request will be invoiced at our cost, F.O.B. job site basis.

i) Water truck service will be provided on the following basis:

(1) Water truck rental charge.....$200.00 per month plus 15¢ per mile traveled while engaged in water hauling activity.

(2) We would expect to utilize the drill helper for the purpose of driving the water truck. As long as this arrangement can be maintained without subjecting the drilling operation to excessive delays as a result of waiting for water or the helper, no charge will be made for his service. However, in the event it should become necessary to hire a full time, separate employee for the purpose of driving the water truck, it is understood and agreed that we would invoice to you $3.50 per hour for his time to offset the resultant additional wages, payroll taxes and other related expenses.

(3) Any charges arising from the purchase of water at its source will be invoiced to you.

j) Tractor or other service, if required for the preparation and maintenance of drill access roads and the preparation of proper drill sites, if not performed by you, will be obtained locally and invoiced to you at our cost, plus a 10% handling fee.

k) Core boxes, cardboard type, capacity ten feet of core will be supplied by the Longyear Company, if requested, in either BX or AX size for.....$1.00 each

6. It is understood if we are awarded this work that the starting date of drilling operations will be contingent upon the availability of equipment and personnel. At the present time, we would expect a minimum of 30 days would be required before mobilizing operations could commence.

7. Due to a lack of necessary financial information, it is understood that if we are awarded this work that you will make suitable financial arrangements with the Longyear Company for payment of the work prior to the time that mobilizing operations commence.

8. Statements would be submitted promptly after the end of each month covering work performed during the month and payment will become due twenty days from date of statement.

9. We appreciate the opportunity to submit this proposal to you and apologize for the time that it has taken us to accumulate the necessary information. Because of the high activity in core drilling operations at this time of the year, we would appreciate learning of your decision concerning the award of this work at the earliest possible date.

If the above proposal is acceptable to you, please sign in the space provided, retain two copies for your files and return the original signed copy to us in Phoenix.

Sincerely,

J.R.Miller:jag

E. J. LONGYEAR COMPANY

ACCEPTED:

Company_____

J. R. Miller

By_____

Manager, Southwestern Zone
Contract Drilling Division

Date_____

DIAMOND CORE DRILLING
DIAMOND DRILLING EQUIPMENT
GROUTING
FOUNDATION TESTING
MINING
QUARRYING
SHAFT SINKING
TUNNEL DRIVING
MINE PLANT DESIGN
AND FABRICATION

Boyles Bros.
DRILLING COMPANY
CONTRACTORS - ENGINEERS - GEOLOGISTS
600 Industrial Way
SPARKS, NEVADA
Phone: 355-3233

General Offices and Plant
1624 Pioneer Road P. O. Box 58
SALT LAKE CITY 10, UTAH
HUnter 7-7595

BRANCH OFFICES
PHOENIX
RENO
SPOKANE
DENVER
SACRAMENTO
ST. LOUIS

January 25, 1966

Mr. Walter M. Hoover
764 Loraine
Grosse Pointe 30, Michigan

Dear Mr. Hoover:

Your letter of January 10th to Boyles Bros. Drilling Company of Vancouver, B.C. has been referred to us. This is the Nevada and Southern California branch of Boyles Bros Inc. of Salt Lake City, Utah. We are familiar with the area you mention and would like to submit the following prices for your consideration.

1. Mobilization $750.00

2. Drilling rates for holes up to 500 feet in depth—NX Size $8.00 per foot.
BX Size $7.50 per foot.

3. All bit cost in excess of $1.50 per foot will be to your account.

4. Moving and setting up between holes and including first set up—$12.50 an hour.

5. Cleaning and casing previously drilled holes—$15.00 an hour.

6. Casing lost in a hole or left at customer's request will be charged at list price f.o.b. the job.

7. Cementing, if necessary, will be charged at $12.50 per hour plus cement or cement substitutes, which include drilling mud and additives. These will be charged at list price f.o.b. the job or customer may furnish them to our specifications if he desires.

8. Water to be charged at cost, based on truck rental of $225.00 per month plus 12 cents per mile and drivers wages including payroll taxes and insurance. Customer may supply the water if he prefers.

9. Delays caused through no fault of Boyles Bros will be charged for at $12.50 per hour.

If these prices meet with your approval we would appreciate an early notification in order toschedule crews and equipment. A formal contract will be sent to you at this time for your signature.

Thank you for the opportunity of bidding on your work.

Yours truly,
Joe D. Fetterhoff
Joe D. Fetterhoff
District Manager

HIMES DRILLING COMPANY
CONTRACT DRILLING
2390 HIGHWAY 6 & 50
GRAND JUNCTION, COLORADO

PHONE 242-8893

March 9, 1966

Via Air Mail

Mr. Walter M. Hoover
764 Loraine
Grosse Point 30, Michigan

Dear Mr. Hoover:

I talked with Mr. Dudley Davis as you suggested in your recent reply. He furnished me with the details on your proposed drilling in Inyo County, California. I respectfully submit the following prices and conditions as my bid on this drilling project:

AX CORE

0-100 feet	$ 7.50 per ft.
101-200 feet	10.00 per ft.
201-300 feet	12.50 per ft.
301-400 feet	15.00 per ft.

The prices quoted are with the understanding we will drill approximately 4,965 feet before moving from the drill location.

Reaming and setting casing and/or cementing and redrilling--
$ 4.00 per ft.

Transporting of water for drilling operation is included in the footage price.

Mobilization of equipment to the drilling location and demobilization of equipment at the completion of the job--Total $2,000.00.

Thank you, Mr. Hoover, for your consideration.

Sincerely,

HIMES DRILLING COMPANY

Bud Himes

Bud Himes

BH/ph

L.J. PRICE & COMPANY

9949 BARIUM LANE
SANDY, UTAH -84070

March 15, 1966

Walter M. Hoover
764 Loraine
Grosse Point, 30 Michigan

Gentlemen;

We present our bid for drilling at the Lee Mine property, near Darwin Cal. We understand that water must be hauled to the drill site, and at our expence, and the distance to haul water is around 21 miles.

Drill site preparation is to be completed by your Company, and any road necessary to bring drilling equipment to the mine is at your expence.

The price we show below for drilling is for Non-silicifed rock a $2.00 pr. foot extra charge will be added to the below prices for all formations penetrated that is silicifed.

Stand pipe or "NX" hole at the collor to 20 feet depth	$10.50 pr.ft.
" BX " to a depth of 100 ft.	$10.00 " "
"AX" from 0 ft. to 250ft.	9.50 " "
"AX from 250 ft. to 400 ft.	$10.00 " "
Reaming AX to BX	$ 2.50 " "

Casing lost in a completed hole to be replaced by the owner at his expence.
Cement placed in the hole and redrilled .... $2.00 " "
Standby time for any reason requested by the project engineer.....
.... or time lost for setting up of cement so it can be drilled out... $20.00 " Hr.

Owner will supply core boxes and care for the same.

Very Truly Yours,

L. J. Price & Company

L.J.Price

L.J.Price

DRILLING
BLASTING

QUARRYING
TUNNELING

METLER BROTHERS DRILLING CO.

Core Drilling Contractors

Route 7, Box 945 4001 E. Illinois Street ★ ★ ★ Phone 327-4268 Tucson, Arizona 85714

21 March, 1966

Mr. Walter M. Hoover
764 Lorain
Grosse Point 30, Michigan

Dear Mr. Hoover:

After looking at your proposed drilling program at the Lee Mine near Darwin, California, we are pleased to submit the following prices:

a. Drilling (wireline)	(NX)	(BX)
0 to 500'	8.00 per ft.	7.75 per ft.
500 to 1000'	8.50 " "	8.25 " "

b. Cementing and redrilling cement if required, are to be charged at the rate of #12.50 per hour plus the cost of cement.
c. Drilling mud hauled to jobsite and mixed @2.50 per 50# bag. Other mud additives used will be billed to your company at cost.
d. Reaming if required, will be charged at the rate of $4.00 ft.
e. Casing left in hole due to ground conditions or ordered left in place will be charged at contractor's cost.
f. Water Haul- We will furnish a water truck and haul water for $30.00 per shift plus driver's wages and cost of water if any.
g. Core boxes are to be furnished by your company, however, we will furnish them at $1.00 per box if requested.
h. Mobilization and demobilization -$500.00

Access roads and drill sites are to be prepared by your company in advance.

We intend to put a Joy 22 Truck mounted drill rig. This rig cannot drill angle holes.

Thank you for giving us the opportunity to quote prices on this project.

Very truly yours,

METLER BROS. DRILLING CO.

E. R. Metler

E. R. Metler

ERM/dr

COMPANY	MOBILIZE	OVERBURDEN SETTING UP ETC.	DELAYS	GROUTING & DRILL GROUT	MAT'L	WATER	ROAD WORK	MISC.	TOTAL	PER FOOT
									34,506.75	
LONGYEAR		$6.50	12.25 SETTING UP BTW HOLES 16X12.25X 21 HOLES	13.50 HR. MIN. 100X 8' X 13.50	CORE BOXES 480 X $1.00 480 CEMENT 250	$200 MO 15¢ MILE 10 MO 2000 2700		4965 $695	695 1040 4116 10,800 730 4700 100	
PHOENIX BRANCH	695.00	6.50 X 8' X 20								
	695.00	1,040	4,116	10,800	$730	4,700	100		56,687.75	11.41
BOYLES BROS. SALT LAKE	750	SETTING UP 12.50 HR 16 HRS X 21		12.50 HR. 100X8X12.50	480 250 CEMENT CORE BXS	$225 MO. 12¢ MILE 10 MO AV. 1½ TRIPS/DAY 60X12X300 2160		4965 7.50 37,237.50	750 700 4200 10000 730 4410 37 237.50	
	$750	$4,200		10,000	730	4410	100		57,427.50	11.57
HIMES GRAND JUNCTION COLO.	2000			$4.00 FT. 100X8X$4.00	2100 @ 1635 @ 880 @ 350 @	7.50 = 15,750 10.00 = 16,350 12.50 = 11,000 15.00 = 5,250			2000 3200 48350 53550	
	2000			3200		48,350				10.79
L.J. PRICE SANDY, UTAH		20' @ 10.50 = 21 X 20 X 10.50 20 - 250' @ 9.50 = 250 - 400 @ 10.00 = $2.00 EXTRA SILICIFIED GROUT CORE BOXES $480 + LOST TIME		21 X 50'	= CEMENT 2000	4410 35,957.50 7,600 4,200 1,600 2,480	100		55,947.50	11.27
METLER BROS. TUCSON ARIZ.	500 500		DRILL MUD	$12.50 HR. 100X8X12.50	CEMENT CORE BOXES	$30.00 SHIFT $30 X 250	100	DRILL MUD 4965 7.75 38,478.75	38,478.75 100 7,500 730 10,000 1,000 57,808.75	
	1000			10,000	730	7500	100			11.64
JOHN MADISON PALMDALE						$10.50 PER FT.			52,132.50	$10.50

DATE ____ BY ____ CH'K'D BY ____ JOB ____ NO. ____ SHEET NO. ____

BOARD OF WAYNE COUNTY ROAD COMMISSIONERS DETROIT, MICH.

LEE MINE

LOCATED 11 MILES NORTH OF DARWIN. 1 MILE EAST OF SALINE VALLEY ROAD.

INYO COUNTY CALIFORNIA

HOOVER 1-10-65

HOLES DRILLED	HOLES TO BE DRILLED	DEPTH	REMARKS
1		312'	DRILLED 75° TO CUT FAULT AT 600'-. NOT COMPLETED. SMALL ORE AT 62'
2		181'	CUT 13' GRANODIORITE SILL AT 118'-131'. SMALL ORE ABOVE.
3		224'	" " " " " 44-57'.
11		456'	TRACE MINERALS, Pb, Zn, AG. TO 350'± . HARD SILICIFIED LIME TO 90'±.
	1	100'	EXTEND HOLE 3 IN MINERALIZED AREA BELOW SILL.
	2	100'	TO CUT GRANODIORITE SILL TO DETERMINE ITS ATTITUDE.
	3	170'	" " " " " " " "
	4	175'	" " " " " " " "
	5	220'	TO CUT AREA OF 60° FAULT & QUARTZ LEDGE.
	6	300'	" " " " " " " " "
	7	350'	RECCOMMENDED BY GEOLOGIST McCARTHY. (IN ANOMOLY)
	8	350'	TO CUT AREA AROUND MINERALIZED HOLE 11.
	9	350'	" " " " " " "
	10	300'	" " " " " " "
	11	400'	" " " " " " "
	12	350'	" " " NORTH OF " " "
	13	260'	TO CUT AREA NEAR MINE & No. OF FAULT.
	14	200'	" " " " " " " " "
	15	140'	" " " " " " " " "
	16	100'	" " " " " " " " "
	17	350'	AREA OF EAST ANOMOLY
	18	200'	" " So. EAST "
	19	200'	60°-75° HOLE TO CUT 3' LEDGE AT DEPTH.
	20	150'	TO CUT AREA OF ARAGONITE & $200 FLOAT
	21	200'	AREA OF NORTH ANOMOLY.
		4965'	TOTAL - NEW DRILLING.

COMMENTS:- GROUND, GENERALLY, IS MEDIUM-HARD LIMESTONE. FIRST 100' IN AREA OF HOLE 11 IS VERY HARD, HIGHLY SILICIFIED LIMESTONE. ALL GROUND IS FRACTURED & FREQUENT GROUTING IS NECESSARY. WATER IS AVAILABLE AT DARWIN (20 MILES) OR PANAMINT SPRINGS (21 M.) TRUCK & 600 GAL. TANK TRAILER IS AVAILABLE WITH DRIVER AT $30.00/DAY ALL HOLES CAN BE REACHED BY TRUCK.

PAUL SKINNER

ASSAYER

ONE PINE, CALIFORNIA NOVEMBER 15, 1965

I HEREBY CERTIFY THAT THE SAMPLES DESCRIBED BELOW

ECEIVED FROM W.M. HOOVER ASSAY AS FOLLOWS:

			AU	AG	ZN
ORE HOLE	#11-	186'-6"		TRACE	
" "	"	29'-30'		0.5 OZ	
" "	"	79'		TRACE	
" "	"	193' SOFT WHITE		0.5 OZ	
LUDGE	"	174'-180'		TRACE	
ORE "	"	190' - DARK QUARTZ		2.0 OZ	
" "	"	200' - 7" and LM. PC.		1.0 OZ	
" "	"	230 - 234'		TRACE	
" "	"	148'	TRACE	2.5	0.55

WALTER M. HOOVER
764 LORAINE
GROSSE POINTE 30, MICHIGAN

Extra copy -

March 25, 1966

OFFICIAL COPY
O. M. E.
RECEIVED
MAR 28 1966
CODE

Office of Mineral Exploration
Department of the Interior
Washington 25, D.C.

Re: Re-application for Loan.
"Lee" Mine. OME-6234

Gentlemen:

Since our application #6234 for a loan to explore the "Lee" Mine was denied in 1962, we have done approximately $20,800.00 worth of additional work. We ran a geophysical survey with Sharpe 300 E.M. instruments. Several Anomolies were found, and a sketch, Plate #HL-2 covering them is enclosed. Also, in 1963, '64 and '65, diamond drill cores were taken from holes #(2), #(3) & #(11), 181', 224', and 456' respectively. A 312' hole #(1) was drilled in 1961. These cores are stored at the Anaconda mine in Darwin.

Holes #(2) & #(3) cut through a 12' granitic sill similar to those associated with the ore at Darwin, 10 miles south of the "Lee". This is the first time these sills have been encountered in the "Lee" area. Some ore was cored from Hole #(2). Hole #(11), about 600' S.E. of the old diggings was drilled because the limestone "country rock" from a 20' shaft showed alteration and assayed approximately 2% Zn and 2oz. Ag. The mineralization continued for about 350' when these trace assays faded out. The first 80' ± of this hole was highly silicified and very hard drilling.

1400' S.E. of the mine is an old gold prospect that has a 1/2" to 1" seam of Garnierite that assays $512.00 in Gold. It is part of a ledge of gouge which assayed .20 Zn, .10 Pb, .68 Ag & .10 Au. None of the gold seam was included in the sample which was across a width of 35". We believe the trace assays of Pb, Zn & Ag may be significant. A claim covering this ground has been located as well as three others. A subordination agreement for these new claims is

enclosed. These Hoover-Silver claims #1,2,3,-6 are recorded in Volume 98 page 125 at The Inyo County Recorders office at Independence, California.

The new report of Mr. Dudley Davis geologist, is enclosed. I wish to stick closely to his recommendations; however, there are other holes that I feel are justified in our drilling program.

Specifically:

1. Hole #7 suggested by L.J. McCarthy, geologist, in the area of the anamolies.
2. Holes #4,#5, & #6 to further investigate the granitic sill or sills and to penetrate a likely area near the junction of a quartz ledge and the shear zone south of the main diggings. This fault had some ore in place and some dragged ore, and it seems to me that the possible intersection of a vein leading to the old diggings and this fault might carry ore.

I have, therefore, included these holes in the list of work to be done. If you do not concur, of course we will eliminate them from our program.

A summary of the costs is as follows:

Recondition shaft etc as stated in the original application	$ 2,842.00
Item #5 original application	3,658.00
Phase II " "	11,700.00
Consulting geologist additional 10 Visits @ $250.00	2,500.00
Supervision & Expense $750,00 Mo. X 10	7,500.00
Assays approximate 1 per 100' of core @ $11.00	450.00
4,050' of Dia. Drilling @ $10.50	42,525.00
	$71,175.00
O.M.E. Loan 75%	$53,381.50

Since the first application, Mr. Alden Johnson has discontinued his association with the venture and Mr. Alfred Greenwood has undertaken the financing. A quit claim deed executed by Mr. Johnson, and an agreement with Mr. Greenwood are enclosed.

Diamond drilling bids are enclosed. A tabulation of the bids and a conservative estimate of the extras show costs exceeding $11.00 per foot. Mr. John Madison has verbally agreed to drill the ground for a flat $10.50 (No extras).

In the event that you wish to re-examine the property, Mr. Davis will be available. He can be reached at 1528 Michigan Ave., Salt Lake City 5, Utah, telephone 801-322-4263 or at Box 1481, Grand Junction, Colorado. If his presence is not required, Mr. John Kinneberg, Anaconda Mine, Darwin California will provide you with a guide to the Lee mine.

Five coppies each are enclosed of the following:

(a) Mrs. Reids new subordination agreement.
(b) Hoover's subordination of 4 Hoover-Silver claims.
(c) Johnson's quit claim deed.
(d) Greenwoods agreement.
(e) Geologists new report.
(f) Mine map. Plate HL-1
(g) Map showing anomolies and proposed drill holes. Plate HL-2
(h) New assays
(i) New bank loan refusals
(j) Drill bids
(k) Drill bid recap
(l) Drilling schedule upon which bids were based.

If Mr. Greenwood's signature is necessary on the application, time could be saved by sending it to him directly at 4737 Stamp Road., S.E. Washington, D.C. 20031.

Mr. Madison, the diamond driller, is now available and work could start within ten days of approval. I would be on the job myself to supervise the work, take care of cores, assays etc.

If it would help, I could see your West Coast representative for instructions, on the way out to the mine.

Thank you for your consideration and past courtesies.

Respectfully submitted,

W. M. Hoover, Mgr.

MME Form 40
Dec. 1958

UNITED STATES
DEPARTMENT OF THE INTERIOR
OFFICE OF MINERALS EXPLORATION

Budget Bureau No. 42-R1368
Approval expires Dec. 31, 1963

APPLICATION FOR FINANCIAL ASSISTANCE IN MINERALS EXPLORATION

Pursuant to Public Law 85-701 (72 Stat. 700; 30 U.S.C. 641)

NAME OF APPLICANT *(Full legal name and mailing address as they should appear on contract if one is executed.)*

WALTER M. HOOVER
764 LORAINE,
GROSSE POINTE, MICH. 48230

APPLICANT DO NOT USE THIS BLOCK

DOCKET NUMBER

DATE RECEIVED

REGION

DIVISION CODE

BUSINESS ORGANIZATION *(Check one)*

INDIVIDUAL ☐
CORPORATION ☐
PARTNERSHIP ☐
OTHER *(Specify)* ☑
JOINT VENTURE

STATE IN WHICH FIRM IS ORGANIZED

LIST CORPORATE OFFICERS OR PARTNERS HERE, IF APPLICABLE

NAME	ADDRESS	TITLE
W. M. HOOVER	764 LORAINE, GROSSE POINTE, MICH.	MANAGER
ALFRED GREENWOOD	4737 STAMP ROAD, S.E. WASHINGTON, D.C.	

MINERAL(S) FOR WHICH YOU WISH TO EXPLORE
SILVER WITH LEAD & ZINC SOME AU.

ESTIMATED COST OF PROJECT
$ 71,175

PROPERTY NAME: LEE MINE (SILVER REID CLAIMS & HOOVER SILVER "")
LOCATION COUNTY: INYO
STATE: CALIF.

GENERAL INSTRUCTIONS

Before filling out this application, please read the *OME Regulations for Obtaining Federal Assistance in Financing Explorations for Mineral Reserves* (30 CFR Chap. III). To assure prompt action, your application must provide all applicable material and information specified on the back of this application form. Avoid unnecessary correspondence and delays by submitting complete and accurate information. *Please submit four copies of this application and all accompanying papers* except as otherwise noted. Place your name and address on each sheet. Each item of information, maps, and reports required as a part of this application is described on the back of this form. Identify each attached statement by the item number to which it applies. If an item does not apply to your application, show the item number on your statement and after it write "not applicable." Maps or sketches should be used to supplement narrative descriptions of the property location and boundaries in item 2, existing mine workings and geology in item 3, and the proposed exploration work in item 5. When this information is not too complex, all of it may be shown on one map or sketch. All documents and other attachments submitted as a part of this application, except those in item 3(g) which you mark to be returned, become the property of the Government and will not be returned to the applicant. Send true copies, *not originals*, of leases, contracts, and other documents which are an essential part of your business records. *File this application with the Office of Minerals Exploration, Department of the Interior, Washington 25, D. C., or with the nearest OME Field Office.*

CERTIFICATION

The undersigned, whether as an individual, corporate officer, partner, or otherwise, both in his own behalf and acting for the applicant, certifies that the information set forth in this form and accompanying papers is correct and complete, to the best of his knowledge and belief, and that he would not ordinarily undertake the proposed exploration under current conditions and circumstances at his sole expense.

MARCH 25, 1966
DATED

W M Hoover
BY *(Signature)*

MANAGER
TITLE

A wilfully false statement or certification to any Department or Agency of the United States Government is a criminal offense. U. S. Code, Title 18, Sec. 1001.

Supplementary Report
Silver Reid Mine
Inyo County, California

February, 1966 Dudley L. Davis

INTRODUCTION

This report will bring up-to-date one written in 1962 which became a part of O.M.E. application No. 6234. It is presumed that the reader has access to this prior report, hence the location, accessibility, ownership, history, and record of production are not reiterated.

In the interim, a geophysical survey has been run and three diamond drill holes have been drilled. No production has been made from the mine nor has any underground development work been accomplished.

A summary of results of geophysical survey is presented on Plate HL-2, and Plate HL-1 shows diamond drill holes Hoover No. 1, No. 2, and No. 3 as well as holes previously recommended. A discussion of this work and recommendations for additional exploration is presented below.

DIAMOND DRILL RESULTS

Hoover's No. 1 drill hole followed Davis' recommendation No. 3 (February, 1962 report) and cut silver ore assaying 21.8 oz. per ton at the projected position of the ore bed exploited by mine workings.

Hoover's No. 2 hole extended this ore zone 100' further to the east where it cut ore averaging $33.00 (25.58 oz. per ton) at a depth of 120 feet below the surface. This ore lies above a granite sill twelve feet in thickness.

The granite sill may be important genetically since much of the ore mined by Anaconda at Darwin (about ten miles to the south) was found near similar sills.

Hoover's No. 3 hole was drilled about 220 feet N. 52°E. from No. 2 and was run to prospect the geophysical anomaly shown by McCarthy's E.M. survey. The hole cut the 12-foot granite sill but found no silver ore.

Hoover's No. "11" hole, drilled at a point S. 51°E., 445 feet from No. 2 hole, cut 3 ounce silver mineralization at 148 feet. Traces were found at 313 feet which represents the ore bed as projected but appears off the ore shoot.

GEOPHYSICAL DATA

Plate HL-2 shows the interpretation of an electromagnetic dip-angle survey ~~run~~ INTERPRETATION by L. J. McCarthy with an additional interpretation by Charles E. Melbye.

The principal anomaly lies parallel with known ore structure but approximately 100 feet to the northeast. Depths correspond roughly to a zone 100 feet deeper than the known horizon.

RECOMMENDATIONS

In view of the ore found by drill holes Hoover No. 1 and No. 2, it seems likely that a substantial silver ore deposit may be found at the Silver Reid (Lee Flat) mine. Also, the anomaly map shows the possibility of a new ore horizon at 100 feet below the one mined and generally 100 to 300 feet to the northeast.

Hoover's hole No. 11 showed two ore horizons but was weakly mineralized so additional offset drilling in that area is justified. Likewise, the three-foot shear zone near point 19 just south of the Hoover-Silver No. 3 north side line should be prospected.

Diamond drilling and underground exploration is recommended as shown below.

1. Drill holes 1, 3, 7, 13, 14, 15 and 16 as shown on Plate HL-2. These seven holes will aggregate 1500 feet of "BX" hole if No. 3 is drilled 300 feet deep as geologic structure would indicate rather than 100 feet as shown. These holes will evaluate the geophysical anomaly.

2. Drill holes #4 and #5 as recommended by Davis in 1962. This amounts to 300 linear feet of drilling and will check the deeper zone (indicated by the E.M. survey) under the mine area.

3. Drill two vertical holes 350 feet deep, the first 150 feet N. 45° E. of Hoover No. 11 and the second 150 feet north of No. 11.

4. Drill three inclined holes to prospect the gold-bearing shear zone at 100, 200 and 300 feet below the surface. These holes should be from point 19: drill S. 50° W. for 125 feet at minus 60°, S. 20° W. for 250 feet at minus 70°, and S. 80° W. 350 feet at minus 80°.

5. Rehabilitate mine workings as recommended in the O.M.E. application and sink an inclined winze to ore cut in Hoover's No. 1 hole. This amounts to fifty feet of new winze plus repair of existing shaft and surface facility.

Respectfully submitted,

Dudley L. Davis

DUDLEY L. DAVIS

8 pt. type or larger

RECORDING REQUESTED BY

AND WHEN RECORDED MAIL TO

Name
Street Address
City & State

SPACE ABOVE THIS LINE FOR RECORDER'S USE

QUITCLAIM DEED

FOR A VALUABLE CONSIDERATION, receipt of which is hereby acknowledged

I, ALDEN P. JOHNSON
#4 PAUL REVERE ROAD
WORCESTER, MASS.

do hereby

REMISE, RELEASE AND FOREVER QUITCLAIM to

WALTER M. HOOVER
764 LORAINE GROSSE POINTE, MICH. 48230

the real property in the County of INYO
State of California, described as:

1/4 INTEREST IN A LEASE AND OPTION ON THE "SILVER REID" MINING CLAIMS, MORE COMMONLY KNOWN AS THE LEE MINE, LOCATED 6 MILES NORTH OF STATE HIGHWAY #190 AND 1 MILE EAST OF THE SALINE VALLEY ROAD, IN THE LEE MINING DISTRICT, INYO COUNTY, CALIFORNIA.

Dated: _____

State of ~~California~~, Mass.
County of Worcester } ss

On 3/9/66, before me, the undersigned, a Notary Public in and for said County and State, personally appeared Alden P Johnson

known to me to be the person whose name subscribed to the within Instrument and acknowledged that he executed the same.

Witness my hand and official seal.

(Seal) Frank M. Heath Jr.

My Commission Expires Dec. 23, 1971 FRANK M. HEATH JR.
NAME (TYPED OR PRINTED)
Notary Public in and for said County and State.

Title Order No. _____ Escrow or Loan No. _____

DEED—QUITCLAIM—WOLCOTTS FORM 790
REVISED 11-60

This standard form covers most usual problems in the field indicated. Before you sign, read it, fill in all blanks, and make changes proper to your transaction. Consult a lawyer if you doubt the form's fitness for your purpose.

MEMORANDUM OF AGREEMENT

THIS AGREEMENT, made and entered into this 28th day of April, 1965, by and between WALTER M. HOOVER, whose address is 764 Loraine, Grosse Pointe, Michigan, party of the first part, and ALFRED GREENWOOD, who resides at Great Falls, Virginia, second party,

W I T N E S S E T H :

WHEREAS, first party is the lessee of those certain unpatented mining claims situate in the County of Inyo, State of California, described as follows:

SILVER REID Mining Claim
SILVER REID No. 1 Mining Claim,
SILVER REID No. 2 Mining Claim,
SILVER REID No. 3 Mining Claim,
SILVER REID No. 4 Mining Claim,
SILVER REID No. 5 Mining Claim,
SILVER REID No. 7 Mining Claim, and
SILVER REID No. 8 Mining Claim,

and

WHEREAS, first party is engaged in the business of developing and mining said unpatented mining claims, and desires to associate second party with himself to provide and furnish certain necessary capital for the development and mining of said properties to the best possible advantage and for the mutual benefit of the parties hereto;

NOW, THEREFORE, it is hereby mutually agreed and convenanted by the parties hereto, on the conditions and considerations herein recited, that the second party provide and furnish the sum of Five thousand dollars ($5,000.00) for the development and/or mining of said properties, and such further sums as may be justified and required for the development of the property, and receive as consideration therefore, a sum or sums equal to fifty per cent (50%) of the net proceeds realized from mining operations conducted on said mining premises.

(original)

All sums paid by second party unto first party pursuant to the terms and provisions of this agreement shall be used solely for the development of said mining properties and the expenses of mining, processing and shipping ores and materials from said mining claims to market. First party shall keep accurate accounts showing all sums received and all sums expended in connection with the development and operation of said mining properties, and furnish unto second party accurate accounting showing all such funds received and expended at such times as second party may request the same.

From the net proceeds realized from the development and mining of said mining property first party shall pay unto second party a sum or sums equal to fifty per cent (50%) of such net proceeds. Settlement shall be made at such times as may be mutually agreed upon between the parties, and no funds shall be withdrawn from the venture that might in any way prevent its continuance on a profitable basis.

First party shall have the right and responsibility of the management of the venture, provided, however, that he shall at all times and in all things exercise the utmost good faith toward second party in the conduct, mamagement and operation thereof.

It is understood, stipulated and agreed by and between the parties hereto that second party shall not be liable for any indebtedness created by the venture or for damages to others resulting from the conduct of the business of the venture, or otherwise, except to the extent of his contribution in the amount of Five thousand dollars ($5,000.00).

Upon demand of second party a partnership shall be created between the parties hereto for continuance of the business of the venture, but until the creation of such partnership the relationship hereby created shall be deemed and considered that of a joint venture and not co-partnership.

This agreement shall inure to the benefit of and be binding upon the parties hereto, their heirs, executors, administrators and assigns.

IN WITNESS WHEREOF, the parties have executed this agreement in triplicate the day and year first above written.

Walter M. Hoover
FIRST PARTY

Alfred Greenwood
SECOND PARTY

DETROIT
BANK
& TRUST

DETROIT, MICHIGAN 48231

Fisher Building Office

JOSEPH W. CLARK
ASSISTANT VICE PRESIDENT

January 13, 1966

Mr. Walter M. Hoover
764 Loraine
Grosse Pointe, Michigan 48230

Mr. Hoover - we are not in a position to extend you a loan of $60,000 which you requested to finance your drilling program on the "Lee" Mine, Inyo County, California.

This is a very highly speculative venture and the financial information and other data available to us would not justify a loan of this sort.

We wish you success in your undertaking.

Joseph W. Clark

Cable Address — BANKAMERICA

Bank of America
NATIONAL TRUST AND SAVINGS ASSOCIATION

LONE PINE BRANCH • 400 NORTH MAIN STREET
LONE PINE, CALIFORNIA 93545

January 12, 1966

Mr. Walter M. Hoover
764 Loraine
Grosse Pointe 30, Michigan

Dear Mr. Hoover:

We are not in a position to grant a loan as requested for exploratory work on the Lee Mine.

Sincerely,

W. W. Hastings
Manager

WWH:ab

Longyear

E. J. LONGYEAR COMPANY
General Offices, 76 South 8th St.
Minneapolis 2, Minnesota, U. S. A.
TELEPHONE: FEDERAL 9-7631 • CABLE LONGCO

308 East Pima Street
Phoenix, Arizona 85004
February 28, 1966

Mr. W. M. Hoover
764 Loraine
Grosse Point 30, Michigan

SUBJECT: PROPOSAL COVERING CORE DRILLING ACTIVITY, LEE MINE, INYO COUNTY, CALIFORNIA, VICINITY DARWIN, CALIFORNIA

Dear Mr. Hoover:

1. In response to your request for a proposal covering core drilling operations at your Lee Mine location in Inyo County, California, we are pleased to submit our proposal as outlined below.

2. Our understanding of your program is as follows:

The program will consist of drilling approximately 21 holes ranging in depth from a minimum of 100 feet to a maximum of 400 feet for an approximate total drilling of 4,965 feet. The inclination of the holes will vary from a minus 60 degrees to a minus 75 degrees as measured from the horizontal. Water for drilling purposes is obtainable from the town of Darwin, 20 miles distance one way or Panamint Springs, 21 miles one way. The formation to be penetrated consists generally of medium hard limestone of which the first 100 feet or so is expected to be highly silicified and very hard. Furthermore, the formation can be expected to be highly fractured involving loss of water and requiring frequent grouting to stabilize the hole or to retain water circulation.

It is understood that you will provide suitable access roads and will prepare, if required, suitable drill sites.

Housing for crew is non-existent in the area. It would be necessary for them to live either in Olancha or possibly as far away as Lone Pine, California.

For the most part, the drilling will be carried out with BX and AX size wireline tools.

3. For the work as outlined above, we propose to furnish one complete core drilling machine together with all the required accessory equipment including service and water truck. We would expect to operate the rig on a one shift basis, six days per week.

4. We will carry public liability insurance covering personal injury and property damage, and Workmen's Compensation insurance and also all-risk

insurance on the drilling equipment protecting against loss by theft, fire, flood, landslides and other similar hazards. Certificates showing the coverage referred to will be furnished upon request.

5. Based upon the conditions anticipated in this work, we would expect the following prices and conditions to prevail.

a) Mobilization and demobilization of personnel and drilling equipment.....$695.00 Lump Sum

b) Overburden drilling, where required in alluvial material or eroded ledge rock, including setting casing to ledge.....$6.50 per foot

c) Diamond core drilling, vertical or angle holes with inclination of 60 degrees or steeper -

	AX WL	BX WL
Ledge to 500 feet in depth.....	$6.95/ft.	$7.45/ft.

d) Reaming, if required and where applicable -
AX hole to receive AX casing.....$3.00 per foot
BX hole to receive BX casing.....$3.35 per foot

NOTE: In computing the prices that will prevail under the diamond core drilling section, item c, and the reaming, item d, we assumed a diamond bit cost of $1.25 per foot. In the event actual costs incurred in performing this work exceed the $1.25 per foot allowed, such overage of allowable cost will be invoiced to you. The basis for determining the cost per foot on our diamond bits would be computed using $11.25 per carat diamonds for the diamond loss, plus applicable setting charges divided by the number of feet drilled per bit.

e) Delays or standby time requested by you or for which you are responsible.....$12.25 per hour with 2-man drill crew.

f) Time spent by crews cementing, waiting for cement to set and drilling out cement or other time consumed in hole stabilizing or hole plugging operations will be invoiced at.....$13.50 per hour with 2-man drill crew.

g) Cement, drill mud, additives or other stabilizing or hole plugging material consumed will be invoiced to you at our cost, F.O.B. job site basis.

h) Casing or pipe lost or left in holes at your request will be invoiced at our cost, F.O.B. job site basis.

i) Water truck service will be provided on the following basis:

(1) Water truck rental charge.....$200.00 per month plus 15¢ per mile traveled while engaged in water hauling activity.

(2) We would expect to utilize the drill helper for the purpose of driving the water truck. As long as this arrangement can be maintained without subjecting the drilling operation to excessive delays as a result of waiting for water or the helper, no charge will be made for his service. However, in the event it should become necessary to hire a full time, separate employee for the purpose of driving the water truck, it is understood and agreed that we would invoice to you $3.50 per hour for his time to offset the resultant additional wages, payroll taxes and other related expenses.

(3) Any charges arising from the purchase of water at its source will be invoiced to you.

j) Tractor or other service, if required for the preparation and maintenance of drill access roads and the preparation of proper drill sites, if not performed by you, will be obtained locally and invoiced to you at our cost, plus a 10% handling fee.

k) Core boxes, cardboard type, capacity ten feet of core will be supplied by the Longyear Company, if requested, in either BX or AX size for.....$1.00 each

6. It is understood if we are awarded this work that the starting date of drilling operations will be contingent upon the availability of equipment and personnel. At the present time, we would expect a minimum of 30 days would be required before mobilizing operations could commence.

7. Due to a lack of necessary financial information, it is understood that if we are awarded this work that you will make suitable financial arrangements with the Longyear Company for payment of the work prior to the time that mobilizing operations commence.

8. Statements would be submitted promptly after the end of each month covering work performed during the month and payment will become due twenty days from date of statement.

9. We appreciate the opportunity to submit this proposal to you and apologize for the time that it has taken us to accumulate the necessary information. Because of the high activity in core drilling operations at this time of the year, we would appreciate learning of your decision concerning the award of this work at the earliest possible date.

If the above proposal is acceptable to you, please sign in the space provided, retain two copies for your files and return the original signed copy to us in Phoenix.

Sincerely,

J.R.Miller:jag

E. J. LONGYEAR COMPANY

ACCEPTED:

Company_____

J. R. Miller

By_____

Manager, Southwestern Zone
Contract Drilling Division

Date_____

DIAMOND CORE DRILLING
DIAMOND DRILLING EQUIPMENT
GROUTING
FOUNDATION TESTING
MINING
QUARRYING
SHAFT SINKING
TUNNEL DRIVING
MINE PLANT DESIGN
AND FABRICATION

Boyles Bros. DRILLING COMPANY

CONTRACTORS - ENGINEERS - GEOLOGISTS

600 Industrial Way
SPARKS, NEVADA
Phone: 355-3233

General Offices and Plant
1624 Pioneer Road P. O. Box 58
SALT LAKE CITY 10, UTAH
HUnter 7-7595

BRANCH OFFICES
PHOENIX
RENO
SPOKANE
DENVER
SACRAMENTO
ST. LOUIS

January 25, 1966

Mr. Walter M. Hoover
764 Loraine
Grosse Pointe 30, Michigan

Dear Mr. Hoover:

Your letter of January 10th to Boyles Bros. Drilling Company of Vancouver, B.C. has been referred to us. This is the Nevada and Southern California branch of Boyles Bros Inc. of Salt Lake City, Utah. We are familiar with the area you mention and would like to submit the following prices for your consideration.

1. Mobilization $750.00

2. Drilling rates for holes up to 500 feet in depth--NX Size $8.00 per foot.
BX Size $7.50 per foot.

3. All bit cost in excess of $1.50 per foot will be to your account.

4. Moving and setting up between holes and including first set up--$12.50 an hour.

5. Cleaning and casing previously drilled holes--$15.00 an hour.

6. Casing lost in a hole or left at customer's request will be charged at list price f.o.b. the job.

7. Cementing, if necessary, will be charged at $12.50 per hour plus cement or cement substitutes, which include drilling mud and additives. These will be charged at list price f.o.b. the job or customer may furnish them to our specifications if he desires.

8. Water to be charged at cost, based on truck rental of $225.00 per month plus 12 cents per mile and drivers wages including payroll taxes and insurance. Customer may supply the water if he prefers.

9. Delays caused through no fault of Boyles Bros will be charged for at $12.50 per hour.

If these prices meet with your approval we would appreciate an early notification in order toschedule crews and equipment. A formal contract will be sent to you at this time for your signature.

Thank you for the opportunity of bidding on your work.

Yours truly,
Joe D. Fetterhoff
Joe D. Fetterhoff
District Manager

HIMES DRILLING COMPANY
CONTRACT DRILLING
2390 HIGHWAY 6 & 50
GRAND JUNCTION, COLORADO

PHONE 242-8893

March 9, 1966

Via Air Mail

Mr. Walter M. Hoover
764 Loraine
Grosse Point 30, Michigan

Dear Mr. Hoover:

I talked with Mr. Dudley Davis as you suggested in your recent reply. He furnished me with the details on your proposed drilling in Inyo County, California. I respectfully submit the following prices and conditions as my bid on this drilling project:

AX CORE

0-100 feet	$ 7.50 per ft.
101-200 feet	10.00 per ft.
201-300 feet	12.50 per ft.
301-400 feet	15.00 per ft.

The prices quoted are with the understanding we will drill approximately 4,965 feet before moving from the drill location.

Reaming and setting casing and/or cementing and redrilling--
$ 4.00 per ft.

Transporting of water for drilling operation is included in the footage price.

Mobilization of equipment to the drilling location and demobilization of equipment at the completion of the job--Total $2,000.00.

Thank you, Mr. Hoover, for your consideration.

Sincerely,

HIMES DRILLING COMPANY

Bud Himes

Bud Himes

BH/ph

L.J. PRICE & COMPANY

9949 BARIUM LANE
SANDY, UTAH -84070

March 15, 1966

Walter M. Hoover
764 Loraine
Grosse Point, 30 Michigan

Gentlemen;

We present our bid for drilling at the Lee Mine property, near Darwin Cal. We understand that water must be hauled to the drill site, and at our expence, and the distance to haul water is around 21 miles.

Drill site preparation is to be completed by your Company, and any road necessary to bring drilling equipment to the mine is at your expence.

The price we show below for drilling is for Non-silicifed rock a $2.00 pr. foot extra charge will be added to the below prices for all formations penetrated that is silicifed.

Stand pipe or "NX" hole at the collor to 20 feet depth----------$10.50 pr.ft.

" BX " to a depth of 100 ft. ---- ---- ---- ---- ---- ---- $10.00 " "

"AX" from 0 ft. to 250ft.---- ---- ---- ---- ---- ---- ---- 9.50 " "

"AX from 250 ft. to 400 ft. ---- ---- ---- ---- ---- ---- $10.00 " "

Reaming AX to BX ---- ---- ---- .... $ 2.50 " "

Casing lost in a completed hole to be replaced by the owner at his expence.
Cement placed in the hole and redrilled .... $2.00 " "
Standby time for any reason requested by the project engineer.....
.... or time lost for setting up of cement so it can be drilled out... $20.00 " Hr.

Owner will supply core boxes and care for the same.

Very Truly Yours,

L. J. Price & Company

L.J.Price

DRILLING
BLASTING

QUARRYING
TUNNELING

METLER BROTHERS DRILLING CO.

Core Drilling Contractors

Route 7, Box 945 4001 E. Illinois Street ★ ★ ★ Phone 327-4268 Tucson, Arizona 85714

21 March, 1966

Mr. Walter M. Hoover
764 Lorain
Grosse Point 30, Michigan

Dear Mr. Hoover:

After looking at your proposed drilling program at the Lee Mine near Darwin, California, we are pleased to submit the following prices:

a. Drilling (wireline)	(NX)	(BX)
0 to 500'	8.00 per ft.	7.75 per ft.
500 to 1000'	8.50 " "	8.25 " "

b. Cementing and redrilling cement if required, are to be charged at the rate of #12.50 per hour plus the cost of cement.
c. Drilling mud hauled to jobsite and mixed @2.50 per 50# bag. Other mud additives used will be billed to your company at cost.
d. Reaming if required, will be charged at the rate of $4.00 ft.
e. Casing left in hole due to ground conditions or ordered left in place will be charged at contractor's cost.
f. Water Haul- We will furnish a water truck and haul water for $30.00 per shift plus driver's wages and cost of water if any.
g. Core boxes are to be furnished by your company, however, we will furnish them at $1.00 per box if requested.
h. Mobilization and demobilization -$500.00

Access roads and drill sites are to be prepared by your company in advance.

We intend to put a Joy 22 Truck mounted drill rig. This rig cannot drill angle holes.

Thank you for giving us the opportunity to quote prices on this project.

Very truly yours,

METLER BROS. DRILLING CO.

E. R. Metler

E. R. Metler

ERM/dr

COMPANY	MOBILIZE	OVERBURDEN SETTING UP ETC.	DELAYS	GROUTING & DRILL GROUT	MAT'L	WATER	ROAD WORK	MISC.	TOTAL	PER FOOT
					USE BLANK FOR	INDING			34,506.75	
LONGYEAR PHOENIX BRANCH	695.00 695.00	$6.50 6.50 x 8' x 20 1,040	12.25 SETTING UP BTW HOLES 16 X 12.25 X 21 HOLES 4,116	13.50 HR. MIN. 100 x 8' x 13.50 10,800	CORE BOXES 480 x $1.00 480 CEMENT 250 $730	$200 MO 15¢ MILE 10 MO 2000 2700 4,700	100	4965 $695	695 1040 4116 10,800 730 4700 100 56,687.75	11.41
BOYLES BROS. SALT LAKE	750 $750	SETTING UP 12.50 HR 16 HRS x 21 $4,200		12.50 HR. 100 x 8 x 12.50 10,000	480 250 CEMENT CORE BXS 730	$225 MO. 12¢ MILE 10 MO AV. 1½ TRIPS/DAY 60 x 12 x 300 2160 4410	100	4965 7.50 37,237.50	750 100 4200 10000 730 4410 37 237.50 57437.50	11.57
HIMES GRAND JUNCTION COLO.	2000 2000			$4.00 FT. 100 x 8 x $4.00 3200	2100 @ 1635 @ 880 @ 350 @	7.50 = 15,750 10.00 = 16,350 12.50 = 11,000 15.00 = 5,250 48,350			2000 3200 48350 53550	10.79
L. J. PRICE SANDY, UTAH		20' @ 10.50 = 21 x 20 x 10.50 20 - 250' @ 9.50 = 250 - 400 @ 10.00 = $2.00 EXTRA SILICIFIED GROUT CORE BOXES $480 + LOST TIME		21 x 50'	= CEMENT 2000	4410 35,957.50 7,600 4,200 1,600 2,480	100		55,947.50	11.27
METLER BROS. TUCSON ARIZ.	500 500 1000		DRILL MUD	$12.50 HR. 100 x 8 x 12.50 10,000	CEMENT CORE BOXES 730	$30.00 SHIFT $30 x 250 7500	100 100	DRILL MUD 4965 7.75 38,478.75	38,478.75 100 7,500 730 10,000 1,000 57,808.75	11.64
JOHN MADISON PALMDALE						$10.50 PER FT.			52,132.50	$10.50

FORM 143

DATE ____ BY ____ CH'K'D BY ____ JOB ____ NO. SHEETS ____ SHEET NO. ____

BOARD OF WAYNE COUNTY ROAD COMMISSIONERS DETROIT, MICH.

LEE MINE

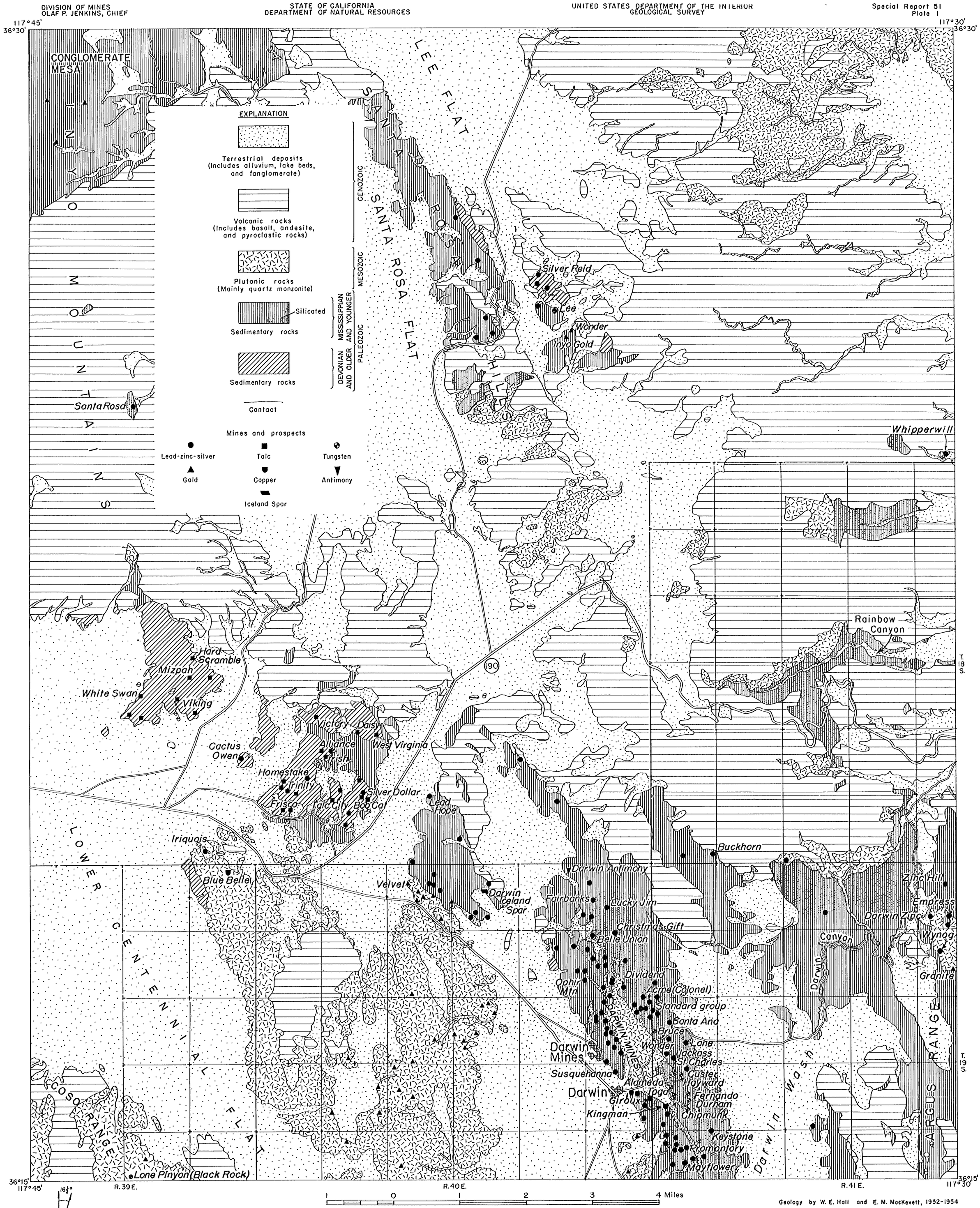
LOCATED 11 MILES NORTH OF DARWIN. 1 MILE EAST OF SALINE VALLEY ROAD.

INYO COUNTY CALIFORNIA

HOOVER 1-10-65

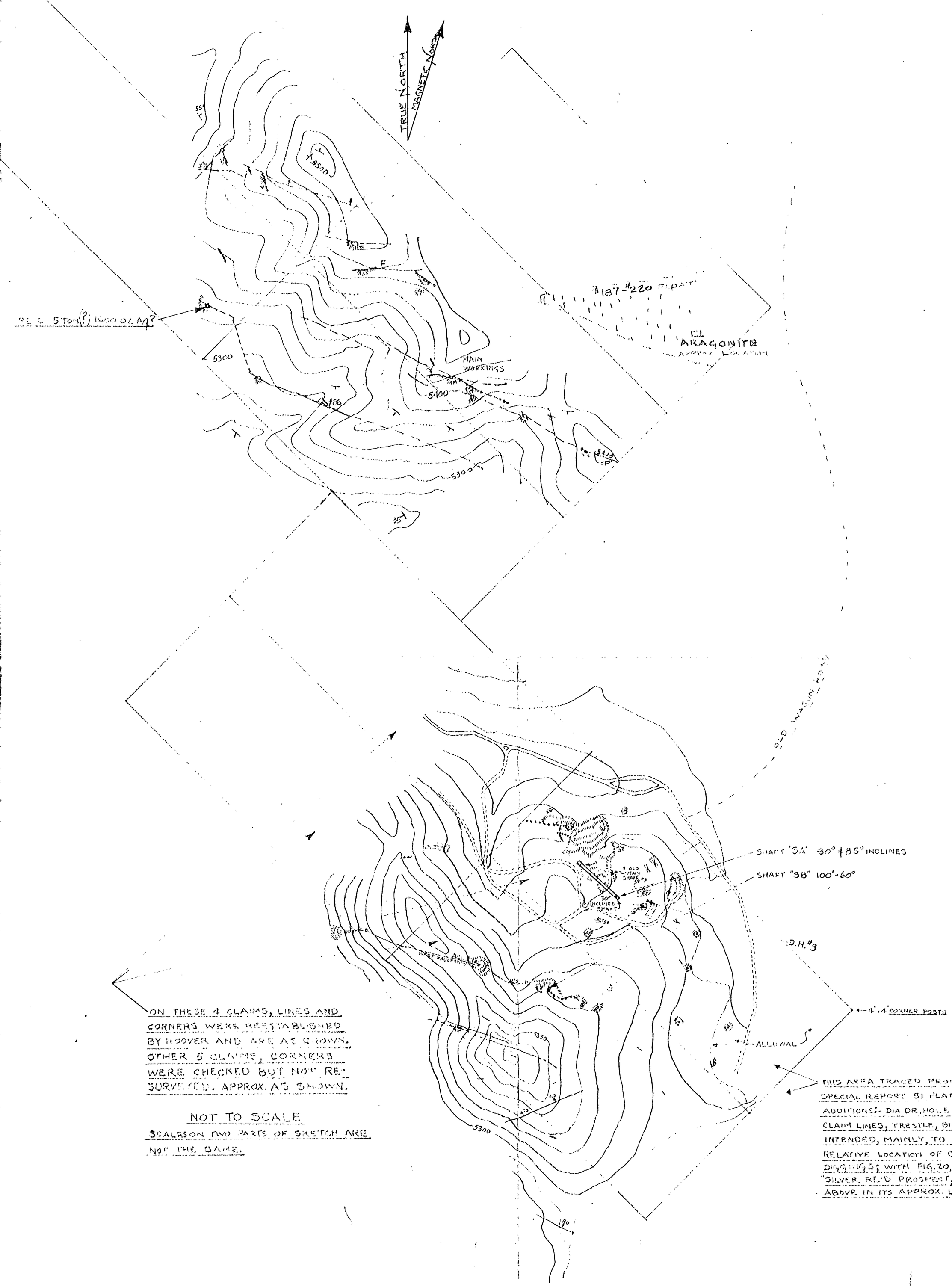
HOLES DRILLED	HOLES TO BE DRILLED	DEPTH	REMARKS
1		312'	DRILLED 75° TO CUT FAULT AT 600'-. NOT COMPLETED. SMALL ORE AT 62'
2		181'	CUT 13' GRANODIORITE SILL AT 118'-131'. SMALL ORE ABOVE.
3		224'	" " " " " 44-57'.
11		456'	TRACE MINERALS, Pb, Zn, AG. TO 350'±. HARD SILICIFIED LIME TO 90'±.
	1	100'	EXTEND HOLE 3 IN MINERALIZED AREA BELOW SILL.
	2	100'	TO CUT GRANODIORITE SILL TO DETERMINE ITS ATTITUDE.
	3	170'	" " " " " " " "
	4	175'	" " " " " " " "
	5	220'	TO CUT AREA OF 60° FAULT & QUARTZ LEDGE.
	6	300'	" " " " " " " " "
	7	350'	RECCOMMENDED BY GEOLOGIST McCARTHY. (IN ANOMOLY)
	8	350'	TO CUT AREA AROUND MINERALIZED HOLE 11.
	9	350'	" " " " " " "
	10	300'	" " " " " " "
	11	400'	" " " " " " "
	12	350'	" " " NORTH OF " " "
	13	260'	TO CUT AREA NEAR MINE & No. OF FAULT.
	14	200'	" " " " " " " " "
	15	140'	" " " " " " " " "
	16	100'	" " " " " " " " "
	17	350'	AREA OF EAST ANOMOLY
	18	200'	" " So. EAST "
	19	200'	60°-75° HOLE TO CUT 3' LEDGE AT DEPTH.
	20	150'	TO CUT AREA OF ARAGONITE & $200 FLOAT
	21	200'	AREA OF NORTH ANOMOLY.
		4965'	TOTAL - NEW DRILLING.

COMMENTS:- GROUND, GENERALLY, IS MEDIUM-HARD LIMESTONE. FIRST 100' IN AREA OF HOLE 11 IS VERY HARD, HIGHLY SILICIFIED LIMESTONE. ALL GROUND IS FRACTURED & FREQUENT GROUTING IS NECESSARY. WATER IS AVAILABLE AT DARWIN (20 MILES) OR PANAMINT SPRINGS (21 M.) TRUCK & 600 GAL. TANK TRAILER IS AVAILABLE WITH DRIVER AT $30.00/DAY ALL HOLES CAN BE REACHED BY TRUCK.



Geology by W. E. Hall and E. M. MacKevett, 1952-1954

SIMPLIFIED GEOLOGIC MAP OF THE DARWIN QUADRANGLE SHOWING THE LOCATION OF MINES AND PROSPECTS

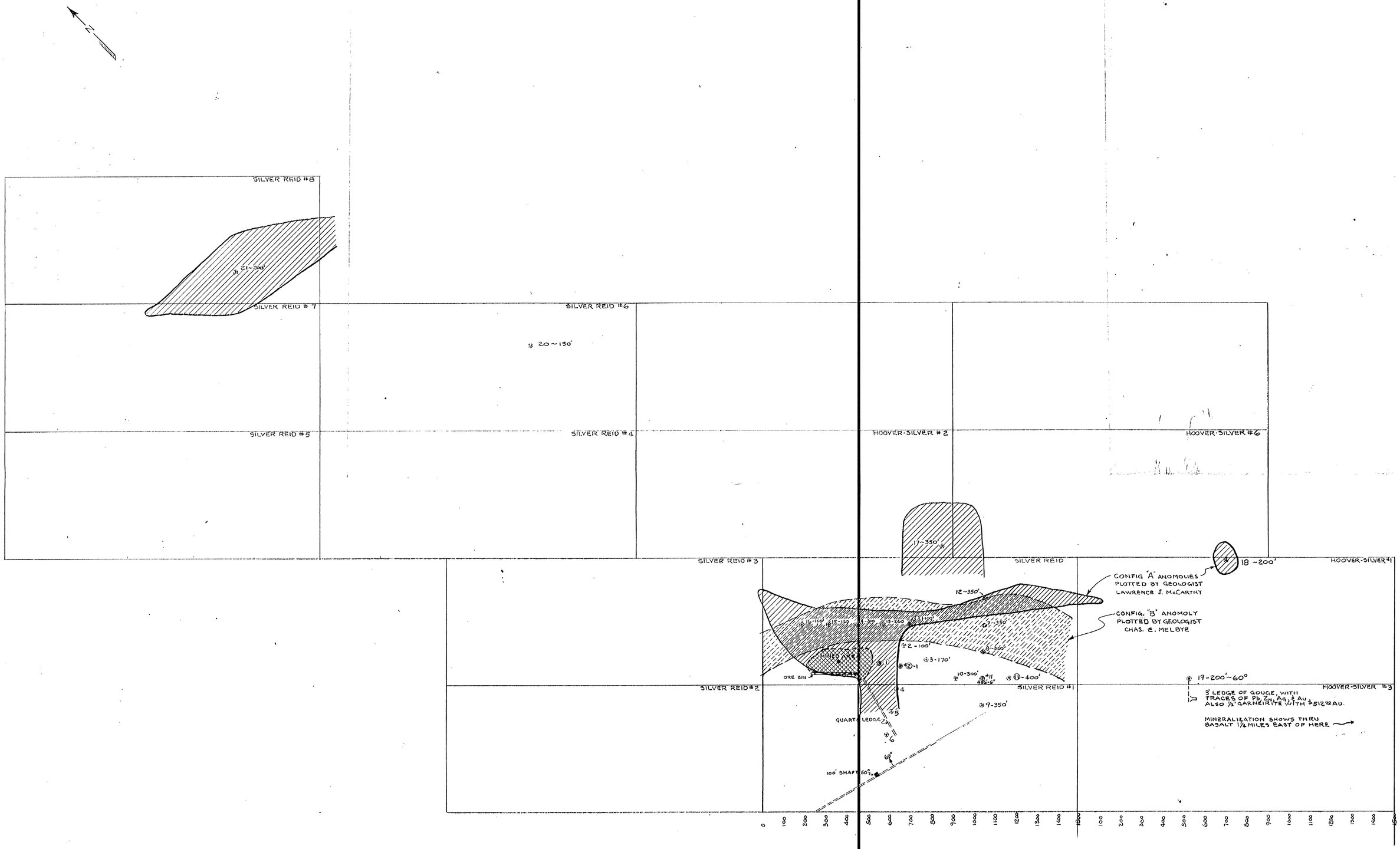


ON THESE 4 CLAIMS, LINES AND CORNERS WERE REESTABLISHED BY HOOVER AND ARE AS SHOWN. OTHER 5 CLAIMS, CORNERS WERE CHECKED BUT NOT RE-SURVEYED. APPROX. AS SHOWN.

NOT TO SCALE

SCALES ON TWO PARTS OF SKETCH ARE NOT THE SAME.

W. M. HOOVER
764 Loraine
Grosse Pointe 30, Mich.



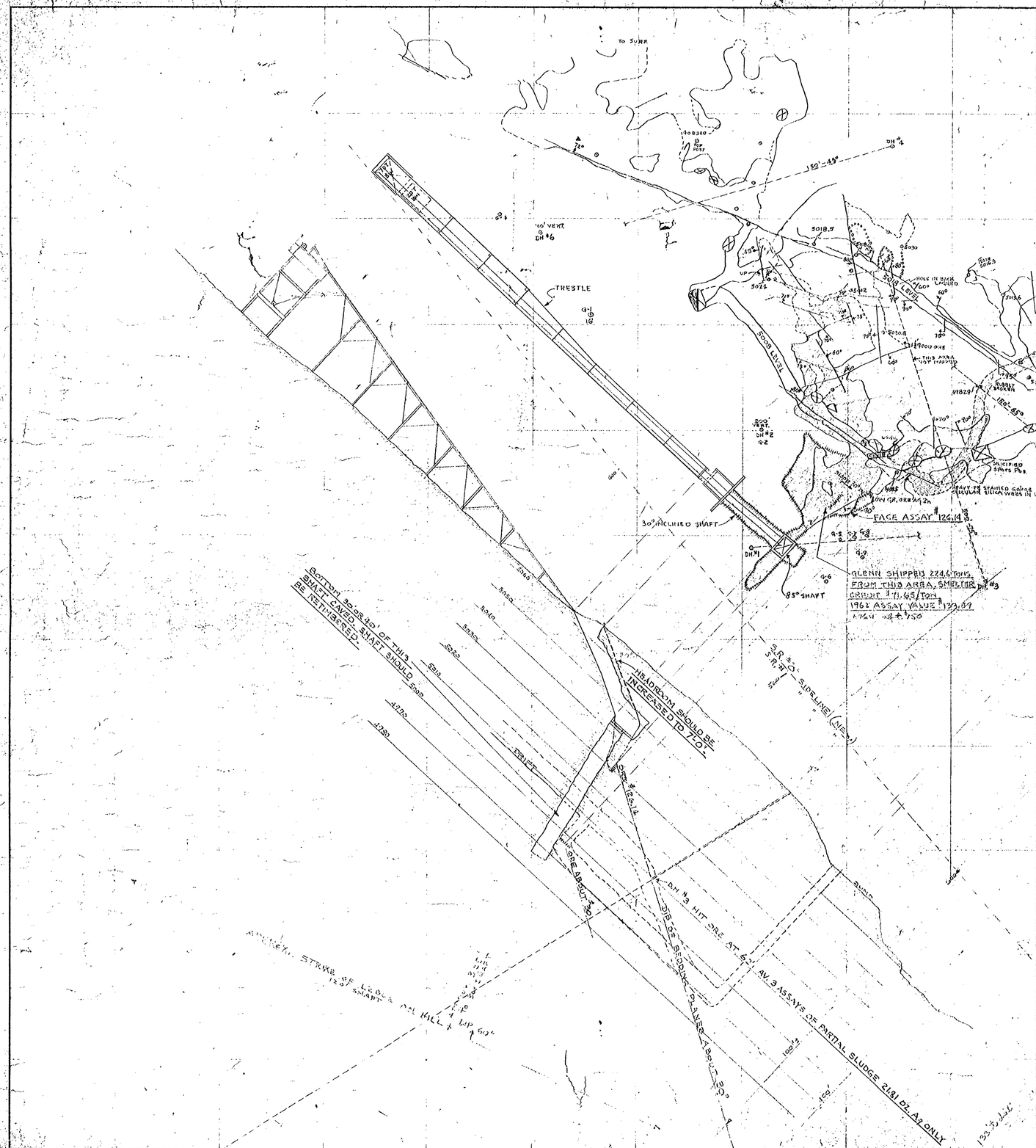
LEE MINE

ELECTROMAGNETIC DIP-ANGLE MAP
INYO COUNTY
CALIFORNIA

HL-2

1" = 200'

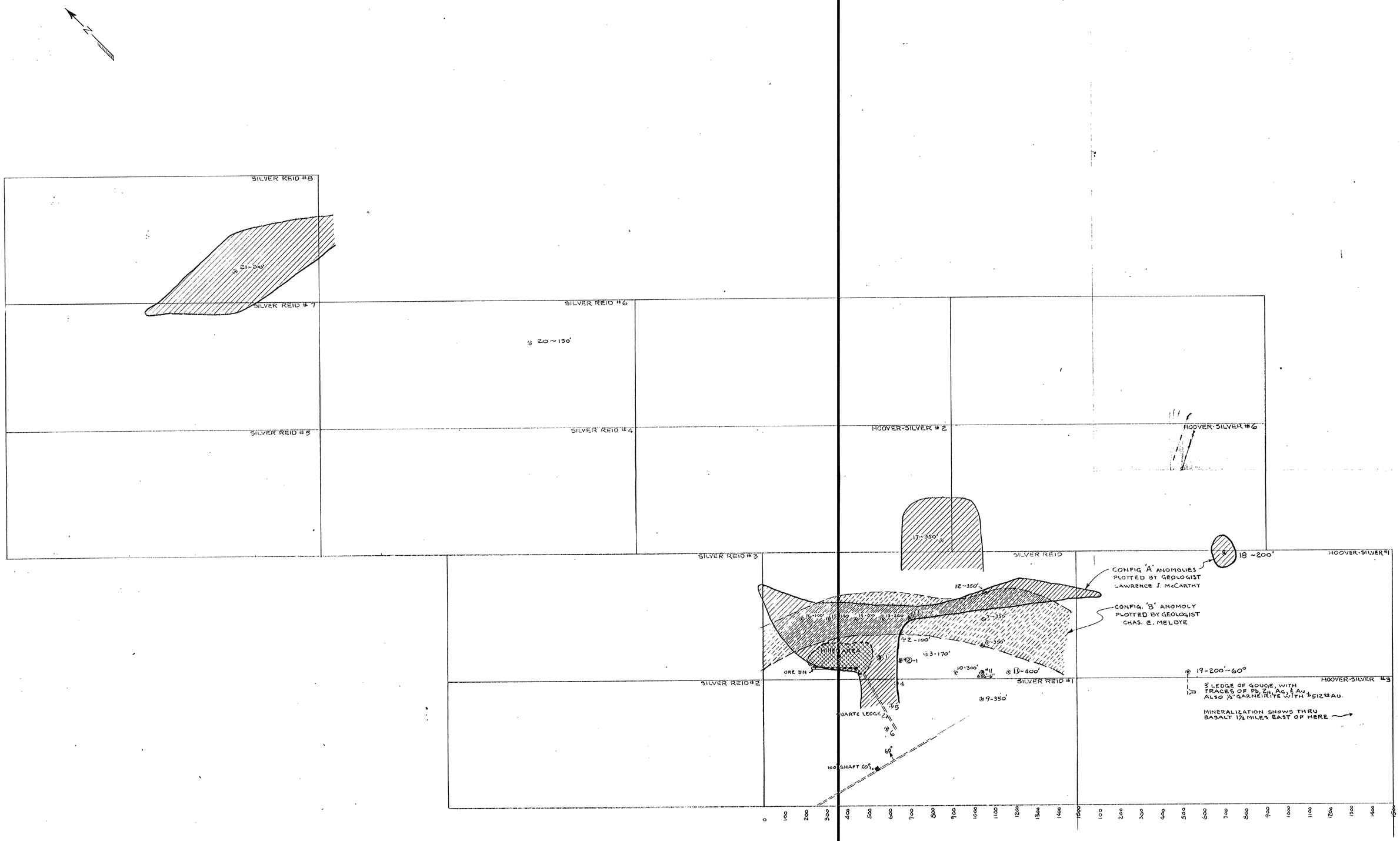
TRACED FROM ORIGINALS REFERED TO ABOVE
BY W.M. HOOVER 1-7-66



Note:- THIS PLAN TRACED FROM AL GLENN'S DWG. WITH RECENT STOPE, INCLINED SHAFT, TRESTLE, & BINS ADDED.
DIAGONALLY SHADED AREA ~ UPPER LEVEL.
SOLIDLY SHADED AREA ~ BOTTOM TUNNEL.
DIA. DRILL HOLES RECOMMENDED BY DUDLEY DAVIS ~ CHIEF GEOLOGIST. ANACONDA-DARWIN.

REVISIONS			DRAWN BY	DATE	APPROVED
			Hoover	10-7-1961	
			CHECKED BY	DATE	APPROVED

FILE	JOB NUMBER
SCALE	SHEET NO. HL-1



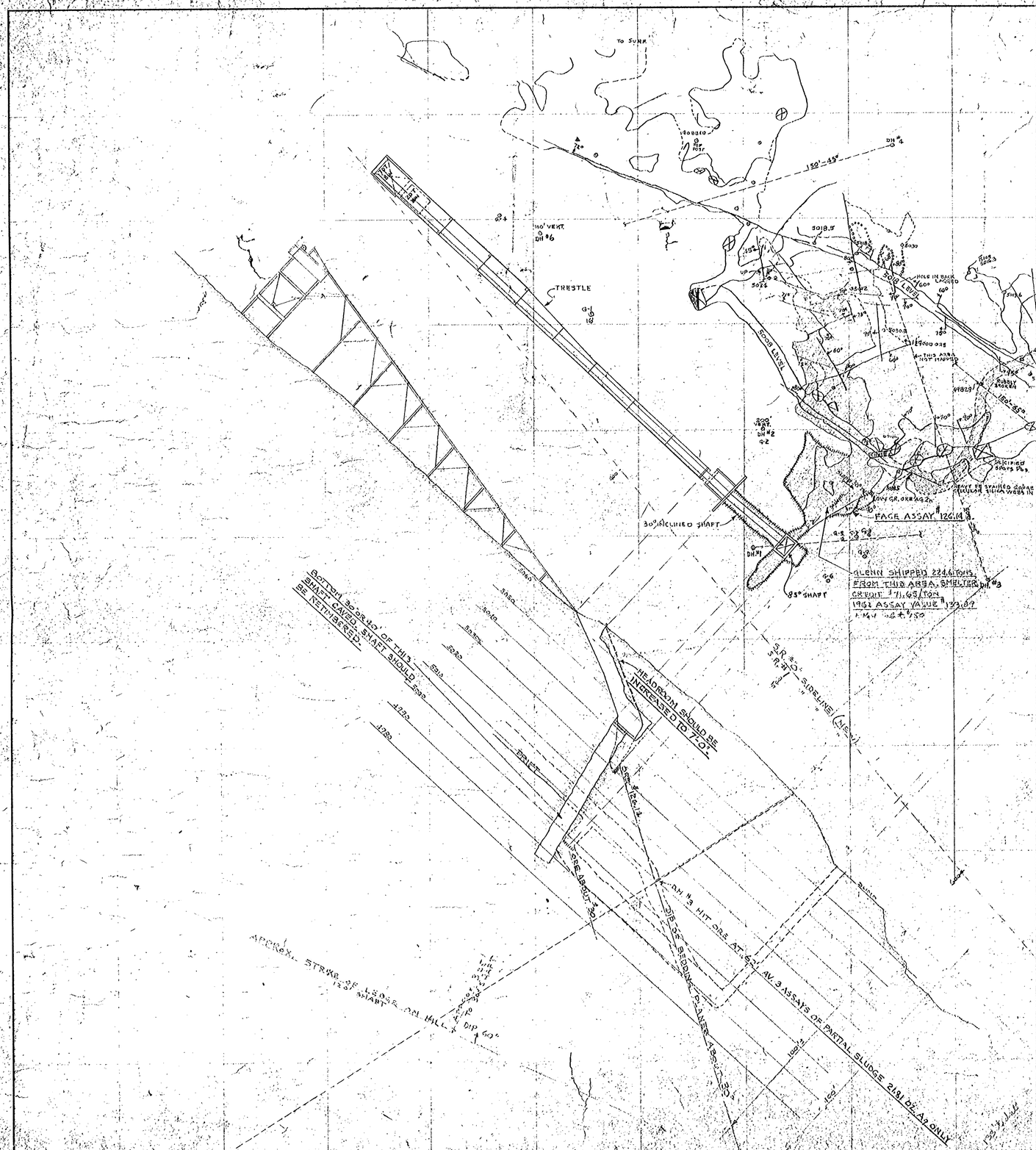
LEE MINE

ELECTROMAGNETIC DIP-ANGLE MAP
INYO COUNTY
CALIFORNIA

HL-2

1" = 200'

TRACED FROM ORIGINALS REFERED TO ABOVE
BY W.M. HOOVER 1-7-66



Note:-

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DIAGONIALY SHADED AREA ~ UPPER LEVEL.
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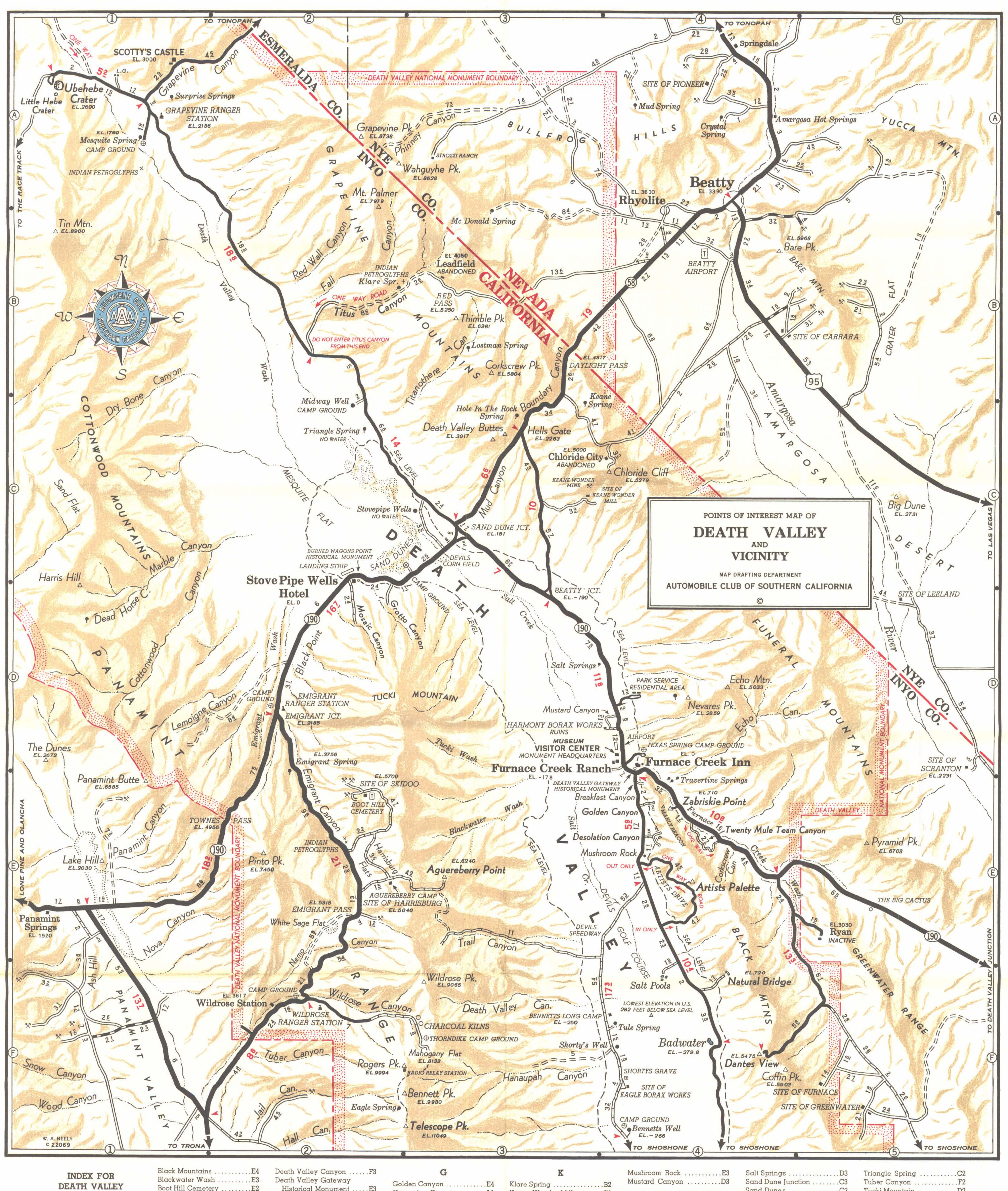
REVISIONS			DRAWN BY	DATE	APPROVED	FILE	JOB NUMBER
			Hoover	10-7-1961		SCALE	SHEET NO.
			CHECKED BY	DATE	APPROVED		

DESERT AREA
LEGEND
Freeways (limited access)
Divided highways
Four or more lanes
Other main roads
Other Roads
PAVED
GRAVEL
IMPROVED DIRT
DIRT
POOR
Interstate Highways
U.S. Highways
State Highways
County Highways
16 – Figures indicate mileages between towns and junctions
20 – Accumulated mileages between points marked thus:
Automobile Club of So Cal. Office
CARTOGRAPHIC MANAGER
HARRY P. PELLIM
FIELD MAPPING BY
H.A. CLINE
G.L. BOYD
K.R. REID
W.A. NEELY
R.P. CONKLIN
CARTOGRAPHY BY
W.A. NEELY
W.T. TAYLOR
COLOR SEPARATION BY
L. J. STUMBAUGH
RELIEF BY F.M. BURKS
TYPE SET BY
L. J. STUMBAUGH
SCALE IN MILES
0 2 4 6 8 10 12 14
MAP DRAFTING DEPARTMENT
AUTOMOBILE CLUB OF SOUTHERN CALIFORNIA
2601 SO. FIGUEROA ST.
LOS ANGELES
2062
COPYRIGHT
AUTOMOBILE CLUB
AAA
SOUTHERN CALIFORNIA
N
S
E
W
RECOMMENDED OVERNIGHT ACCOMMODATIONS
ARE LOCATED IN OR NEAR COMMUNITIES
WHOSE NAMES APPEAR IN RED
MAP NUMBER 2217
Tonopah
Goldfield
Gold Point
Lida
Silver Peak
Bishop
Big Pine
Independence
Lone Pine
Keeler
Olancha
Cartago
Darwin
Trona
China Lake
Inyokern
Lake Isabella
Beatty
Rhyolite
Death Valley Jct.
Shoshone
Tecopa
Pahrump
Mercury
Lathrop Wells
Indian Springs
Las Vegas
North Las Vegas
Henderson
Boulder City
Goodsprings
Jean
Pioche
Panaca
Caliente
Alamo
Hiko
Mesquite
Bunkerville
Overton
Logandale
Glendale
Moapa
Tempiute
Stove Pipe Wells Hotel
Furnace Creek Ranch
Furnace Creek Inn
Panamint Springs
LAS VEGAS BOMBING AND GUNNERY RANGE
DEATH VALLEY NATL. MONUMENT
CALIFORNIA NEVADA
LAKE MEAD NATIONAL RECREATION AREA
LAKE MEAD
HOOVER DAM
NAVAL ORDNANCE TEST STATION
INYO NATIONAL FOREST
SEQUOIA NATIONAL PARK
KINGS CANYON NATIONAL PARK
TOIYABE NATIONAL FOREST
DIXIE NATIONAL FOREST
DESERT GAME RANGE
CATHEDRAL GORGE STATE PARK
KERSHAW CANYON RYAN STATE PARK
BEAVER DAM STATE PARK
VALLEY OF FIRE STATE PARK
DEATH VALLEY NATIONAL MONUMENT
UTAH
ARIZONA
TO RENO
TO ELY
TO KINGMAN
TO BAKER & BARSTOW
TO MOJAVE
TO RANDSBURG



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Tippipah Spring E10
Titus Canyon F6
Tobias Creek K1
Toiyabe National Forest A1-H12
Tokop Spring D6
Toler Creek C2
Tolicha Peak D7
Tonopah A6
Tonopah Airport A6
Toowa Range H1
Tower Rock H1
Townes Pass H5
Trail Canyon B2-H6
Trail Peak H2
Travertine Springs H7
Tres Plumas Flat C2
Triangle Spring G6
Triple Divide Peak G1
Trona K5
Trona Airport K5
Trout Camp K16
Trout Canyon J12
Trout Spring J12
Tuber Canyon J6
Tuber Spring J6
Tucki Mountain H6
Tucki Wash H6
Tule Canyon D4
Tule Spring J7
Tule Springs K10
Tule Springs Ranch H13
Tunnabora Peak G1
Tuttle Creek G2
20 Mule Team Canyon ...H7

U
Ubehebe Crater F5
Ubehebe Mine G4
Ubehebe Peak G4
Ulida Flat G4
University Peak G1
Upper Cactus Flat J3
Upper Centennial Flat J3
Upper Emigrant Spring H6
Upper Pahranagat Lake ...D14
Upper Warm Springs F4
Ursine B18
Ursine Valley B17-B18
U.S.G.S., Rabbit Spring ...G18
U. S. Lime Products Corporation K14
U. S. Lime Products Quarry .H15
U. S. Weather Bureau ...H12
Ute G16
Uvada C18

V
Valley of Fire State Park ...H16
Valley Siding H14
Valley Wells K5
Vandeman Mine L16
Vega Mines G3
Vermilion Canyon H3
View Point J18
Vigo E16
Virgin G17
Virgin Canyon J18
Virgin Mountains G18
Virgin Peak G18
Virgin River G17
Virgin Spring K8
Virgin Spring Canyon K8
Volcanic Tableland C1
Volcano Butte K4
Volcano Falls H1
Volcano Peak K3

W
Wagon Spring G13
Wahguyhe Peak F6
Walker Pass L2
Walker Pass Station ...L2
Walkers Spring D4
Wallace Creek G1
W. & W. Pumice Quarry J3
Wann J14
Warm Spring K7
Warm Spring Canyon K6
Warm Sulphur Spring ...J6
Warner Springs Resort J13
Water Canyon J4-K5
Waucoba Canyon F2-F3
Waucoba Mountain E2
Waucoba Spring F3
Weepah B4
Weldon L1
Wellspoint J17
Westend L5
West End Chemical Company J16
West End Wash J16
Western Talc Mine K10
Westgard Pass D2
Wheelbarrow Peak D10
White Basin H16
White Hills L17
White Mountain J1
White Mountain Peak ...C2
White Mountains B1-C1
White Point Spring J13
White River B14-C14
White Rock Spring B14-E10
White Sage Flat G13-H6
White Swan Mine H4
Whitesylica Mine H16
Whitney Pass G1
Whitney Portal Pack Station G1
Whitney Portal Public Camp G2
Whitney Ridge G18
Widow Mine H8
Wildhorse Creek C2
Wildhorse Flat B2
Wild Horse Mesa J4
Wildrose Canyon J6
Wildrose Peak H6
Wildrose Spring J6
Wildrose Station J6
Wiley Green Mine E5
Wilkerson Springs E2
Willow Beach K16
Willow Creek C1-F3-H1-J8
Willow Spring D4-H11-J8 K6-K10
Willow Springs C6
Wilson Canyon K5
Wilson Creek Range A17
Wilson Pass K12
Wilson Ranch H4
Window Peak F1
Wingate Pass L6
Wingate Wash K7
Wire Grass Spring G14
Wonder Mine K9
Wonoga Peak H2
Wood Butcher Mine A16
Wood Canyon H6-J5
Woods Creek F1
Woods Lake F1
World Beater Mine J6
Worthington Mountains ...B12
Wyman Creek D2

X
Xmas Mine L13

Y
Yellow Horse Mine K12
Yellowjacket Spring ...C1
Yellow Pine Mine K13
Yucca Flat F10
Yucca Forest G14
Yucca Mountain F8-F9
Yucca Pass F10

Z
Zabriskie Point H7
Zinc Hill H5

DESERT DRIVING

Driving across the deserts of the west is no longer a thing to be dreaded. With excellent highways, faster cars and air-conditioned accommodations available, the hazards and difficulties met in the past are non-existent today.

This desert area is neither flat, nor is it devoid of all vegetation. On the contrary, it is largely mountainous and, though extremely dry, supports an interesting variety of colorful desert plants. Traffic across the desert is steady and constant in both directions, day and night. You'll also find well-spaced service stations and cafes that serve meals and refreshing cold drinks.

When crossing desert country it is wise to:

1. Check your tires in the morning to normal driving pressure. During the day pressure will build up in them from the heat, but it's artificial heat pressure. If you think the tires are riding hard, stop along the road for a few minutes, as there's always a breeze on the desert and it will cool the tires quickly.

2. Check the water and the oil when buying gasoline. Unless you have a leaky radiator, you won't need to add water — if you drive at sensible speeds. Many drivers carry desert water bags, but you will seldom see a motorist filling his radiator from one.

3. Most important is to drive at reasonable speeds. Watch your water temperature gauge, especially on long upgrades.

GOOD DRIVING HABITS

A highway is only as safe as its users wish to make it. The practice of the following good driving habits will add pleasure to your trip.

1. Get an early start in the morning and stop early in the afternoon.
2. Never exceed the posted speed limits. In trying to save a few minutes, you may lose your life.
3. When traveling at higher-than-usual speeds on expressways, allow plenty of following distance from the car ahead. Distance disappears at an alarming rate when approaching obstacles at high speed.
4. Pay strict attention to "Stop" and "Slow" and other traffic signs and signals.
5. Don't pass on hills, curves or in tight traffic. Pass only when you can with absolute safety; if you are traveling 50 mph, your car will move more than the length of a city block after you've perceived the necessity for applying your brakes.
6. Keep to the right, except when passing, to assure faster drivers plenty of room to pass and to reduce headlight glare from the opposite road strip at night.
7. Avoid driving if drowsy or fatigued. Keep the car well ventilated and take as many refreshment stops as necessary. Get out of the car and walk around whenever you stop for gasoline. In case of real fatigue, pull off the road and take a good nap before going any further.
8. From time to time, consciously direct your attention momentarily to points other than directly ahead to avoid frozen vision.
9. Relax when the road permits; this does not mean inattention.

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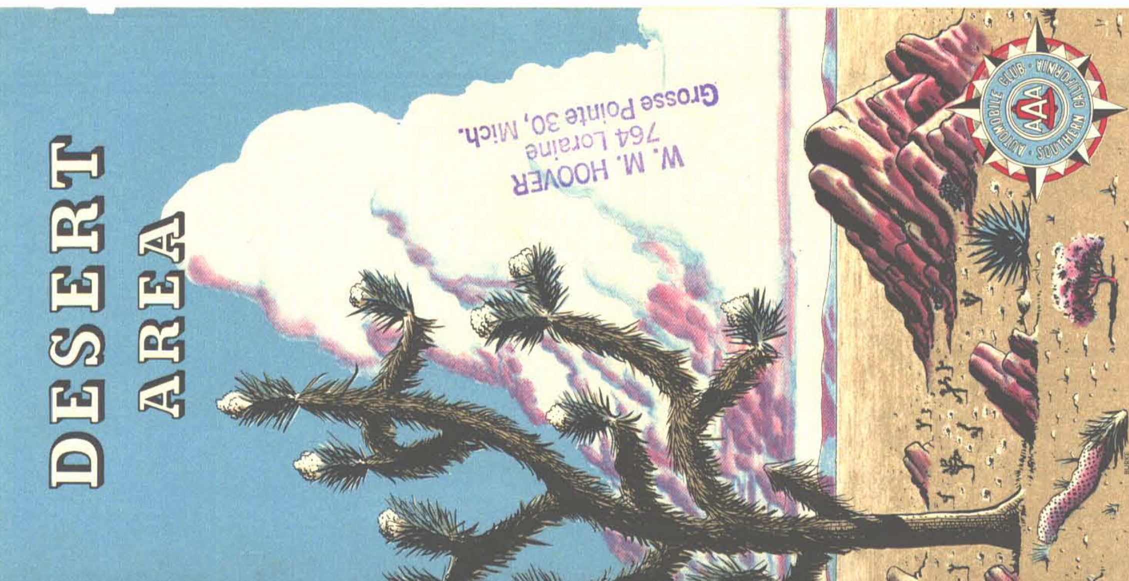

W. M. HOOVER
764 Loraine
Grosse Pointe 30, Mich.

AUTOMOBILE CLUB OF SOUTHERN CALIFORNIA

C-10610

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UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

STATE OF CALIFORNIA
REPRESENTED BY THE
DIRECTOR OF PUBLIC WORKS

DARWIN QUADRANGLE
CALIFORNIA-INYO CO.
15 MINUTE SERIES (TOPOGRAPHIC)

Mapped, edited, and published by the Geological Survey

Control by USGS and USC&GS

Topography from aerial photographs by multiplex methods
Aerial photographs taken 1947. Field check 1950

Polyconic projection. 1927 North American datum
10,000-foot grid based on California coordinate system, zone 4

Unchecked elevations are shown in brown

TRUE NORTH
MAGNETIC NORTH
16½°
APPROXIMATE MEAN DECLINATION, 1950

SCALE 1:62500

1 ½ 0 1 2 3 4 MILES

3000 0 3000 6000 9000 12000 15000 18000 21000 FEET

1 .5 0 1 2 3 4 5 KILOMETERS

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

ROAD CLASSIFICATION

Heavy-duty — 4 LANE | 2 LANE
Medium-duty — 4 LANE | 2 LANE
Light-duty
Unimproved dirt
U. S. Route
State Route

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS

FOR SALE BY U. S. GEOLOGICAL SURVEY, FEDERAL CENTER, DENVER, COLORADO OR WASHINGTON 25, D. C.
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C. 1956
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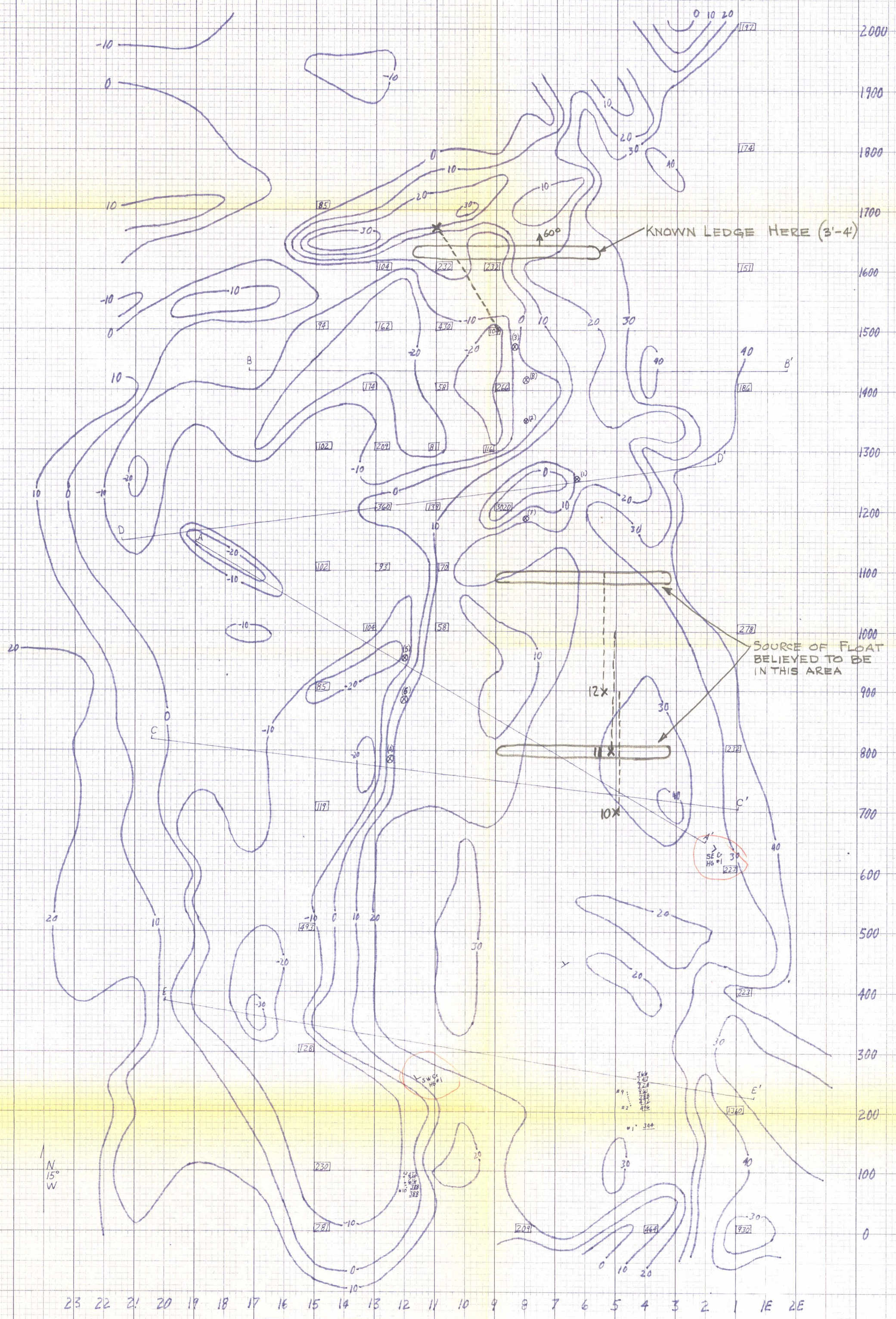
W. M. HOOVER
764 Loraine
Grosse Pointe 30, Mich.

DARWIN, CALIF.
N3615—W11730/15

1950



LEGEND

SP Contour Interval = 10 Millivolts

Geochem Results in Parts Per Billion (Silver)

PPB Soil Samples

PPB Drill Samples

Scale : 1 inch = 100 feet

Claim Corners : L ⌋

Air-Trac Drill Holes : • • •

Recommended Drill Sites : ⊗

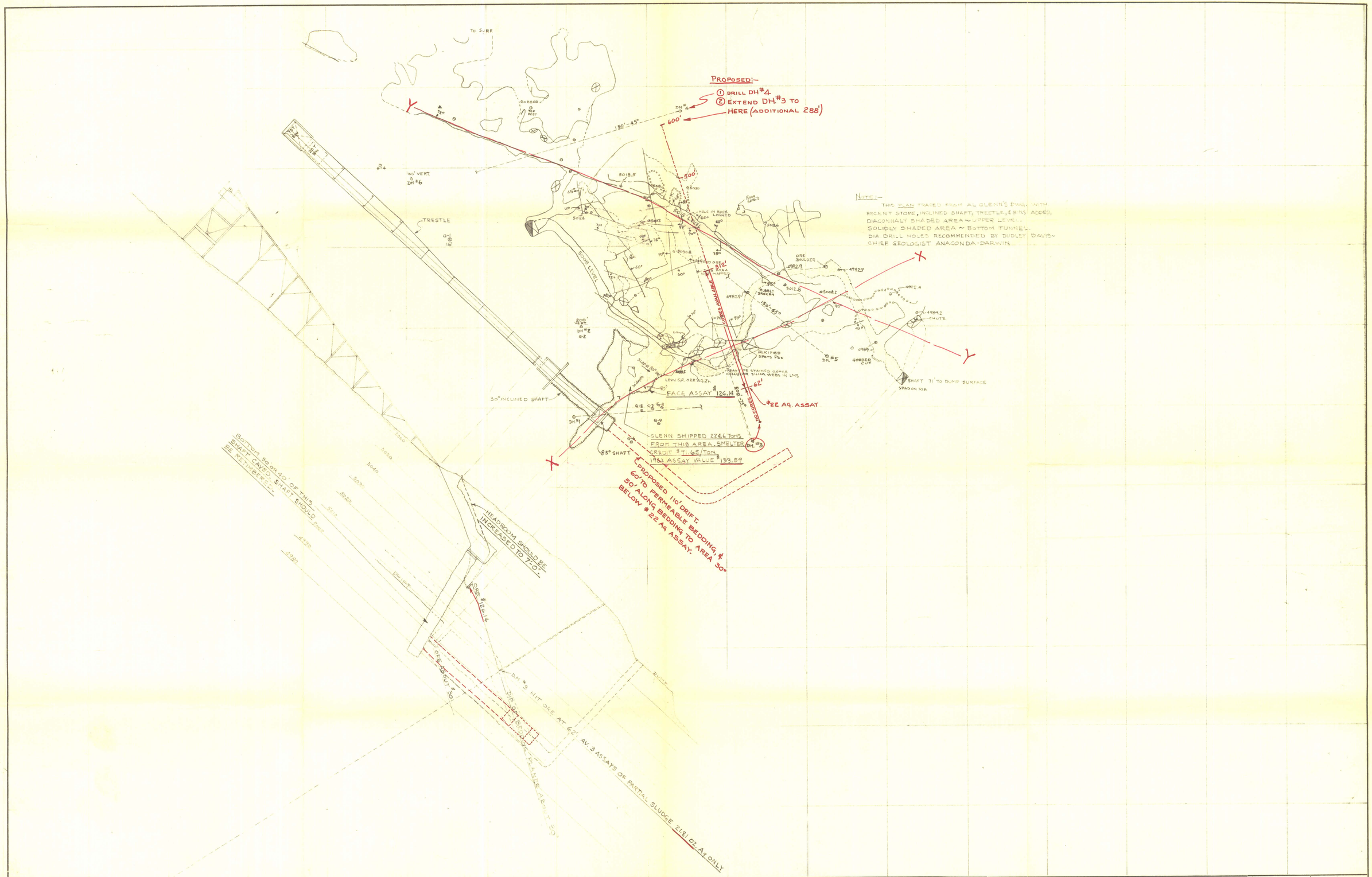
Figure 1. Self Potential Map With Geochem Data

Notes:-

THIS PLAN TRACED FROM A. L. GLENN'S DWG. WITH RECENT STOPE, INCLINED SHAFT, TRESTLE, & BINS ADDED.
DIAGONALY SHADED AREA ~ UPPER LEVEL.
SOLIDLY SHADED AREA ~ BOTTOM TUNNEL.
DIA. DRILL HOLES RECOMMENDED BY DUDLEY DAVIS ~ CHIEF GEOLOGIST. ANACONDA - DARWIN.

REVISIONS			DRAWN BY	DATE	APPROVED
			Hoover	10-7-1961	
			CHECKED BY	DATE	APPROVED

FILE	JOB NUMBER
SCALE 1" = 20'	SHEET NO. HL-1



REVISIONS			DRAWN BY	DATE	APPROVED
			Hoover	10-7-1961	
			CHECKED BY	DATE	APPROVED

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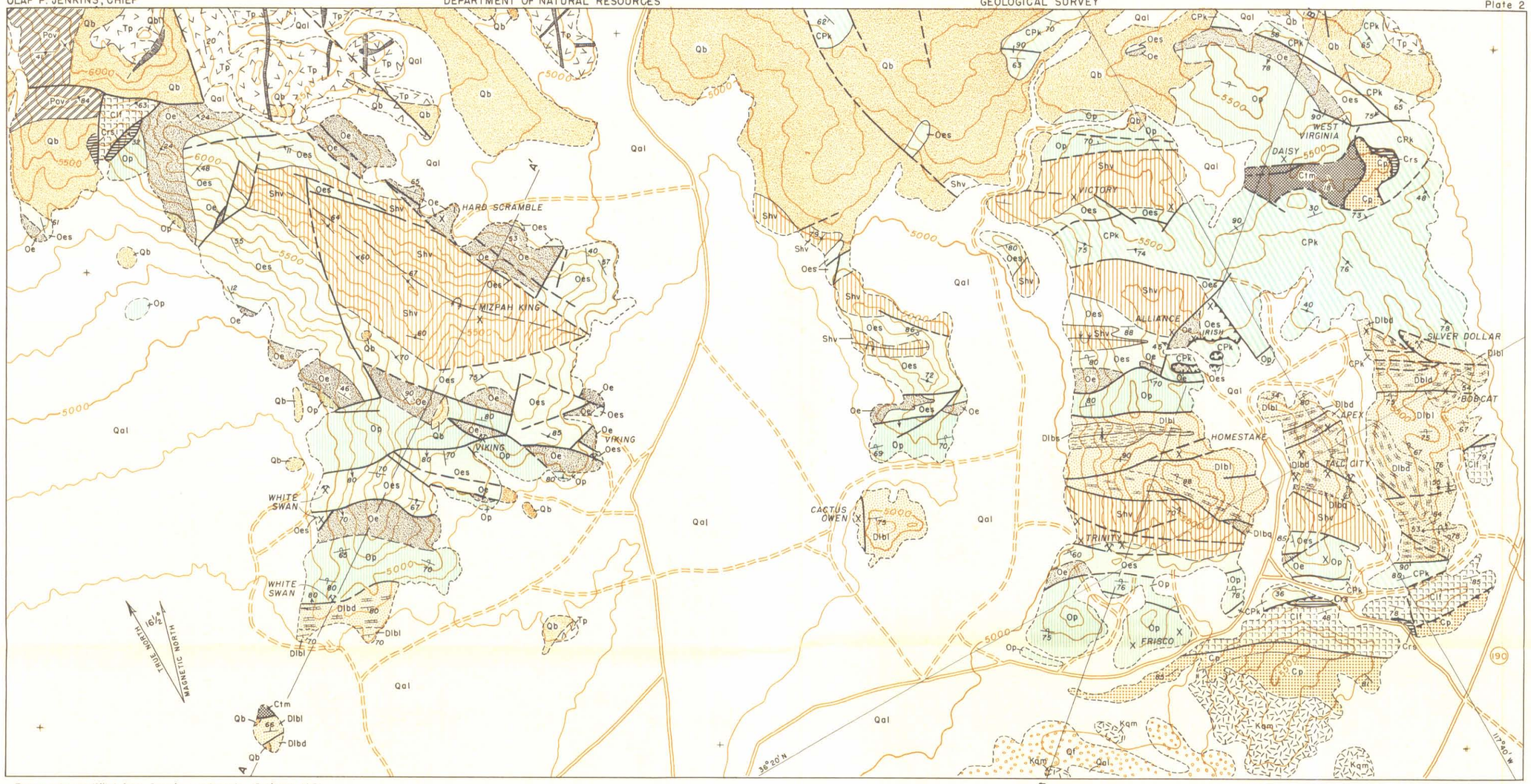
FILE	JOB NUMBER
SCALE	SHEET NO.



Topography modified from Darwin quadrangle, 15 minute, 1951, U.S. Geological Survey

Geology by W. E. Hall and E. M. Mackevett, 1953

0 1 2 MILES

Contour interval 100 feet; datum mean sea level

EXPLANATION

QUATERNARY

Recent

Qal — Alluvium

Pleistocene

Qb — Olivine basalt (dike)

Qf — Fanglomerate

TERTIARY

Pliocene(?)

Tp — Pyroclastic rocks (Includes tuff-breccia, agglomerate, and basalt cinders)

CRETACEOUS

Kqm — Quartz monzonite

PERMIAN

Pov — Owens Valley formation

PENNSYLVANIAN

CPk — Keeler Canyon formation

Crs — Rest Spring shale

CARBONIFEROUS

MISSISSIPPIAN

Clf — Lee Flat limestone

silicated Cp — Perdido formation

Ctm — Tin Mountain limestone

DEVONIAN

Dlbs, Dlbl, Dlbd, Dlbq — Lost Burro formation (Shale, Dlbs; limestone, Dlbl; dolomite, Dlbd; quartzite, Dblq)

SILURIAN

Shv — Hidden Valley dolomite

ORDOVICIAN

Oes — Ely Springs dolomite

Oe — Eureka quartzite

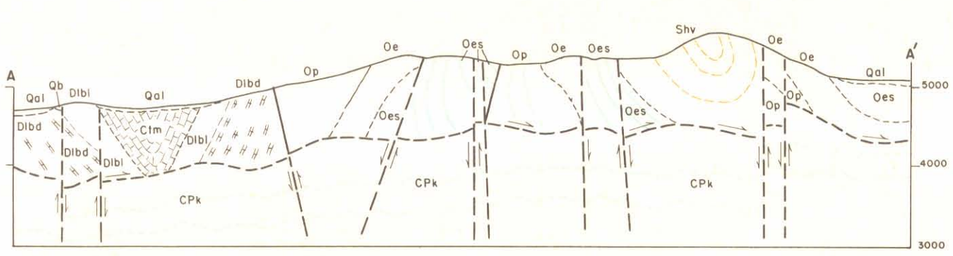
Op — Pogonip group

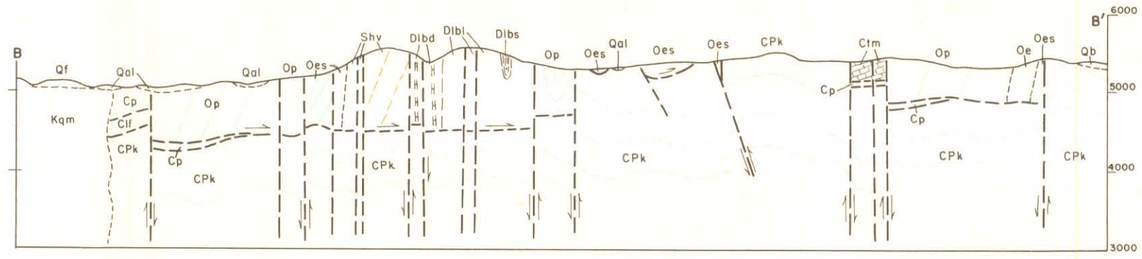
Talc

Lead, zinc, silver minerals

Mine

Prospect





EXPLANATION

Contact (Dashed where approximate)

Indefinite contact

Overturned contact, showing dip

Fault, showing dip (Dashed where approximate)

Vertical fault

Thrust fault, showing dip (Saw-teeth on side of upper plate)

(Fault, showing relative movement)

Syncline

Overturned syncline

Inverted anticline, showing plunge

Inverted syncline, showing plunge

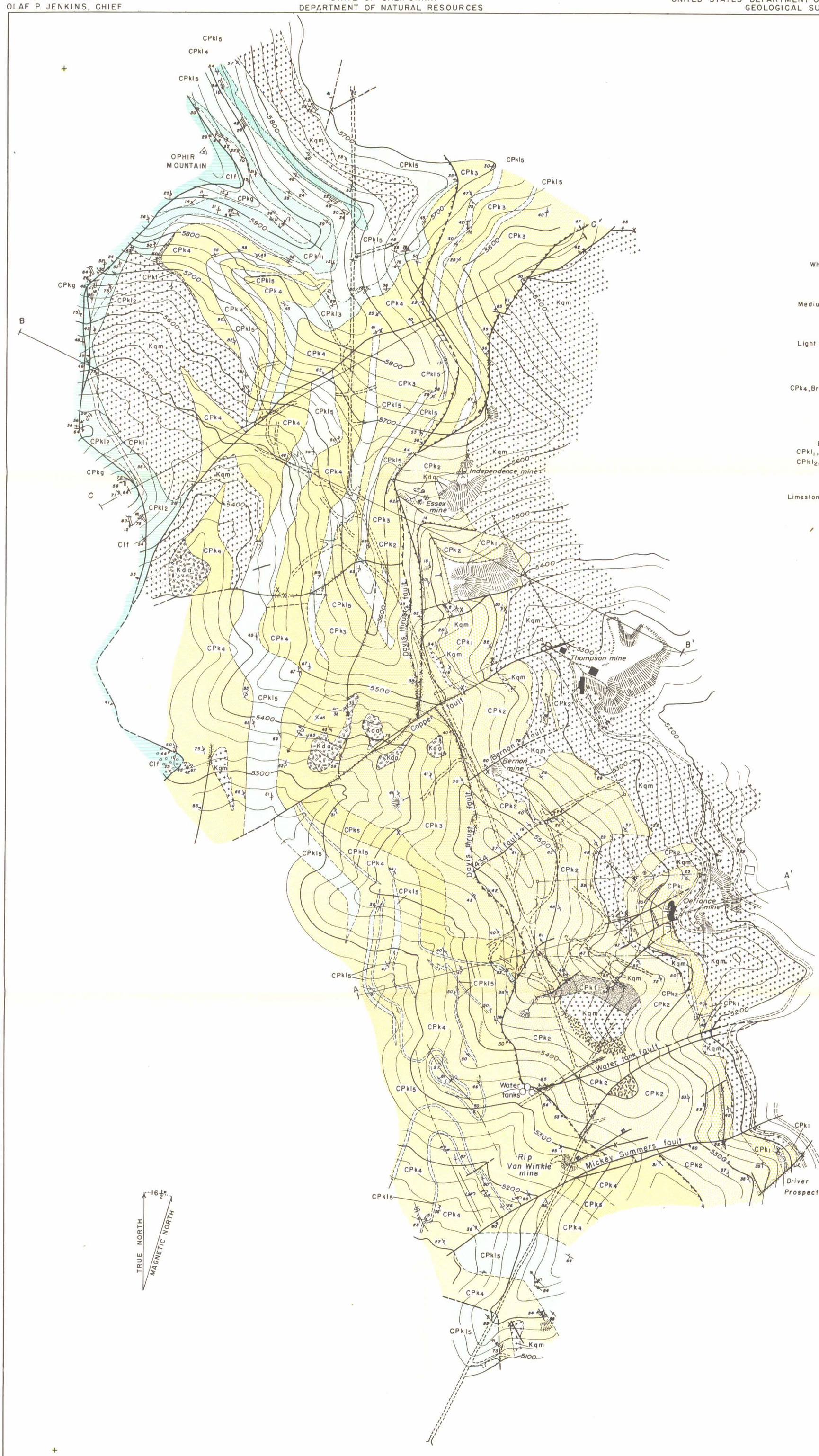
Tops known — Tops unknown

Vertical — Overturned

Attitude of beds

GEOLOGIC MAP AND CROSS SECTIONS OF THE TALC CITY HILLS

INYO COUNTY, CALIFORNIA



EXPLANATION

CRETACEOUS

- Kqm — Quartz monzonite
- Kda — Diorite and amphibolite

PENNSYLVANIAN - PERMIAN (?)

- CPk_1 — White, dense calc-hornfels
- CPk_2 — Medium-grained calc-silicate rock
- CPk_3 — Light gray, dense calc-hornfels
- CPk_4 / CPk_5 — CPk_4, Brown and gray dense calc-hornfels; CPk_5, siltstone
- $CPkl_1$ / $CPkl_2$ — Bluish-gray limestone; $CPkl_1$, sandy and silty limestone; $CPkl_2$, thinly bedded limestone
- CPkg — Limestone with 1-inch chert nodules (Golfball horizon)
- CPkt — Tactite
- $CPkl_3$ — Thinly bedded shaly limestone
- $CPkl_4$ — Bluish-gray sandy limestone
- $CPkl_5$ — Thinly bedded bluish-gray limestone
- Units with no stratigraphic significance

Keeler Canyon formation

MISSISSIPPIAN (?)

- Clf — Lee Flat limestone

Contact
Dashed where approximate

Fault showing dip
Dashed where approximate

Thrust fault showing dip
Dashed where approximate
(Saw-teeth on side of upper plate)

Inverted syncline showing trace of axial plane and plunge of axis; dashed where approximate.

Inverted anticline showing trace of axial plane and plunge of axis; dashed where approximate.

Strike and dip of overturned beds

Horizontal beds

Strike and dip of foliation

Strike and dip of axial plane of left hand drag fold, showing bearing and plunge of axis of fold.

Strike and dip of axial plane of right hand drag fold, showing bearing and plunge of axis of fold.

Bearing and plunge of lineation

Strike and dip of joints

Strike of vertical joints

Ore, showing dip

Disseminated limonite

Feldspathic alteration

Dolomitized limestone

Vertical shaft

Inclined shaft

Portal of adit

Small mine working

Open pit

Dump

Radiore tunnel (400 level)

Mapped by W. E. Hall and E. M. MacKevett, August 1954

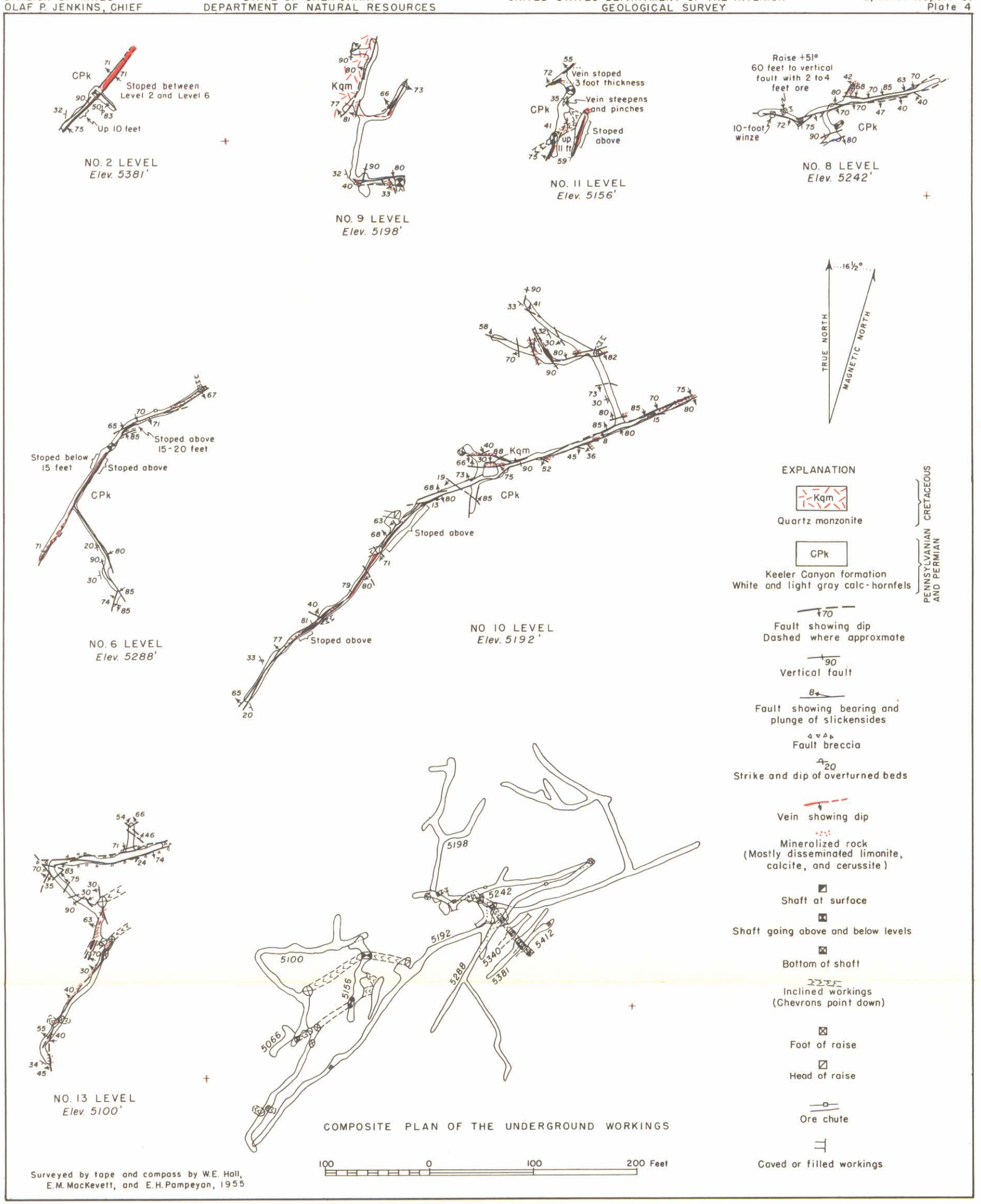
Geology by W. E. Hall, 1954
Topography by E. M. MacKevett and W. E. Hall

GEOLOGIC MAP OF THE DARWIN MINE AREA, INYO COUNTY, CALIFORNIA

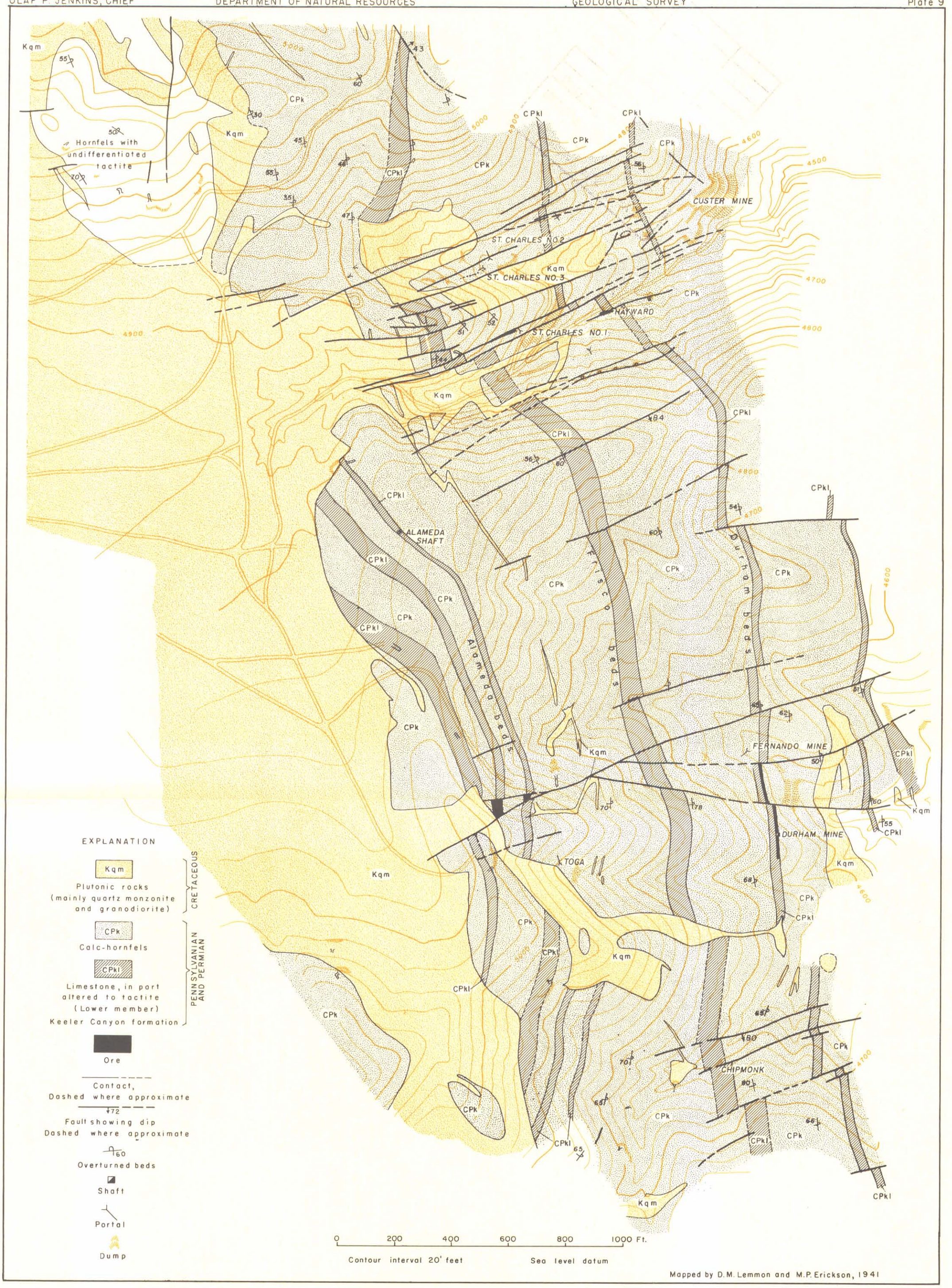
200 0 200 400 600 Feet

Contour interval 25 feet
Datum is mean sea level

GEOLOGIC MAP OF CHRISTMAS GIFT MINE AREA



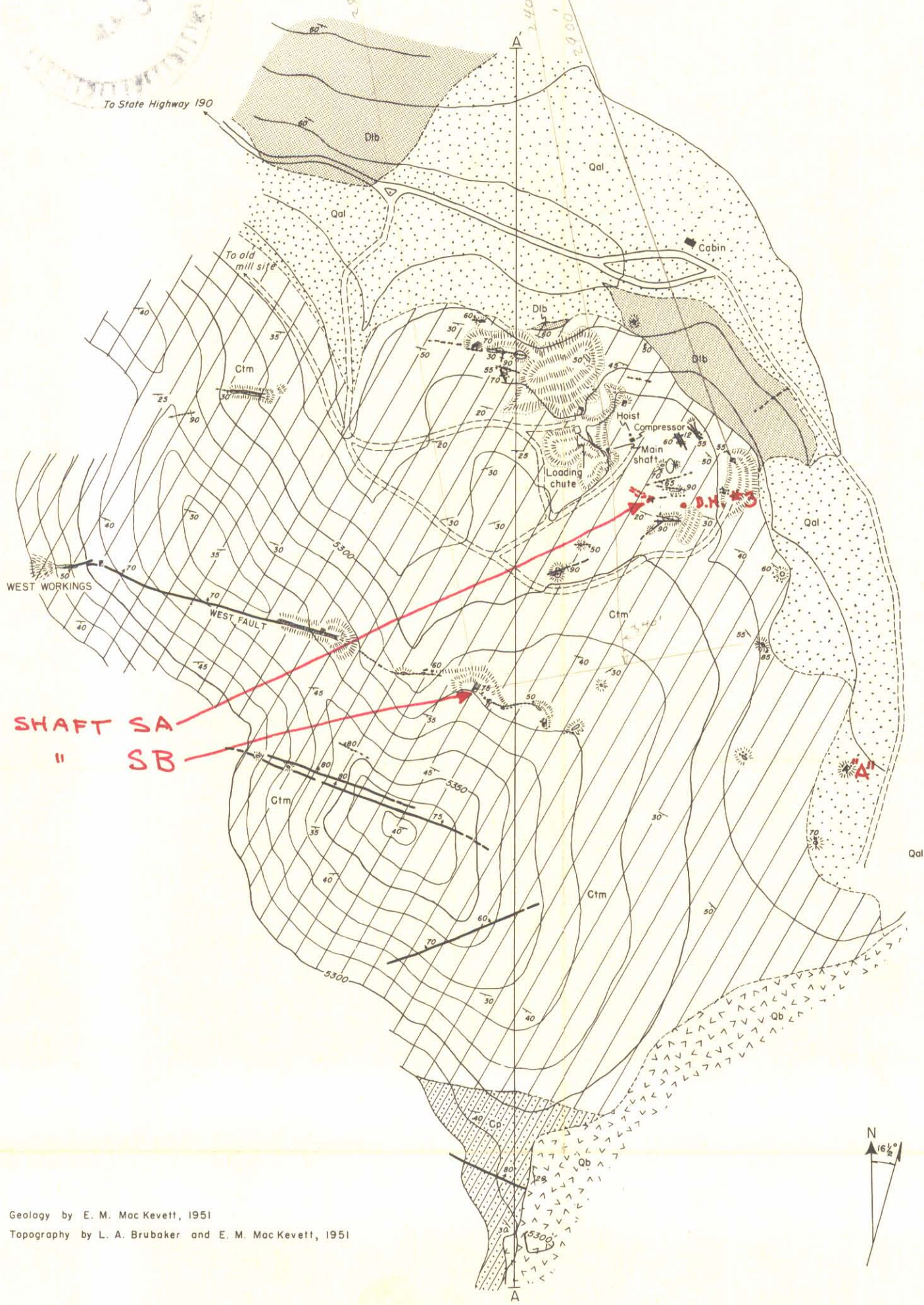
GEOLOGIC MAPS OF THE UNDERGROUND WORKINGS OF THE CHRISTMAS GIFT MINE



GEOLOGIC MAP OF THE DURHAM, FERNANDO AND ST. CHARLES MINES AREA, INYO COUNTY, CALIFORNIA

"LEE" MAP

SEE P. 54 FOR OTHER DIGGINGS.



EXPLANATION

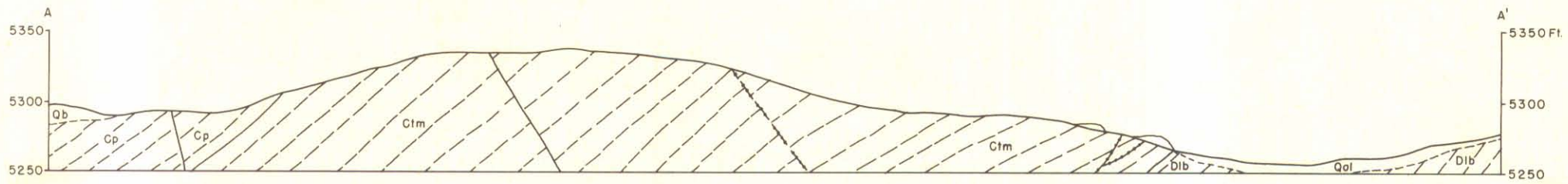
QUATERNARY
- Qal — Alluvium
- Qb — Olivine basalt

MISSISSIPPIAN
- Cp — Perdido formation (Interbedded limestone and chert)
- Ctm — Tin Mountain limestone (Dark grey cherty limestone)

DEVONIAN
- Dlb — Lost Burro formation (Mainly white marble)

- 60 — Contact, showing dip (Dashed where approximately located)
- 50 — Fault, showing dip (Dashed where approximately located)
- 90 — Vertical fault
- Breccia
- 30 — Strike and dip of beds and flows
- Vein, generally quartz, calcite, and barite rich (Dashed where approximately located)
- 90 — Vertical vein
- Vertical shaft
- Inclined shaft
- Portal and open cut
- Trench
- Dump
- Dirt road (Dashed where poor)

Geology by E. M. MacKevett, 1951
Topography by L. A. Brubaker and E. M. MacKevett, 1951

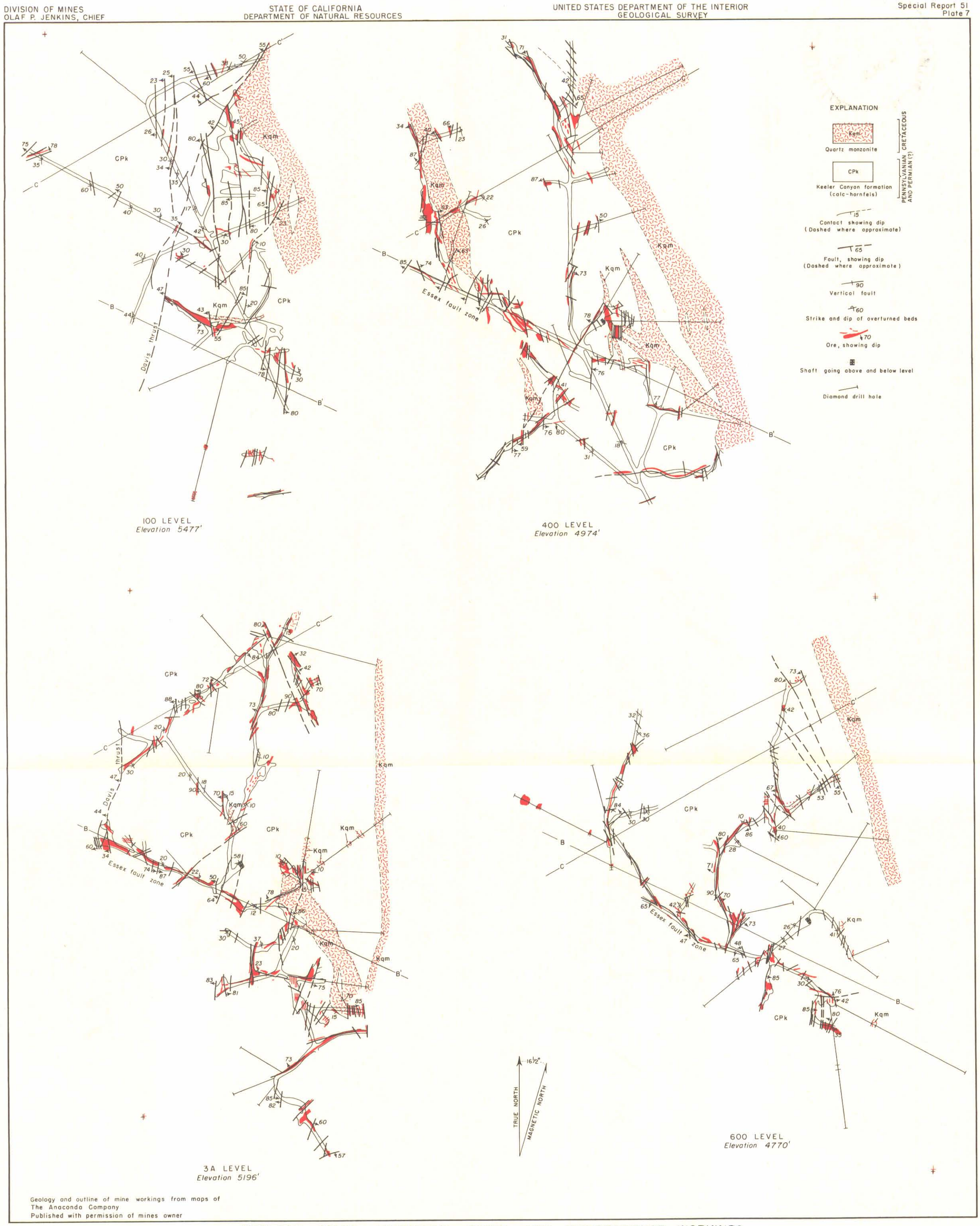


CROSS SECTION A-A'

GEOLOGIC MAP OF THE LEE MINE AREA

100 0 100 200 Feet

Contour interval 10 feet



Geology and outline of mine workings from maps of
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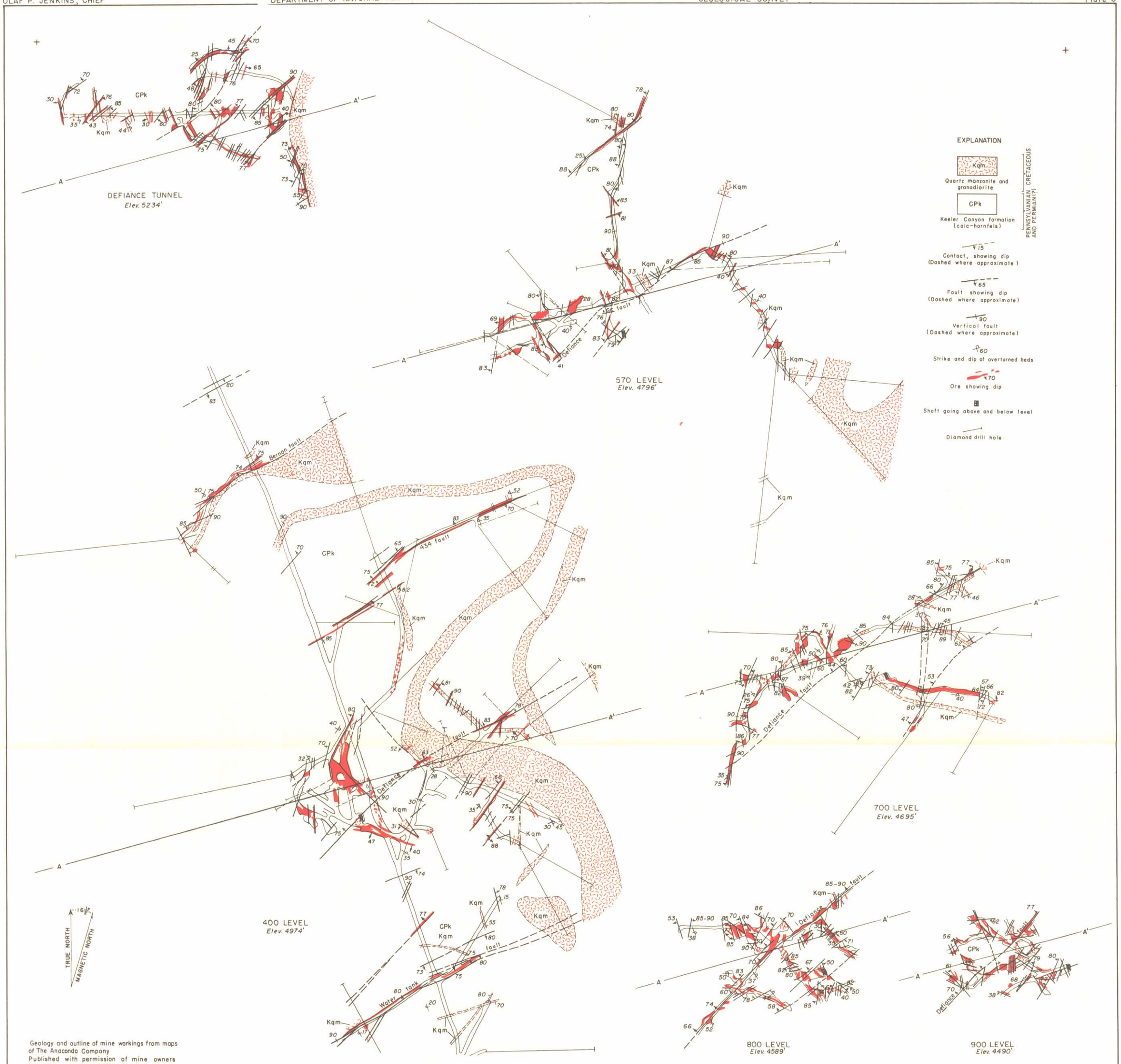
GEOLOGIC MAPS THOMPSON, ESSEX AND INDEPENDENCE WORKINGS OF THE DARWIN MINES



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GEOLOGIC MAPS OF THE DEFIANCE WORKINGS OF THE DARWIN MINE, INYO COUNTY, CALIFORNIA