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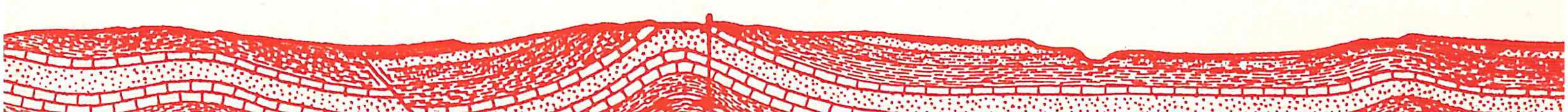
ECONOMIC GEOLOGY AND GEOCHEMICAL STUDY OF WINSTON MINING DISTRICT, BROADWATER COUNTY, MONTANA

By

F. N. Earll



MONTANA BUREAU
of
MINES AND GEOLOGY

Butte, Montana

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ECONOMIC GEOLOGY AND GEOCHEMICAL STUDY OF WINSTON MINING DISTRICT, BROADWATER COUNTY, MONTANA

by

F. N. Earll

ABSTRACT

The Winston mining district was studied to determine the present status and future potential of its numerous mines and prospects and to provide information that would aid in, and encourage future prospecting and development. To this end, all accessible workings were entered, mapped, and sampled. Maps of inaccessible workings have also been included where available, and where no map could be found, the surface was examined and a map of surface exposures prepared from which some conclusions as to future potential could be drawn.

A second phase of the program involved a geochemical survey of the district. This survey included soil sampling on a rectangular grid pattern throughout the district, plus sampling along a series of line traverses across several of the known veins in the district. Results of the geochemical survey are presented in the form of a series of anomaly maps and graphs, which indicate areas of possible interest.

The examination of individual mines has led to the conclusion that additional ore may be found in several of them. The geochemical survey indicated the presence of almost all of the known productive properties in the district, and in addition has indicated several areas that have not been adequately explored as yet.

INTRODUCTION

PURPOSE AND SCOPE

The investigation of the Winston mining district is one in a continuing series of similar studies of Montana mining districts made by the Montana Bureau of Mines and Geology. The purpose of these studies is to provide information on what has been done and what is being done in the district. Wherever possible, conclusions are drawn as to the future potential of the district as a metal producer, and suggestions are given as to areas and methods of prospecting for new ore. Geologic mapping of the surface is undertaken if such information is not available from another source.

No detailed map of surface geology was made in the course of the present investigation; a study of the geology of the Boulder batholith, which includes the Winston district, was underway at the same time. This work, by Montis Klepper, geologist for the U. S. Geological Survey, satisfactorily covers features of surface geology of the district.

Vein structures in and around the several mine groups in the district were mapped in detail, and underground mapping was done in all accessible mines. Unfortunately, many of the mines were inaccessible, and most of the mines that were mapped will not remain open more than a few years longer.

A geochemical soil survey of the district was undertaken to determine whether a district of this type could be prospected satisfactorily by this method. It was hoped that one or more areas of mineral potential within the district could be found that had not yet been adequately prospected.

LOCATION AND ACCESSIBILITY

The Winston mining district, or the Beaver or Beaver Creek district as it has sometimes been called, is on the northeast flank of the Elkhorn Mountains, in Broadwater County, Montana. The district, as presently defined, occupies the area north of the Park district, or essentially the area lying north of the divide south of Whitehorse Creek. The district includes the eastern two-thirds of T. 8 N., R. 1 W., plus the westernmost column of sections in T. 8 N., R. 1 E., and the northernmost row of corresponding sections in T. 7 N. (Fig. 1). The small town of Winston, which is a stop on the

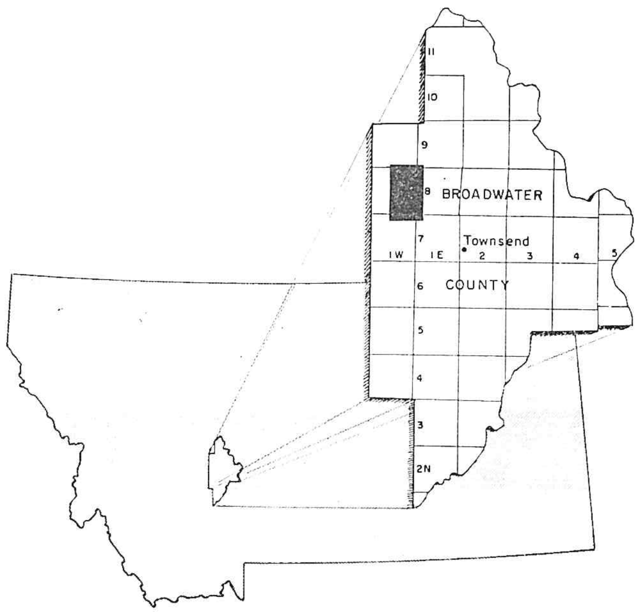

Figure 1.—Index map showing location of Winston mining district.

Helena line of the Northern Pacific Railroad, is in the northeastern corner of the district.

Access to the district is provided by U. S. Highway 12, which passes through Winston about 20 miles southeast of Helena. From this highway several dirt and graveled roads penetrate the interior of the district. These include roads up Kimber Gulch, Kelly Gulch, Iron Age (or Custer) Gulch, Weasel Creek, Beaver Creek, North Pole Creek, Staubach Creek, and the unnamed creek on which the Orphan Boy mine is located. The road from Winston up Weasel Creek goes through the center of the district, then over the divide south of Whitehorse Creek, and down Indian Creek through the Park district to Townsend. Access roads lead from the main roads to the numerous mines of the district. Most of the mine access roads and the Weasel Creek road above the junction leading to the Carlson crosscut of the Kleinschmidt mine are not recommended for passenger car travel.

Elevations in the district range from 4,320 feet at Winston to 8,360 feet in the southwest corner of the district. A gently sloping surface in the northeast quarter of the district leads up to the foothills of the Elkhorn Range. From there, the surface rises fairly sharply toward the crest of the range. The southwestern part of the district is characterized by fairly rugged topography, but difficulty of access is caused more by the dense growth of timber than by topography.

PREVIOUS WORK

The oldest published work on the Winston district is that of Stone (1911), who investigated lands adjacent to the Northern Pacific Railroad right-of-way. He gave brief descriptions of several of the mines in the district and prepared a geologic map of the Elkhorn Mountains, which includes the area of the district. This map, though uncomplicated by refinements, indicates the general surface geology of the district and has been reproduced in published reports as recently as 1951. Pardee and Schrader (1933) provided information on mines and mining in the district, and compiled production records for the district from its earliest days through 1928. Reed (1951) provided more recent production data and maps of several mines that are no longer accessible. Klepper (1964) has completed a study of the surface geology of the region and some investigation of several of the mines in the district.

The works of Knopf (1913), Billingsley and Grimes (1918), and Klepper, Weeks, and Ruppel (1957), although not bearing directly on deposits of the Winston district, provide important data applicable to them.

ACKNOWLEDGMENTS

Field work in the Winston mining district was conducted during the summers of 1962 and 1963. In this work the author was assisted by Mr. D. C. Lawson, mineralogist for the Montana Bureau of Mines and Geology, who also made all the soil analyses for the geochemical study, and by Mr. D. H. Rife and Mr. D. C. Hruska, part-time field assistants.

Others who made important contributions in regard to the history, mines, mining, and production of the district include Mr. George Neill and Mr. Carl Voss of Helena, Mr. Fred Schneider of Townsend, Mr. Ray Reynolds and Mr. Adam Stabler of Winston, and Mr. Edwin Pohl of Seattle.

GEOLOGY

EXTRUSIVE ROCKS

The prevalent rocks in the Winston district are late Cretaceous volcanic rocks of generally andesitic composition, named the Elkhorn Mountains volcanics by Klepper, Weeks, and Ruppel (1957, p. 31). Exposures are to be found over a large area extending from Deer Lodge on the west to

Townsend on the east, and from Helena southward as far as Whitehall. Total thickness of these volcanic deposits probably exceeds 10,000 feet (Klepper, and others, 1957, p. 32), but only a part of this total thickness is exposed within the Winston district.

Generally speaking, the volcanic rocks are fine-grained, gray-green to dark-gray andesite. In most exposures they are massive, though in some they show a distinct layering. Most of the rocks exposed in the district seem to belong to the lower member of the volcanic sequence (Klepper and others, 1957). These rocks are described as being predominantly fragmental deposits, interbedded with lesser flows and a few thin beds of welded tuff. "Banded" layers in the sequence are particularly well exposed along low cliffs beside Beaver Creek, in sec. 10 and 15, T. 8 N., R. 1 W.

As one moves westward across the district, he moves upward in the volcanic section, probably into the middle member of the sequence. This unit is described as being composed of welded tuff, ash-fall crystal tuff, and water-laid volcanic ejectamenta (Klepper and others, 1957, p. 32).

One of the most important features of the volcanic rocks, from the miner's point of view, is their conspicuous closely spaced jointing, which causes the rock to separate into blocks too small to be held adequately by simple timber sets yet too large to be ignored. This widespread jointing prevents the rock from holding up well in unsupported workings and is directly responsible for the caving evident at most mines in the district.

INTRUSIVE ROCKS

Intrusive rocks in the Winston district include small to moderate-size stocks of generally granodioritic composition. Although these stocks exhibit minor differences in mineral composition and texture, they all seem to be genetically related, and probably all are offshoots or outliers of the huge Boulder batholith, which is exposed more or less continuously west of a line 3 to 5 miles west of the district. Brief comment on some of the individual stocks follows.

LITTLE OLGA STOCK

The Little Olga stock is a medium- to coarse-grained granodiorite porphyry, grading to medium-grained granodiorite in some exposures. The porphyritic nature of the rock is best exhibited in the vicinity of the Vosburg mine, where orthoclase phenocrysts as much as 3 inches in length are common. In most exposures, however, the phenocrysts are much smaller, probably averaging between one-quarter and one-half inch in maximum dimension.

The rock is composed of plagioclase (var. oligoclase), which is the mineral present in greatest quantity, and orthoclase, quartz, and hornblende, in decreasing order of abundance. On fresh exposures, the rock is light colored and has a sparkling appearance owing to the abundance of fairly large cleavage surfaces of feldspar grains.

The Little Olga stock is the largest intrusive mass exposed entirely within the district, its surface area of exposure exceeding one-half square mile.

FRIEBURG STOCK

The small Frieburg stock, exposed in a more or less circular area on the east side of Weasel Creek, in sec. 26, T. 8 N., R. 1 W., consists of medium-grained, granitic-textured granodiorite. Like the Little Olga stock, it has a generally light colored appearance, owing to the scarcity of dark minerals. Mineral composition includes plagioclase (var. oligoclase) most abundant, somewhat less orthoclase and quartz, and minor hornblende.

EDNA STOCK

The Edna stock is a small body, circular in section, located in the SE¼ of sec. 13, T. 8 N., R. 1 W. It differs from the other stocks in being more acid in composition and much finer grained.

The fine-grained holocrystalline groundmass of anhedral quartz and orthoclase grains, plus minor plagioclase, surrounds abundant phenocrysts of quartz and orthoclase, 1 to 2 mm in length, and lesser amounts of plagioclase and biotite phenocrysts. Such a rock might best be described as an adamellite porphyry.

Although distinctly different from the other stocks in the district, this body probably is genetically related to them.

ORPHAN BOY STOCK

The Orphan Boy stock, exposed in the north half of sec. 4, T. 8 N., R. 1 W., extends about a mile beyond the mapped area. It too is somewhat different from most stocks in the district, being darker because richer in ferro-magnesian minerals. In the order of their abundance the constitutent minerals are plagioclase, orthoclase, biotite, hornblende, and quartz.

The rock is medium to dark gray and medium grained, and tends to weather as dark-brown boulders.

GENERALIZED GEOLOGIC SETTING

Although the Winston district may be underlain at depth by sedimentary rocks such as are exposed in the Park district to the south, none are exposed in this district. The oldest rocks exposed are the andesitic Elkhorn Mountain volcanic rocks, of late Cretaceous age.

After the volcanic activity, minor folds were developed in these bedded deposits, probably in connection with the late Cretaceous Laramide orogeny, and probably only slightly before intrusion of the stocks.

Intrusion of the Boulder batholith followed at the close of the Cretaceous Period or during earliest Tertiary time. It seems obvious that the numerous stocks in the Winston district were intruded at the same time. Then, after solidification of the intrusive bodies, the generally east- and northeast-striking faults were formed. These faults then acted as channelways for mineralizing solutions rising from the inner and deeper portions of the intrusive mass.

ORE DEPOSITS

HISTORY AND PRODUCTION

Interest in mining in the Winston area began with the discovery of rich gold placers at Helena, and soon after at Confederate Gulch, in 1864. These discoveries sent prospectors swarming over the surrounding country and led to the discovery of additional placers and of the East Pacific vein in 1867, the first discovery in what is now recognized as the Winston mining district (Reed, 1951).

Although discovery was made in 1867, active mining did not begin until the early 80's. Discovery and development of mines in most of the other productive areas of the district soon followed, notably on Iron Age Gulch, and in and around the Little Olga stock. Most of the major mines of the district had been opened by 1900, and many of them had amassed enviable production records by that time.

Production continued, more or less steadily, until 1918, when activity fell off. There is no record of production between 1918 and 1923, although some development work was accomplished.

In 1924, production resumed at the January and Little Olga mines, and in short order most of the mines in the district appeared as producers. This period of steady production continued through 1955 but production gradually diminished thereafter as one after another of the mines was abandoned. The most recent production of record came in 1961, mainly from the January mine.

Total production of the Winston district is valued in excess of $4,000,000 realized from approximately 150,000 tons of ore (Appendix I). It has been intimated (Pardee and Schrader, 1933, p. 212) that although early production from the district was of value mainly for its gold, the then current production and ores to be mined in the future would be of value chiefly for their base metal and contained silver. This erroneous impression seems to have resulted from the fact that ores mined in the period 1926-28 came almost entirely from the East Pacific and Little Olga mines, and were not characteristic of the district as a whole. Examination of the total product of the district through 1961 shows that the value of gold produced exceeds the total of all other metals combined, and that the value of gold and silver, taken together, is more than three times that of base metals produced. Interestingly, this is almost exactly the ratio of values that has obtained since the earliest days of the district's development. In short, although the base metals constitute a valuable product, the district has been and remains of interest as a producer of the precious metals.

As has been true of many mining districts, many times in the 80 years since mining began there, production from Winston has diminished and seemed destined to cease. Time after time, however, mines that have lain dormant have been reopened to make additional contributions to total district production. Each time that the mines close it is commonly assumed that this time it is forever, but each time, when conditions are right, the mines have been reopened. Certainly there are individual mines that have been worked out, but the present investigation has shown that there are many that have excellent possibilities for producing more ore. It seems unlikely that any will be large producers, nor will they be of the type to attract investment by major companies, but the history of the Winston district need not all be behind it.

ORE OCCURRENCE

Veins in the district are of two types. First there are the 'flat veins,' actually veins ranging in dip from horizontal to about 30 degrees. Strike is variable, but is generally northeast. Veins of this type are present in most of the mines along Iron Age Gulch and at the Sunshine mine on Weasel Creek. They are characteristically developed in the volcanic rocks adjacent to intrusions. On first inspection, these veins might seem to be controlled by bedding in the volcanic rocks, but the fact that they pass without apparent interruption into intrusive rock (as at the Edna No. 2 mine), shows that they are actually fissure controlled. Vein material is essentially quartz-pyrite, containing very minor base-metal sulfides. None of these veins has been developed beyond the oxide zone, thus the vein matter observed is composed of limonite, quartz, variable amounts of gold and silver, and occasional relict grains of unaltered pyrite. Veins pinch and swell from place to place, and are offset by numerous faults, but offsets are generally small.

The second group is composed of steeply dipping to vertical veins that strike approximately east-west. Veins of this group are the most common in the district, and are found in the mines of Kleinschmidt-Vosburg group, the Stray Horse-Little Bonanza group, the East Pacific-January group, the Hyantha mine, and the several individual mines in the northern and western part of the district. Vein material is again basically quartz-pyrite, but with the important addition of galena, sphalerite, and some chalcopyrite locally. In a few veins, notably the Little Olga, January, and East Pacific, galena and sphalerite were so abundant in some ore shoots as to constitute a lead-zinc ore.

Two veins in the districts do not seem to fit into either of the above groups. The Custer vein dips steeply northward, yet strikes northeast. Mineralization in the Custer vein corresponds, in general, to that of the 'flat vein' group, and is unlike that in the neighboring Hyantha vein to the south, which has produced important amounts of lead and zinc. The other vein that departs from the usual is that of the Lily mine. This vein strikes northwest and dips 50 to 55 degrees to the south. Again, mineralization seems related to that of the 'flat vein' group, rather than to that of the east-west veins.

All productive veins in the district lie within or close to intrusive rocks, and it is clear that the minerals in them were derived from the intrusive masses. Although the two most productive mines in the district, the Custer and the East Pacific, are both on veins in volcanic rock adjacent to intrusive bodies, there is no clear indication that this host rock is more favorable to the formation of rich or more extensive deposits. Mines such as the Kleinschmidt and Vosburg, which are completely within an intrusive mass, have produced nearly as much, and both the Edna No. 2 and January veins pass from volcanic into intrusive rocks without apparent change in the type or degree of mineralization. From this, it can be concluded that the size and value of ore bodies has been controlled by the strength and continuity and to some extent the physical condition of vein structures, rather than by the type of rock in which they occur.

CUSTER-HYANTHA GROUP

GENERAL COMMENT

The mines herein described as belonging to the Custer-Hyantha group are those mines clustered around the mouth of what has been called, for lack of a better name, Iron Age Gulch, and lying north of the unnamed west fork of that gulch. Separation of these mines as a group apart from the mines of the Iron Age-Lily group, which lie directly south, is somewhat arbitrary but is based upon physical as well as geographical differences in the two groups.

Mines of the Custer-Hyantha group are distributed around a small porphyry stock that has been referred to as the Edna stock. Localization of ore is provided by three, or possibly four, strong vein structures. The dominant structure is the strong Custer vein, striking northeast and dipping steeply north, which is traceable from near the stock contact northeastward to and beyond the old Custer mine shaft. Perhaps second in importance is the more or less parallel Hyantha vein. This vein too is traceable from a point near the contact with the Edna stock well outward to the margin of the mine group. The third vein structure of importance might best be called the Edna vein. It is a 'flat' or slightly dipping vein, which girdles the hill upon which the mine group is located. The vein, in general, dips inward toward the Edna stock, and its outcrop seems to nearly circle the group. It seems likely that the Edna, Edna No. 2, and General Sherman mines are all on this same vein, although there is the possibility that two sub-parallel and very similar veins are involved.

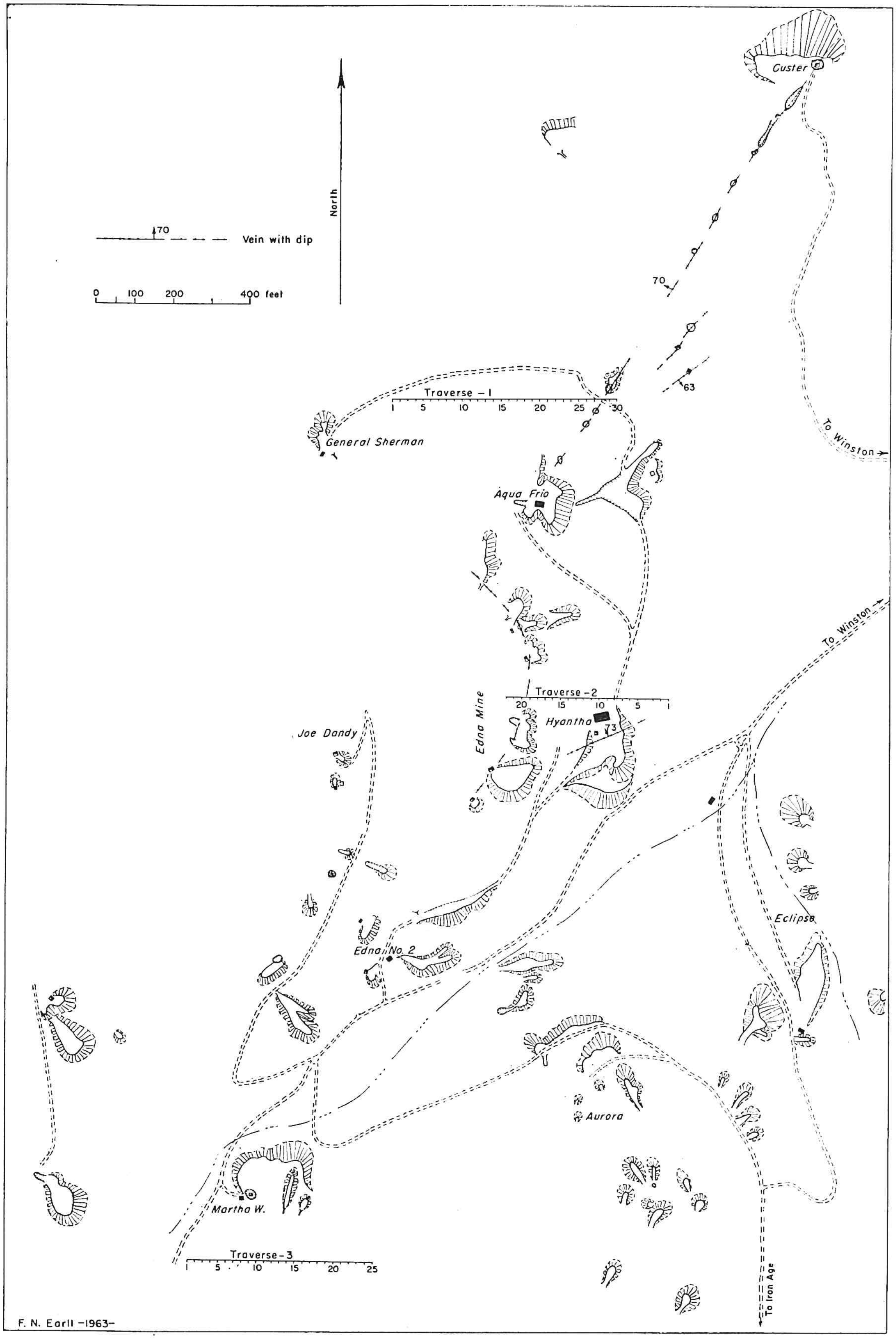

Figure 2.—Map of surface workings Custer-Hyantha group mines, Winston mining district, sec. 13, T. 8 N., R. 1 W.

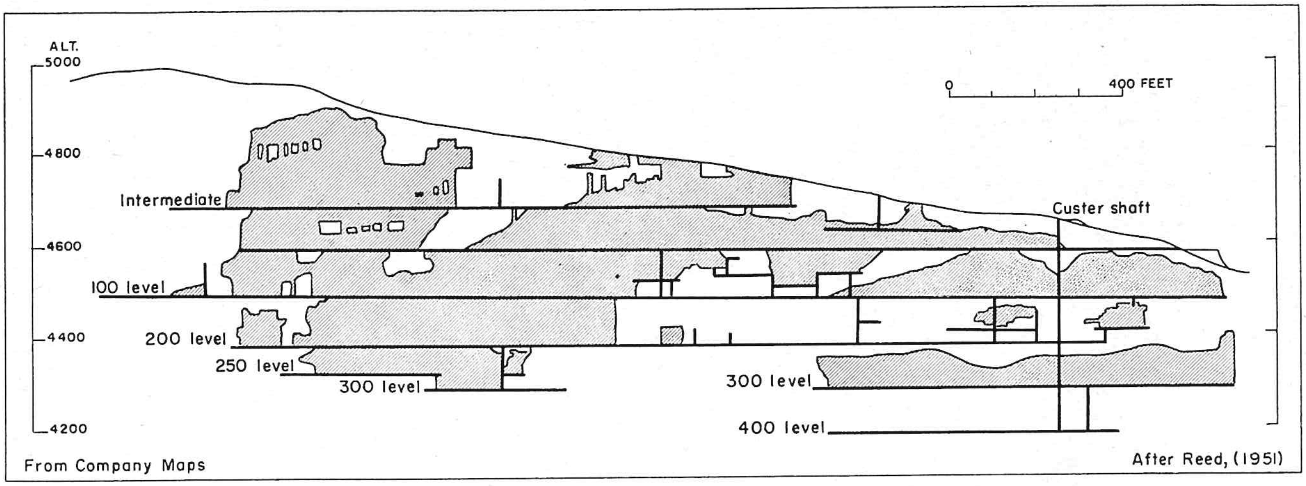

Figure 3.—Longitudinal section of Custer vein.

It should be pointed out that there has been no small amount of confusion regarding the location and names of various mines in the Custer-Hyantha and the neighboring Iron Age-Lily groups in previously published literature. The author, in the present report, has attempted to unravel the maze of conflicting reports and maps, and provide a correct picture of the mines, and can only hope that this effort will lessen the misunderstanding, rather than add to its immensity. In defense of the mine names and descriptions offered here, the author submits Plate 2, a map that faithfully portrays the location of patented lode mining claims in the district. These locations are a matter of public record and presumably are not subject to gross error. Claim names corresponding to the survey numbers on the map are given in Appendix III. The mines described are the mines or mine workings located upon the patented claim of the same name and therefore would seem to be technically correct even though in conflict with some past and current usage.

CUSTER MINE

The shaft and dump of the Custer mine is located on the northeast edge of the mine group, just west of the mouth of Iron Age Gulch (Fig. 2). The Custer vein strikes N. 30° E., dips approximately 70° N., and was traced on the surface for 1,200 feet, from the Custer shaft to the Aqua Frio adit.

No access to the mine was possible at the time of the present study, as both the shaft and the main adit, which is about 600 feet west of the shaft, were caved. A section view of the workings, reproduced from Reed (1951), is presented here (Fig. 3). This map was obtained from the files of the company that operated the mine most recently, and presumably it gives an accurate picture of development to date.

Examination of the longitudinal section shows that ore was found more or less continuously along the vein structure for a strike length exceeding 2,400 feet. It is said (personal communication, Mr. Adam Stabler, Winston) that this was the longest continuous gold ore shoot in the world at the time that it was being mined. The map gives no indication that the ore 'pinched out' at depth, therefore it seems likely that mine closure resulted from economic conditions rather than ore depletion, although ore grade could be expected to diminish in the lower levels.

Accurate estimation of the total production from the Custer mine is impossible because much of its production antedates the orderly compilation of production records. It seems likely that the Custer mine was the second largest single producer of the district, exceeded only by the East Pacific mine.

The Custer vein is clearly a fissure vein, cutting steeply through the andesitic volcanic rocks that are intruded by the Edna stock. Mineralization introduced pyritiferous gold ore in quartz gangue. There is no indication that the vein received significant base metal minerals, although such might be encountered at some depth below present development.

HYANTHA MINE

The Hyantha shaft and headframe are approximately 1,700 feet south of the Custer shaft, about halfway up the slope northwest of Iron Age Gulch.

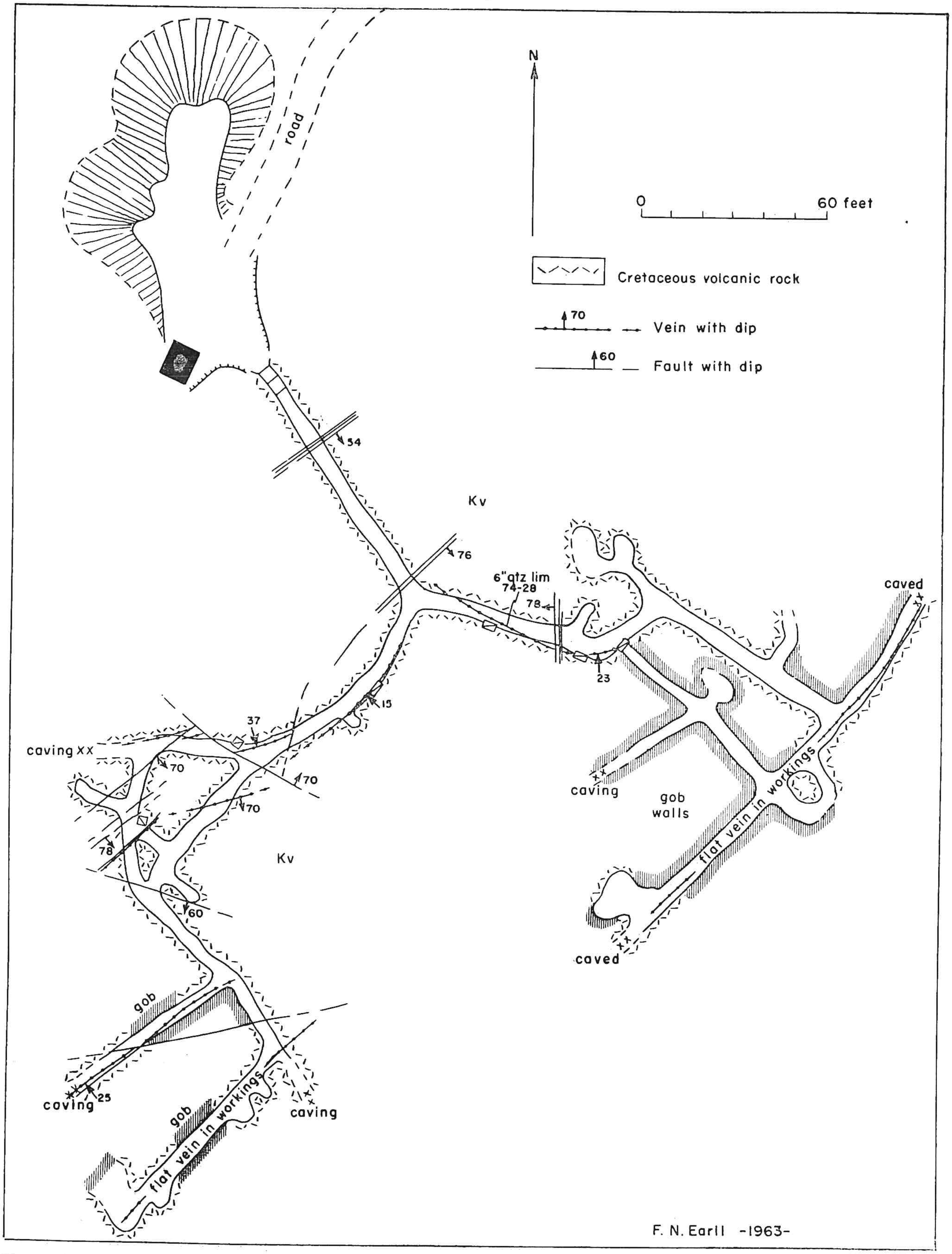

Figure 4.—Accessible workings General Sherman mine, Winston mining district, sec. 13, T. 8 N., R. 1 W.

Figure 2 shows the location of the mine and its relation to other mines in the group. The shaft extends to a depth of 400 feet (personal communication, Mr. Adam Stabler); when visited by the author, it was flooded to the 125-foot level. Shaft timber was in good condition down to the water level, the shaft having been retimbered about 1956.

The Hyantha vein strikes approximately N. 65° E. and dips 73° N. Although narrow at the surface, it is said to be about 4 feet wide in the lower levels (personal communication, Adam Stabler). Minerals, as deduced from samples selected from the dump, are similar to those in other mines in the district; chiefly auriferous pyrite in quartz gangue, but with the important addition of galena, sphalerite, and some chalcopyrite. In the lower levels, the major ore mineral is said to have been galena.

A small caved shaft 40 or 50 feet west of the main shaft was probably a ventilation raise. An adit level (caved) enters the hillside near the bottom of the gulch to the east approximately at the 100-foot level. Indications in the shaft are that this adit connected with the main shaft at the 100-foot level station, but at present it is gob filled.

GENERAL SHERMAN MINE

The General Sherman mine workings are among the most extensive accessible workings in the group. The mine portal is approximately 1,000 feet northwest of the Hyantha shaft, on the northwest side of the small hill capped by the Edna stock (Fig. 2). The accessible portions of the workings are shown in Figure 4. It will be noted that at several points the workings continue beyond the area mapped; the mapping was suspended either because the workings are blocked by backfill, or because they were judged to be unsafe.

The Sherman vein, which may well be continuous with the Edna vein, is a 'flat' vein ranging in width from an inch or so to 3 feet. Overall the vein is horizontal, although dips as great as 25 degrees toward the portal were observed in places, and it dips slightly to the southeast in the workings farthest from the portal. The vein is offset at several points by steeply dipping cross faults, but at no point is the displacement more than a few feet. The vein is developed in andesitic volcanic rocks, more or less parallel to the bedding. One channel sample was taken of the vein (sample 74-28, see Appendix IV and Fig. 4) at a point near the portal. Assay of this sample showed 0.615 oz. gold and 0.40 oz. silver, or approximately $22.00 at current prices. This suggests a mineable grade of ore, although at the point sampled the narrowness of the vein would prevent profitable operation. Vein filling is quartz containing auriferous pyrite, which has been altered to limonite containing residual gold and silver.

The General Sherman mine, like most mines in the group, is clearly a hand sorting operation. The narrow width of the vein requires that ore be separated from waste, most of the waste remaining in the mine as fill and providing most of the support required in the workings. As the vein is not seen to pinch out, nor has it been faulted off, there would seem to be a good chance that additional ore remains to be found beyond the existing workings.

EDNA MINE

The Edna mine is composed of a series of accessible and inaccessible adits along the Edna vein, which strikes generally north along the hillside about 200 feet west of the Hyantha mine shaft. General location is shown on Figure 2, and details of the accessible workings are shown on Figure 5.

The Edna vein, along these workings, dips 15 to 22 degrees west toward the nearby Edna stock. The vein, throughout the area of the Edna mine, is developed in andesitic volcanic rocks, again more or less parallel to the bedding, and offset to a minor degree by steeply dipping cross faults. Vein width ranges from 6 to 12 inches. The ore is quartz and limonite, the alteration product of auriferous pyrite. Three samples were taken of the vein: sample 74-17 taken in the northernmost accessible adit, sample 74-14 taken in an adit south of the first one, and sample 74-18 taken in the southernmost of the mine workings. Results of analyses are given in Appendix IV, and locations of the sample channels can be determined from examination of Figure 5. Of the three samples, only 74-14 showed a mineable grade of ore. This sample was taken over an 8-inch width of vein and assayed 0.545 oz. gold and 2.50 oz. silver, indicating a value of about $22.00 per ton at present prices. Again, as at the General Sherman mine, the narrow width of the vein at the point sampled would militate against operation.

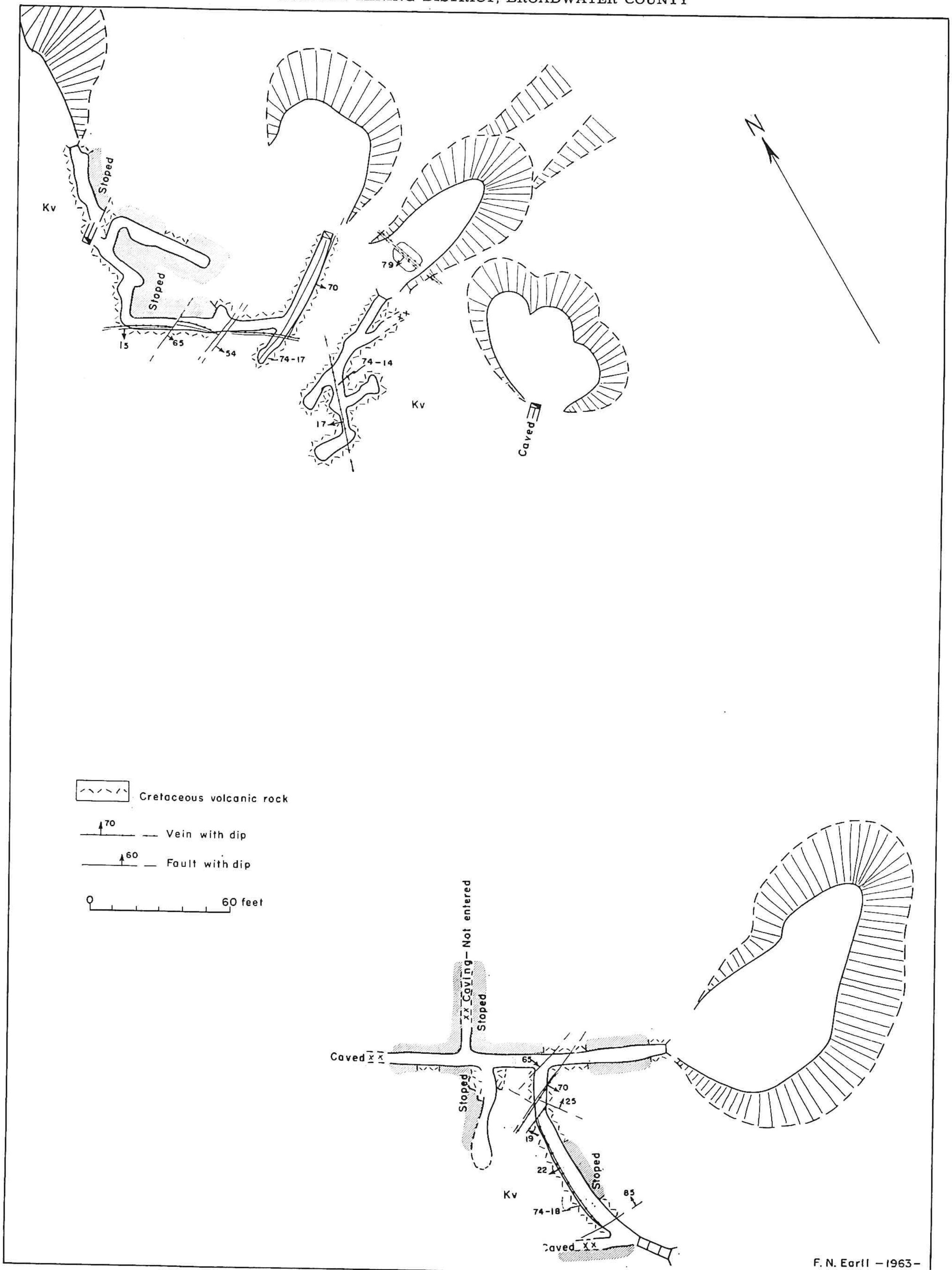

Figure 5.—Accessible workings Edna mine, Winston mining district, sec. 13, T. 8 N., R. 1 W.

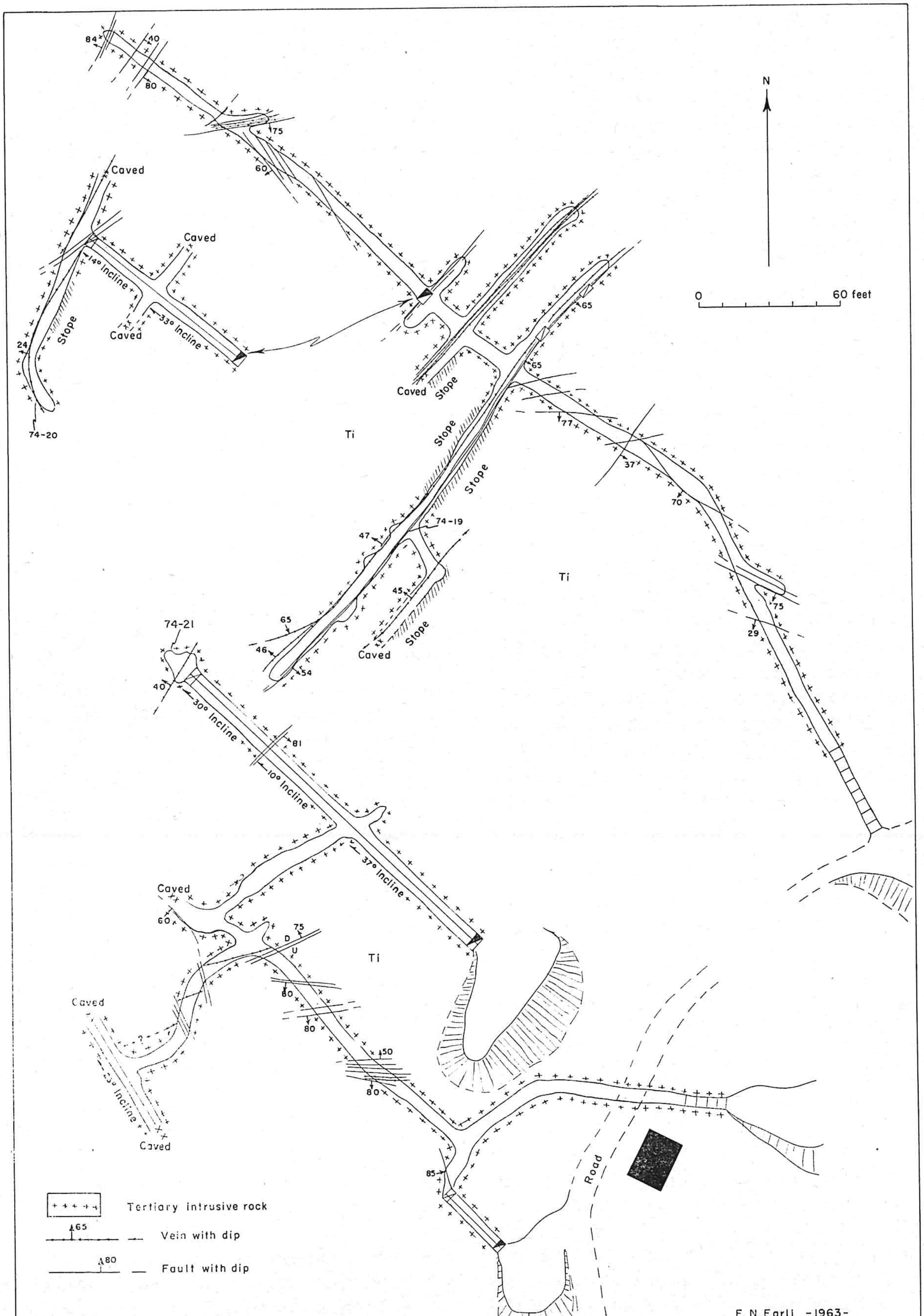

Figure 6.—Accessible workings Edna Number 2 mine, Winston mining district, sec. 13, T. 8 N., R. 1 W.

As in all mines developed along these 'flat' veins, vein width pinches and swells, and mineable ore is obviously restricted to the high-grade portions or shoots along the vein. Unexplored portions of the vein extend beyond the present workings in all accessible areas, and it seems unlikely that all the high-grade shoots have been discovered and mined. Because the vein is thin, even at its widest points, a selective mining procedure would be required.

EDNA NO. 2 MINE

The Edna No. 2 mine comprises two adits and three inclined shafts (one of them caved) along the westward extension of the Edna vein (Fig. 2). Although the vein seems to be continuous with the Edna vein, at the Edna No. 2 mine the vein is formed entirely in the intrusive rock of the Edna stock. This is of interest in that it shows the true nature of the vein. Whereas the 'flat' vein as viewed at the Gereral Sherman and Edna mines appeared to be a bedding vein in the volcanic rocks, passage of the vein into the intrusive rocks at the Edna No. 2 mine shows it to be a true fissure or fault-controlled vein. Certainly the attitude of the vein outside the stock is affected by bedding in the volcanic rocks, but primary control must have been afforded by a fault plane. This observation also allows another conclusion; because ore is known to continue into the stock for several hundred feet along the structure, it seems likely that ore may be found in other parts of the vein structure that have not yet been developed as far as the stock.

The strike of the Edna vein, which is approximately north-south at the Edna mine, is here N. 20° E. to N. 60° E., and average dip is about 25° N., although it ranges from 10 to 40° N. within the mine.

As in all mines in the group, the Edna No. 2 mine structure is affected by cross faults, but here fault activity has been stronger and offsets are greater. The structure is still relatively simple, however, and no great difficulty is occasioned by the faulting.

Three samples were taken in the mine. The first of these (sample 74-19) was of a small amount of ore that had been collected on a muck pan in the first drift left of the most northerly of the workings (Fig. 6). This ore proved to be low grade. The second sample (sample 74-20) was taken of a 4-inch width of vein at the end of the drift on the lowest level of the same workings. This sample assayed 3.16 oz. gold and 4.80 oz. silver —very worthwhile ore indeed. The third sample (sample 74-21) was taken of a 6-inch width of vein at the bottom of the incline in the more southerly workings. This sample assayed 1.04 oz. gold and 0.70 oz. silver.

OTHER MINES

Other mines in the group worthy of mention include the Aqua Frio and Joe Dandy mines. Both of these mines were inaccessible at the time of the present study, so no direct examination was possible. The Aqua Frio mine was developed through a shaft, presumably on the extension of the Custer vein, or possibly one or both of the minor footwall splits of that vein shown on the map (Fig. 2). Workings of the Joe Dandy mine are distributed along the hillside southwest of the Edna stock. The nature of the vein here was not determined.

IRON AGE-LILY GROUP

GENERAL COMMENT

Separation of the Iron Age-Lily group mines from the related mines of the Custer-Hyantha group lying to the north was made more or less arbitrarily, the West Fork of Iron Age Gulch serving as a dividing line. Separation of the groups, however, has its practical aspects, as the only accessible workings in the group, the Iron Age, Lily, and Stolen Sweets mines, lie well to the south of the mines clustered around the Edna stock. Furthermore, most if not all of the mines in the group seem to be related to a vein complex centering around the Iron Age mine, as opposed to the northern group, which are clearly associated with the Edna stock. For map reference, the reader is referred to Figure 2 for the more northerly mines of the group, including the Martha W., Aurora, and Eclipse mines; and for the more southerly properties, including the Iron Age, Lily, Stolen Sweets, and Bridgeton mines to Figure 7.

IRON AGE MINE

Two mine openings seem to be located on the Iron Age claim. They are on the west side of Iron Age Gulch, above a large dump, which blocks the gulch about three-quarters of a mile above its confluence with the west fork. The more southerly of these openings, now caved, seemingly was an inclined shaft that prospected a gently dipping vein. From the size and configuration of the dump,

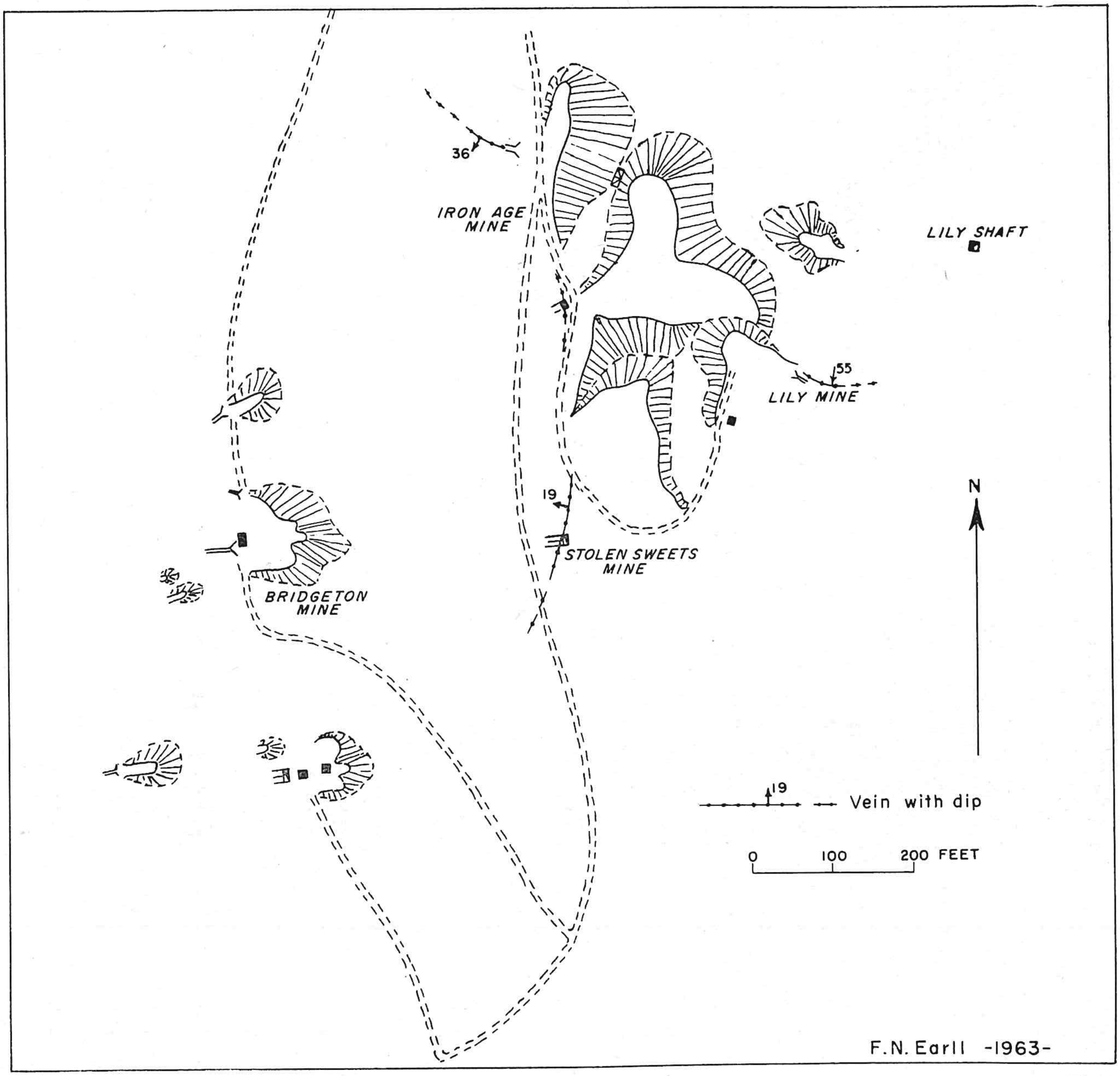

Figure 7.—Map of surface workings Iron Age-Lily group mines, Winston mining district, sec. 24, T. 8 N., R. 1 W.

this is judged to be the most extensively worked vein of the mine. The other mine opening, lying 200 feet to the north, is an adit, which was still accessible at the time visited. This adit explores a relatively steeply dipping northwest-striking vein, which is thought to be the westward extension of the Lily vein.

The Lily vein, where explored by the Iron Age adit, is a narrow vein of quartz and limonite containing gold and silver. Strike of the vein, within the 200 feet of development work, swings from N. 80° W. at the portal to N. 50° W. at the current face, and the dip increases from 34° S. at the portal to 52° S. at the farthest point explored. Sample 74-23, taken of a 6-inch width of the vein beside a small overhand stope about 40 feet inside the portal, showed interesting, though noncommercial values of 0.28 oz. gold and 0.20 oz. silver (Appendix IV).

Of possibly greater interest is a small cross vein, explored for a few feet by a short drift to the right (north) of the main adit about 160 feet from the portal (Fig. 8). Although this vein is narrow and is not commercial at the point explored,

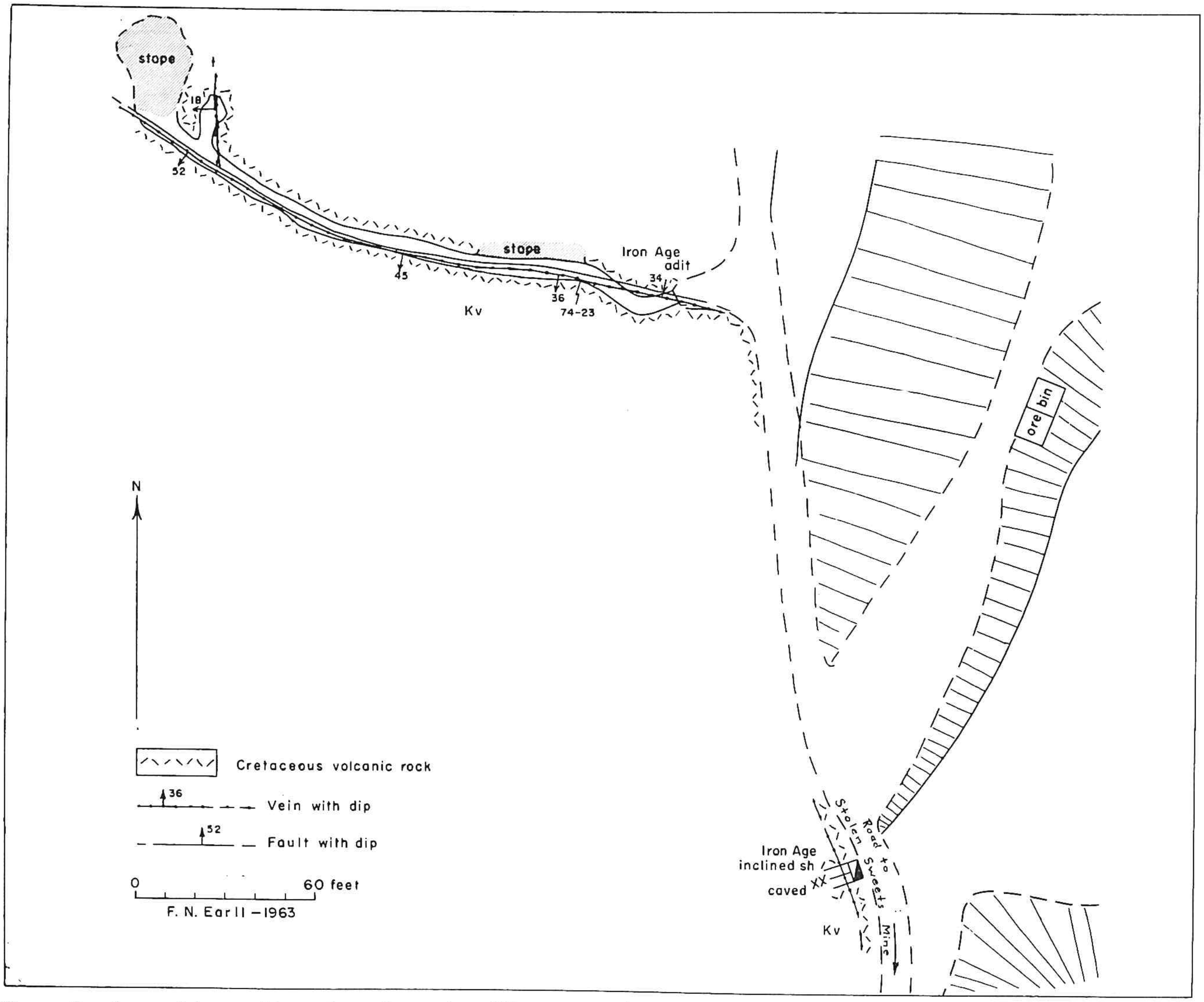

Figure 8.—Accessible workings Iron Age mine, Winston mining district, sec. 24, T. 8 N., R. 1 W.

it may be the northward extension of the Iron Age vein, displaced by the Lily vein fault. If so, a considerable area on a known productive vein remains to be explored in the area north of the Iron Age adit.

STOLEN SWEETS MINE

A 16° inclined shaft, 280 feet south of the Iron Age shaft and 480 feet south of the Iron Age adit, was taken to be the Stolen Sweets mine. This shaft explores the gently dipping Iron Age vein to slope depth of 180 feet, where the vein is cut off by a strong, northeast-striking fault. Some effort was made to find the displaced portion of the vein beyond the fault, but the ground had caved to such an extent that the workings could not be entered farther at the time of the writer's visit.

Workings in the Stolen Sweets mine are extensive (Fig. 9) but most have been back filled with waste so that the stopes could not be examined directly. A drift on the lowest accessible level was examined, and a sample of the vein was taken at a point beyond previous stoping. This sample, number 74-22, assayed 0.545 oz. gold and 0.50 oz. silver together with minor amounts of copper and lead, corresponding to a gross value of approximately $21.50 at current prices (Appendix IV).

From the size of the dumps, and the extent to which waste has been used as back fill, it seems probable that most of the area between the Stolen Sweets incline and the Iron Age mine has been mined out. There remains the possibility of ore below the cross fault, and south of the Stolen Sweets incline, although the vein would have to become

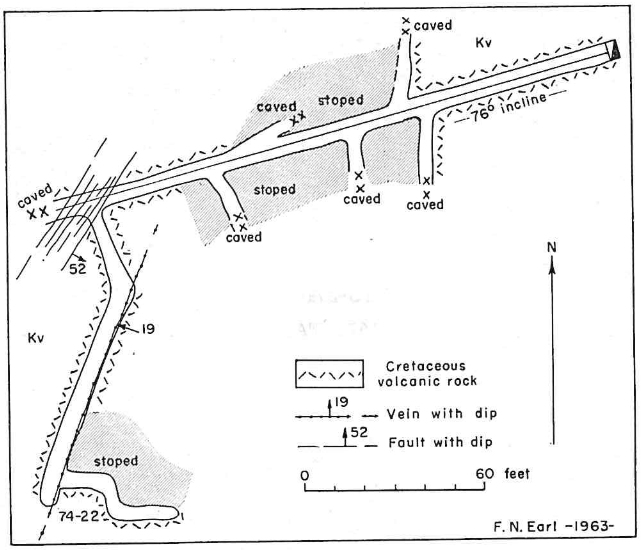

Figure 9.—Accessible workings Stolen Sweets mine, Winston mining district, sec. 24, T. 8 N., R. 1 W.

either wider or richer to constitute ore. Ore from the mined-out portion of the vein is said to have run 2 to 3 ounces of gold to the ton (personal communication, Mr. Adam Stabler).

LILY MINE

The Lily mine, owned and being developed by Mr. Carl Voss of Helena, Montana, at the time visited, is located across from the Stolen Sweets and Iron Age mines, on the east side of Iron Age Gulch.

The mine was originally developed by an inclined shaft collared on the ridge to the east of Iron Age Gulch, and by an adit about half way down the slope. The adit is caved, but from the size of its dump, it was not extensive; the shaft was open for most of its depth, but timbers were no longer standing, and condition of the hanging wall made examination unwise.

The new workings begin well down the slope of the hillside, directly across from the Iron Age shaft. Development by drift and crosscut has encountered the vein at two separate points, one at the end of a short crosscut about 50 feet in from the portal, and the other at the base of the old inclined shaft (Fig. 10).

The vein, as exposed in the Lily mine workings, is narrow and contains quartz and limonite carrying residual gold and silver. The vein strikes N. 60° W. and dips 50 to 55° S. This seems to be the same vein explored by the Iron Age adit on the west side of Iron Age Gulch. Two samples of the Lily vein were taken. The first sample was taken of a 6-inch width of vein on the edge of what seemed to be a small stope off the old inclined shaft. The assay of this sample, number

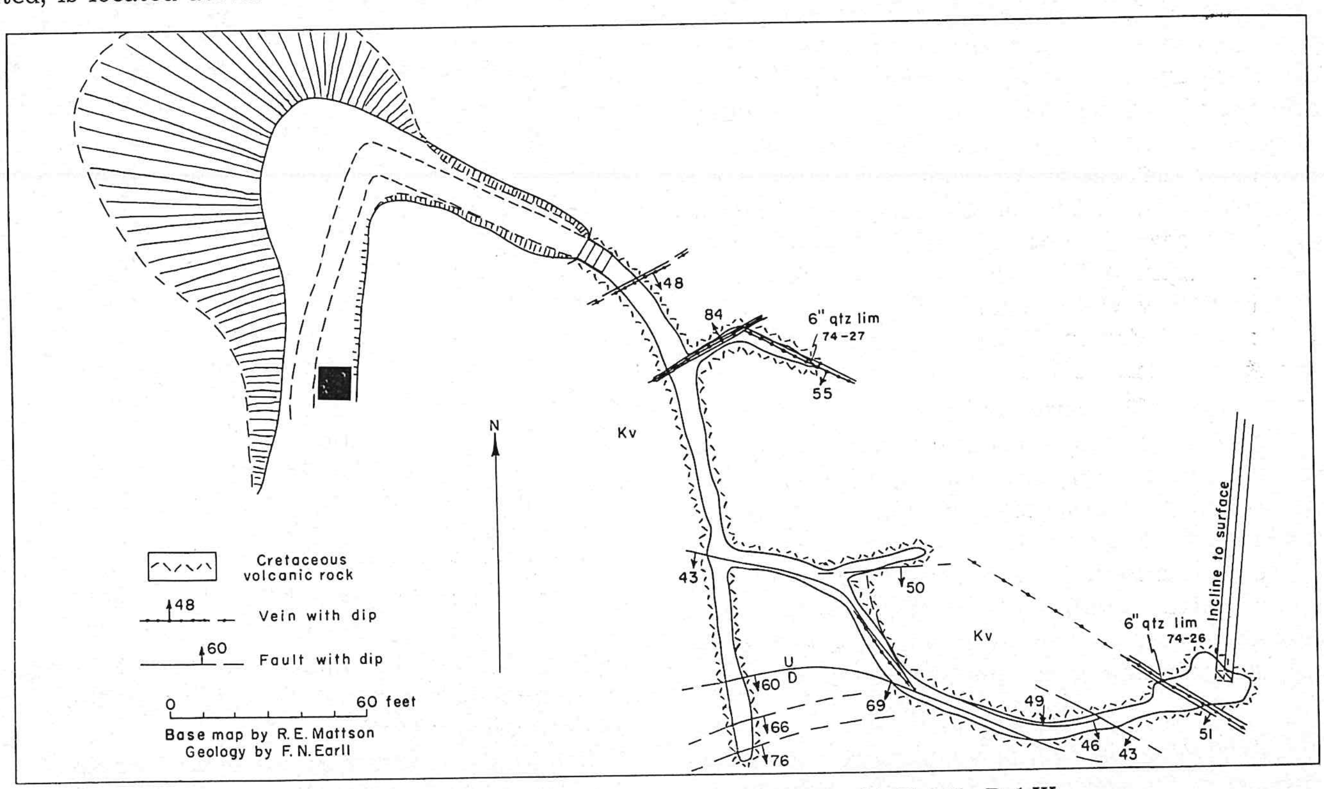

Figure 10.—Accessible workings Lily mine, Winston mining district, sec. 24, T. 8 N., R. 1 W.

74-26, showed 1.44 oz. gold and 0.60 oz. silver. Such values are certainly encouraging, although the width of the vein at the point sampled would make this ore marginal at best. The second sample taken, number 74-27, was of a 6-inch width of vein where exposed by the second crosscut left of the portal (Fig. 10). Here, values were less encouraging, the assay showing 0.09 oz. gold and 0.10 oz. silver.

According to Mr. Voss, future work is planned to extend the second crosscut left to intersect the vein between the two points presently exposed, in the hope of finding a wider or richer portion of the vein.

MARTHA W. (Martha Washington) MINE

The Martha W. mine is located on the south side, and well up the West Fork of Iron Age Gulch. It is the farthest west of the major workings in the group.

No direct examination of the workings of the mine could be made, as all mine workings were caved at the time visited. From the position of the workings, however, some conclusions can be drawn as to the nature of the structure developed. The vein has a southeast strike, and is probably one of the steeply dipping type. This last conclusion is based upon the fact that there are remains of a vertical or steeply inclined shaft, and upon the nature of the ore samples found on the dump, which contained unaltered pyrite, a mineral that has not been found to be characteristic of any of the 'flat' veins examined. Pardee and Schrader (1933, p. 226) show the Martha W. vein striking northeast and dipping 50° S. The location shown on Pardee's map, however, is approximately one-half mile from the Martha W. claim, more or less on the Aurora Millsite claim; there is doubt as to whether the description applies to the Martha W. vein or not.

AURORA MINE

The Aurora mine comprises a few caved adits on the north face of the divide between Iron Age Gulch and its West Fork (Fig. 2). None of the workings were accessible at the time visited.

From the location and configuration of the Aurora mine workings, it is likely that the mine developed a segment of a flat vein, which is probably an extension of the Iron Age vein.

OTHER MINES

Other mines in the group that have received mention in the statistics of district production include the Eclipse and the Bridgeton. Neither of these mines could be examined, as their workings were not accessible at the time visited.

The Eclipse mine is located on Iron Age Gulch about 600 feet upstream from its junction with the West Fork. The mine was developed by several adits and an inclined shaft, which has filled with water. It is difficult to determine what relation the vein bears to those of other mines in the group, but the indications suggest a flat vein, similar to the Iron Age vein, but a hundred feet or so lower. It is possible, of course, that it is a faulted segment of the same vein.

The Bridgeton mine is located above the Stolen Sweets mine, and here, also, caving of the workings prevented examination.

EAST PACIFIC-JANUARY GROUP

GENERAL STATEMENT

The East Pacific-January group includes four mines—the East Pacific and Frieberg mines, associated with the Frieberg stock, and the January and Sunrise mines, associated with the January stock—plus several minor prospects, most of which lie west of the East Pacific mine (Pl. 1).

All mines in the group are located in a cluster of patented mining claims extending across Weasel Creek in sec. 26 and 27, T. 8 N., R. 1 W. (Fig. 2). Also, all mines in the group have certain features in common. All are developed at least partly on veins in the andesitic volcanic rocks, although close to the contact with small quartz monzonite intrusive bodies; the January, Sunrise, and Frieberg mines are actually within the intrusive rock in part. All are localized by steeply dipping east-west veins; The East Pacific and Frieberg veins strike somewhat northeast, and the January and Sunrise veins strike slightly northwest. Finally, all seem to have produced similar ores, notably of gold, silver, and lead, with minor amounts of zinc and copper.

EAST PACIFIC MINE

The East Pacific mine, in addition to being the discovery mine of the Winston district and the first to go into production, is also the largest single metal producer in the district. Total production from the mine, as estimated by Reed (1951), exceeds $2,000,000 the value being almost equally distributed between the gold-silver content and the lead-zinc content.

Workings of the mine were not accessible at the time visited, so no direct examination could

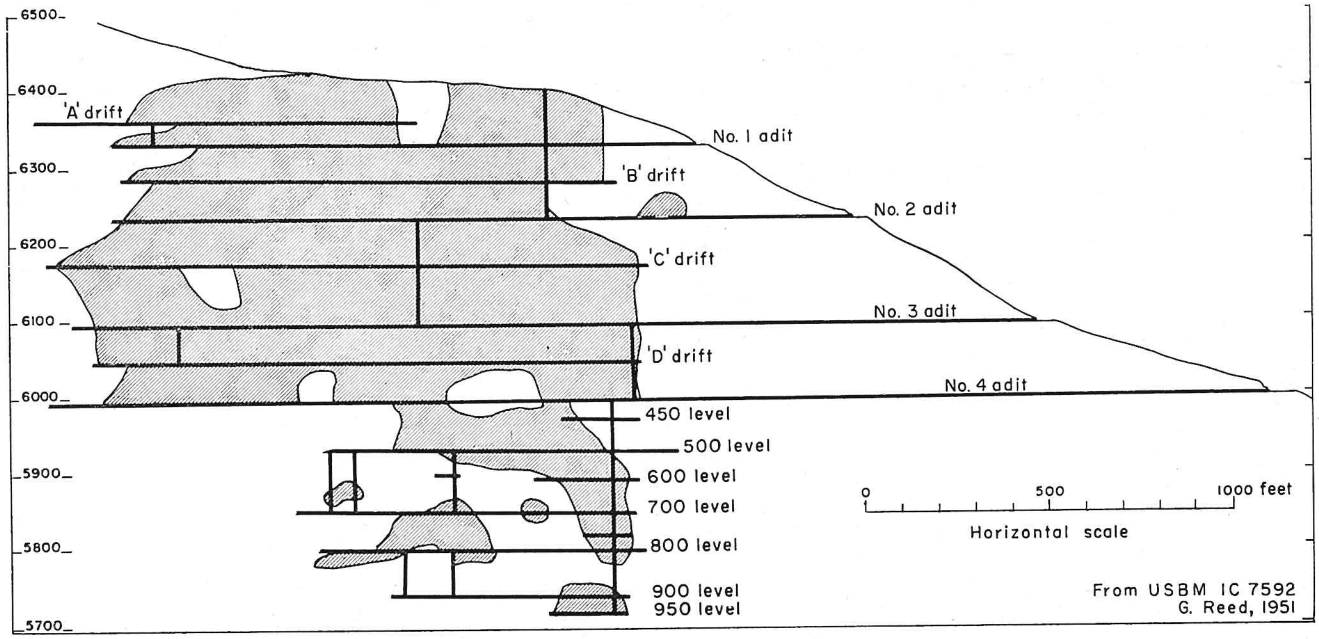

Figure 11.—Longitudinal section of East Pacific mine.

be made. A section view of the workings, reproduced from Reed's report (1951), is included (Fig. 11), which shows development to the 950-foot level, the deepest level reached in the mine. This map shows a virtually continuous ore shoot, extending for as much as 1,800 feet along the strike and for a vertical distance of 1,400 feet. There is an apparent discrepancy in the scale of this map, however, and therefore the reader is cautioned not to place much confidence in it. There is some indication that the shoot may be pinching out to the west on the lower levels of the mine.

Reed reports the vein to be a fissure filling in andesite, ranging in width from 1 to 60 inches. Vein filling is quartz and minor calcite and rhodochrosite as gangue, containing pyrite, galena, sphalerite, tetrahedrite, chalcopyrite, and native gold (Reed, 1951, p. 38).

JANUARY MINE

The January mine is on Weasel Creek, about a half a mile south of the East Pacific mine, in the SW¼ sec. 26, T. 8 N., R. 1 W. Strike of the vein ranges from west to about N. 75° W. and dip is 40 to 75° N. A series of adit levels extends about 800 feet up the slope on the west side of Weasel Gulch.

To date, the mine has been developed on six levels over a vertical distance of approximately 400 feet (Fig. 12). The lowermost two levels (1 and 2 levels) were not entered by the writer. Approximately 2,000 feet of workings in the upper four levels were accessible at the time of the writer's visit, but timbers are taking weight and it is not expected that they will remain open much longer; a considerable portion of the open area could be classified as dangerous at the present time. None of the stopes could be entered for examination.

The January vein is controlled by a northwest-striking fault fissure, which lies close to and along the contact of andesite volcanic rocks and a small quartz monzonite stock. In the lowest accessible workings (3 level) the vein is entirely within the quartz monzonite as far as the level could be entered. On the next higher level (4 level) the vein lies on the contact of quartz monzonite and andesite at the portal, but continues on into altered andesite about 150 feet inside the portal. The 5 and 6 levels are developed entirely within the volcanic rocks. The vein itself is actually a zone of shearing 1 to 4 feet wide, containing abundant crushed and broken blocks of the country rock and considerable soft clay gouge, which contribute to the support problem that now threatens to close the workings. Mineralization produced narrow stringer veins of quartz and sulfides cutting through the sheared country rock. Ore minerals include major auriferous pyrite, galena, and sphalerite, and minor chalcopyrite and tetrahedrite.

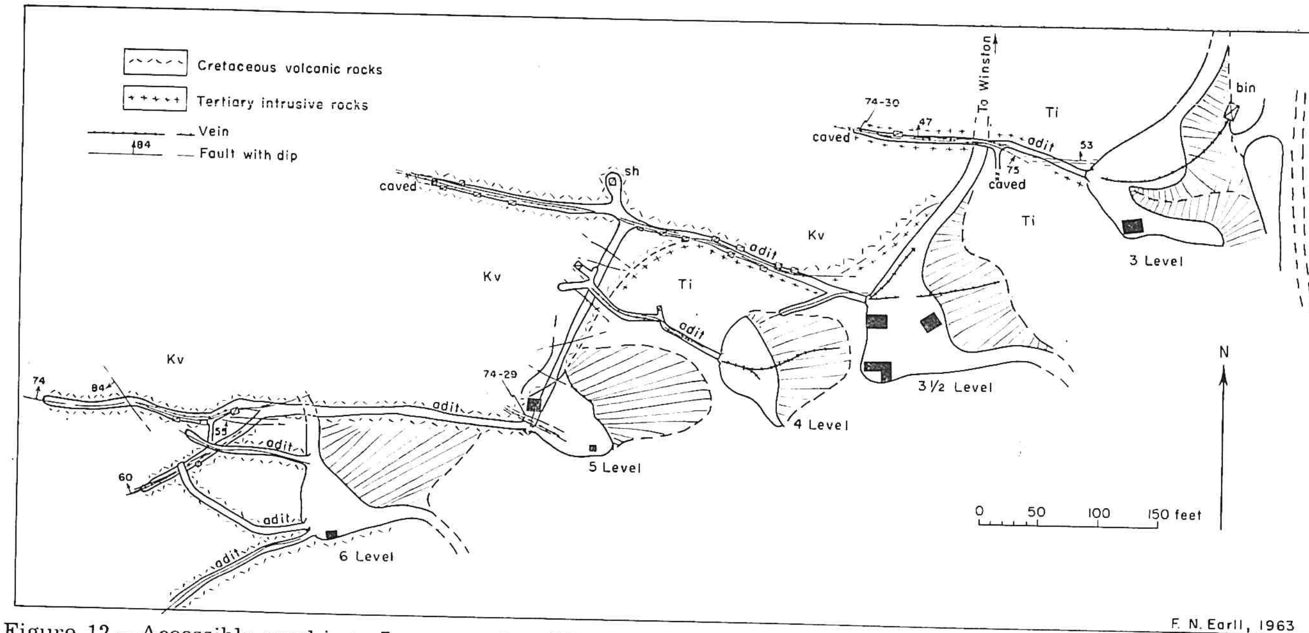

Figure 12.—Accessible workings January mine, Winston mining district, sec. 26, T. 8 N., R. 1 W.

Two samples were taken in the mine. The first of these, number 74-29, was taken of a 5-foot width of crushed and sheared quartz monzonite at the end of a crosscut, 180 feet south of the January vein on the 4 level. Assay of this unnamed vein showed little more than trace amounts of the metals (Appendix IV). The second sample, number 74-30, was taken 190 feet from the portal on the 3 level, across an 18-inch width along the hanging wall of the January vein. The vein at this point proved to be unexpectedly rich in zinc, assaying 0.08 oz. gold, 2.3 oz. silver, 1.07 percent copper, 0.16 percent lead, and 6.4 percent zinc.

A third vein, striking northeast, is seen to intersect the January vein on the 4 and 5 levels. This vein, known as the Montana-Idaho vein, is said to have been explored to some extent on the lowest level (Klepper, 1964).

The January mine is the most recently operated mine in the district, its latest period of production extending from 1956 through 1961. In this period, the mine produced approximately 1,700 tons of ore averaging 0.41 oz. gold, 17.7 oz. silver, and 12.6 percent lead. Total production from the mine is estimated to have been worth $140,000.

Future prospects of the January mine, if any, would seem to be related to the possibility of finding additional ore at depths below present development, or possibly along parallel and intersecting vein structures in the upper levels. In view of the condition of the workings in the upper levels, even if some ore does remain there on the main vein structure, it is unlikely that it could be extracted profitably.

SUNRISE MINE

The Sunrise mine is on the east side of Weasel Creek, almost directly opposite the January mine. It has been developed by drifts on two levels, only the lower of which is accessible at the present time. The mine, owned by Mr. Adam Stabler, of Winston, was being developed on the lower level by leasers in the summer of 1962, but only minor assessment work was performed during 1963.

The upper level drift explored a narrow fissure vein that strikes approximately N. 45° W. and dips 40 to 50° N. Minerals are said to have been of value primarily for the contained lead.

The second level, 60 feet (vertically) below the first, enters the hillside along a sheeted or multiple sheared mineralized zone, which also strikes approximately N. 45° W. and dips 40 to 80° N. Then, 140 feet inside the portal, the drift veers sharply to the right (south) for about 80 feet, reportedly to avoid bad ground, where it intersects and then follows the vein explored by the upper level adit (Fig. 13). Two samples were taken of this vein on the lower level; sample number 74-15 taken over a 1-foot width at the present face; and sample number 74-16, taken of a 1½-foot width of the vein 180 feet back (west) from the face. Neither sample showed encouraging values (Appendix IV).

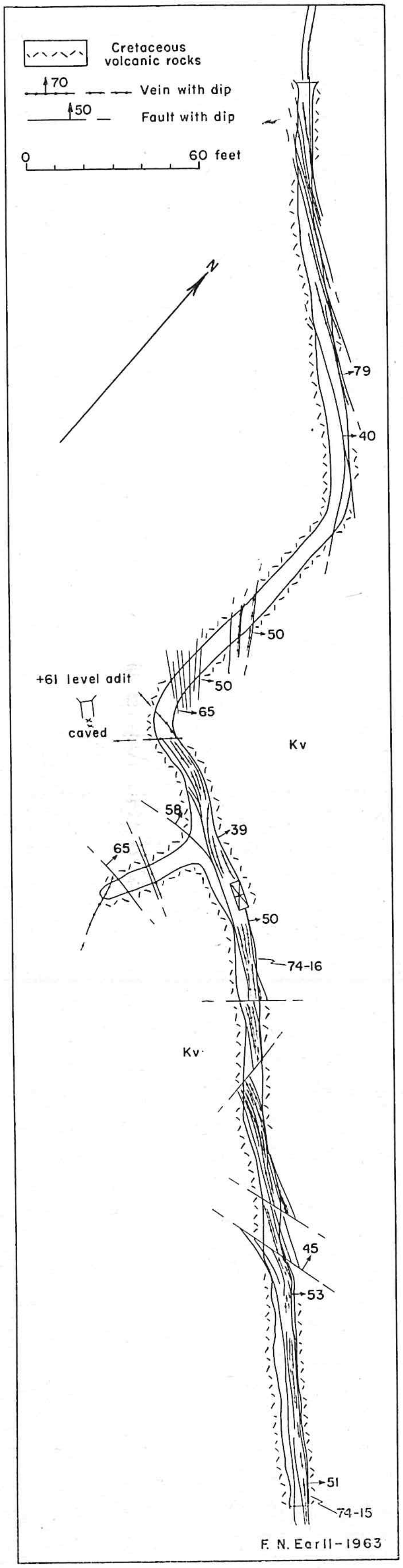

Figure 13.—Accessible workings Sunrise mine, Winston mining district, sec. 26, T. 8 N., R. 1 W.

Examination of the map of the Sunrise mine (Fig. 13), shows that there are two sub-parallel vein structures in the mine. The more northerly of these, explored in the outer portion of the lower level, is said (by Mr. Stabler) to have shown encouraging values in the precious metals. If so, further prospecting of this structure would appear warranted.

FRIEBURG MINE

The Frieburg mine is on the east side of Weasel Creek, directly across from the East Pacific mine. The vein, which strikes N. 70° E. and dips steeply south, is probably the eastward extension of the East Pacific vein. According to Reed (1951), the vein minerals included pyrite, galena, and chalcopyrite, and production through 1900 was valued at $5,000. All underground workings were inaccessible at the time of the writer's visit, as they were when last reported on in 1951. Some bulldozer work had been done on the eastern end of the property, probably in 1960 or 1961, but there was no activity at the mine during the present study.

STRAY HORSE-LITTLE BONANZA GROUP

GENERAL COMMENT

The Stray Horse-Little Bonanza group mines are located on a series of more or less parallel vein structures that cross the divide on the east side of Weasel Creek and extend east to the head of Kimber Gulch, in sec. 35 and 36, T. 8 N., R. 1 W., approximately a mile south of the East Pacific mine. The major producing mine of the group has been the Stray Horse mine, but the group also includes the Condon and Little Bonanza mines, which are located on the same northeast-striking vein or vein complex, the Gold King mine, which is located somewhat to the north of the main group and on a separate northwest-striking vein, and several other small prospects and mines. All mines in the group explore veins in andesite, north of the contact of these volcanic rocks with the large Little Olga stock. Figure 14 shows the location of the veins and dumps of all mines and prospects of the group except the Little Bonanza mine, which is shown on Figure 15.

STRAY HORSE MINE

The Stray Horse mine explores two parallel veins or vein splits, striking east-west and dipping steeply northward, which cross the divide between

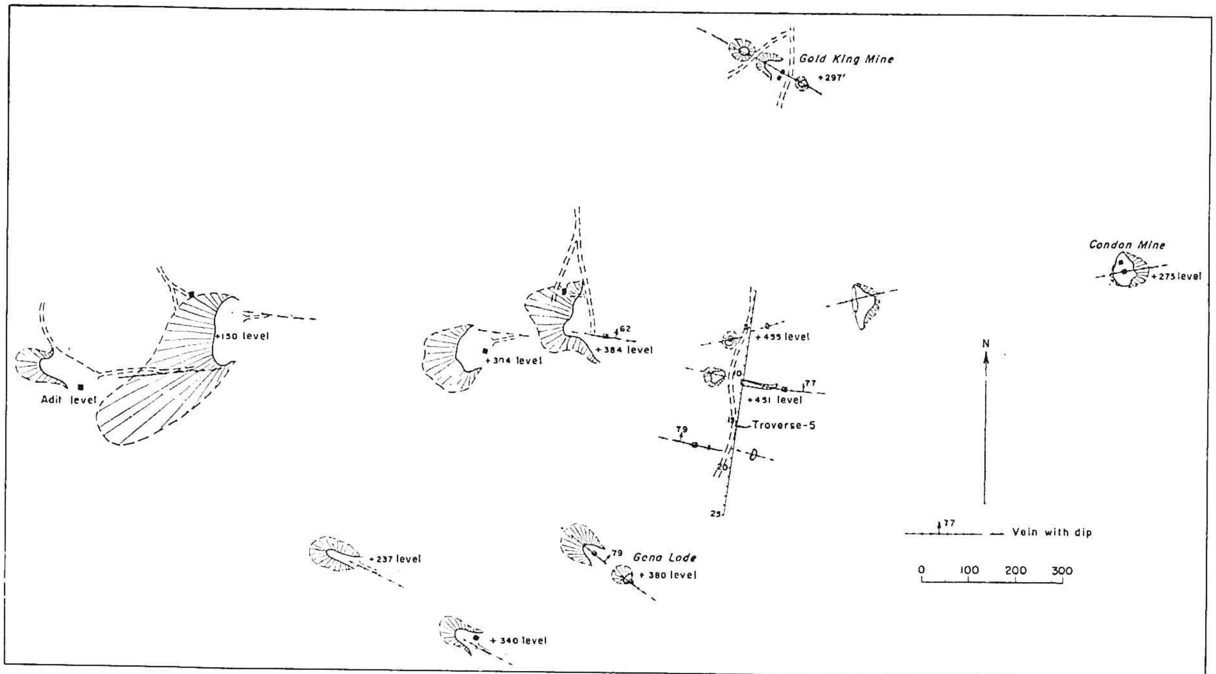

Figure 14.—Map of surface workings and dumps Stray Horse-Little Bonanza group mines, Winston mining district, sec. 35, T. 8 N., R. 1 W.

Weasel Creek and Kimber Gulch. Mining was accomplished through a series of adits and several small shafts along the veins. The workings were inaccessible at the time visited except for a short distance in the lowest level adit, which had caved 230 feet inside the portal, at a point where cross-faulting had caused unstable ground conditions. The vein, where exposed in this adit, was clearly noncommercial as is shown by the assay of the sample taken (sample 74-11, Appendix IV). Other samples taken on this same vein at the Condon mine, about 2,000 feet farther east, show very good values.

According to Reed (1951, p. 41) the major part of the ore was produced prior to 1901, although leasers operated the property off and on over the years through 1942. Total production probably does not exceed $250,000. Ore averaged 0.37 oz. gold, 21.1 oz. silver, and 10.7 percent lead, thus placing the Stray Horse among those mines in which base-metal production has constituted an important by-product.

In view of the lack of accessibility of the workings, little can be said as to the future prospects of the mine as a metal producer. From the size of the dumps, it can be concluded that the upper 300 feet of the vein structure has probably been explored fairly thoroughly, and such future prospects as there may be are related to the possibility of finding ore at greater depth. The lowest adit level of the mine is approximately 450 feet below the crest of the ridge. Many of the mines of the district have been mined over a greater vertical range than this, some of them two to three times as great, so the possibilities of ore on deeper levels cannot be completely ignored.

CONDON MINE

The Condon mine is located on the north split of the Stray Horse vein, just east of the ridge between Weasel Creek and Kimber Gulch, probably on the Keystone claim (Pl. 2, Fig. 14). The mine is developed by a shallow shaft, which extends to a depth of about 30 feet. At the shaft, the vein strikes N. 59° E. and dips 76° N. Although the shaft was open, there were no facilities present to allow entry. Two samples were taken at the mine. The first of these, sample number 74-1, was taken across the vein just west of the shaft, at the surface. Here, the vein was only 6 inches wide, but values were encouraging, the assay showing 0.05 oz. gold, 11.6 oz. silver, and 14.7 percent lead (Appendix IV). The second sample, number 74-2, was from ore that had been stockpiled on the dump. This sample assayed 0.08 oz. gold, 10.7 oz. silver, and 17.6 percent lead. These samples, although much richer in lead (compared to their precious-metal content) than most ores of the district, constitute a good grade of shipping ore provided the

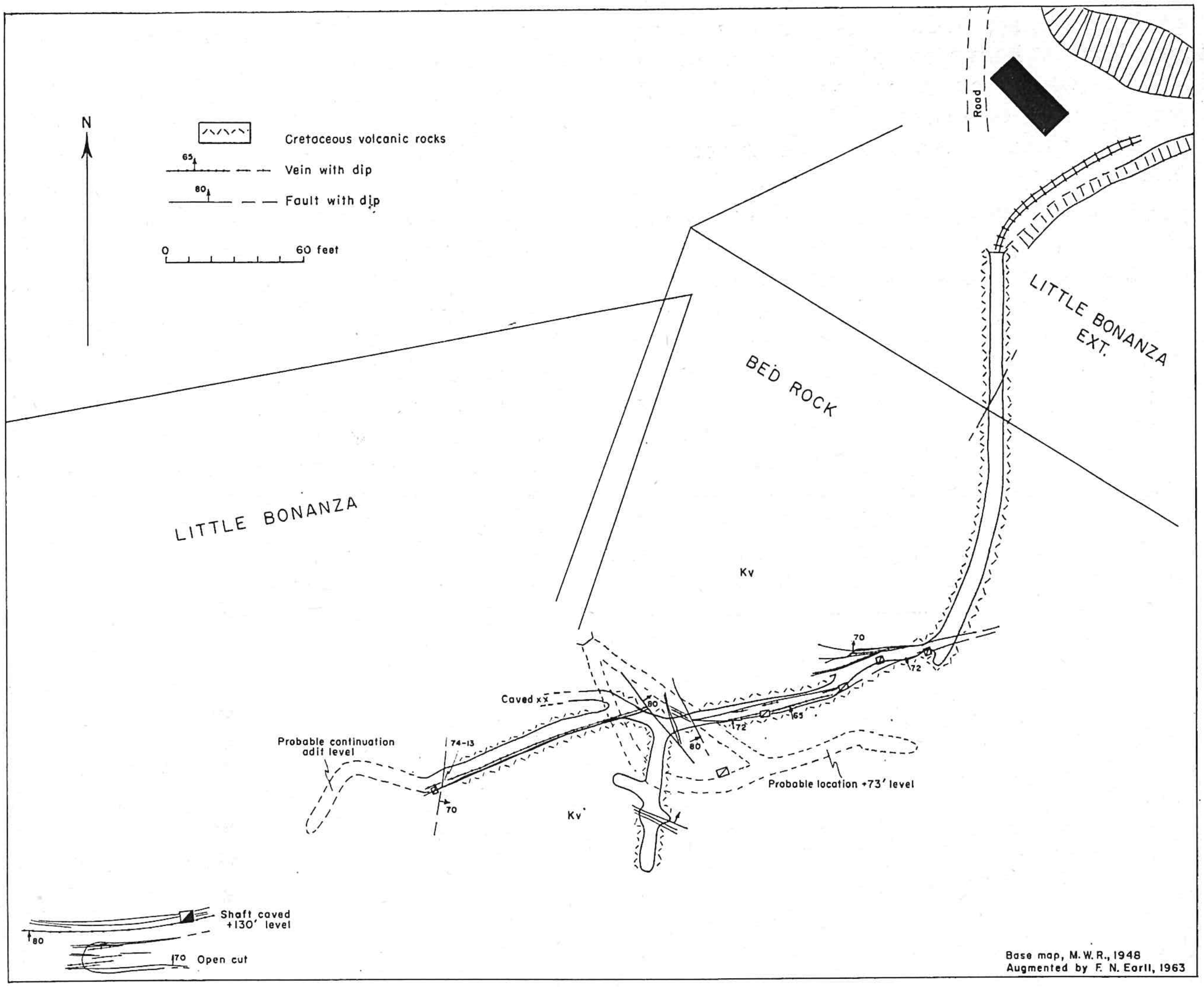

Figure 15.—Workings of Little Bonanza mine, Winston mining district, sec. 35 T. 8 N., R. 1 W.

vein widens sufficiently to allow mining. Although the shaft could not be entered for a direct examination, the vein could be seen to widen somewhat at the bottom of the shaft.

GOLD KING MINE

The Gold King mine is located approximately 1,000 feet northwest of the Condon shaft, on the ridge east of Weasel Creek. The mine has been developed by a vertical shaft of undetermined depth, and an adit lower on the hillside to the northwest. The vein, at the shaft, strikes N. 60° W. and dips nearly vertically. The adit level was caved at the portal, and a fire some years ago had destroyed the shaft timbering and headframe, therefore direct examination of the mine workings was impossible. A sample of the ore was taken from a small pile that had been separated on a small loading platform near the shaft. This sample, number 74-12, assayed 0.105 oz. gold, 5.4 oz. silver, and contained a minor amount of lead. The vein at surface is strong, however, and approximately 4 feet wide, and might bear further investigation. As judged from the size of the mine dumps, underground development has not been extensive.

LITTLE BONANZA MINE

The Little Bonanza mine is near the head of Kimber Gulch, probably on the eastward extension of the Stray Horse vein, which strikes approximately N. 70° E. and dips 65 to 70° N. The vein is localized by a fault fissure in andesite and contains chiefly pyrite, galena, and sphalerite. The mine is developed by two adit levels and a shallow prospect shaft. At the time visited, only the lower adit level was accessible. This level was open for most of its length, although sloughing from the back had dammed mine waters to such an extent that the last 80 feet or so of the level was not entered. The last known operation of the mine was in 1954-55, when the mine was under lease to Mr. Fred Schneider of Townsend, Montana. During this period, a small lens of rich lead-silver ore was mined.

According to Reed (1951, p. 39), the mine was discovered during the 1890's, and has been operated off and on over the years since discovery, producing from small lenses of high-grade ore. Total production is probably small. Reed's examination of past production records indicates an average grade of shipments of 0.04 oz. gold, 26.0 oz. silver, and 37.7 percent lead. Sample 74-13, taken of an 8-inch vein width in the lower level adit (Fig. 15, Appendix IV), was less rich than this average; the assay showed 0.05 oz. gold, 4.8 oz. silver, and 10.7 percent lead. These figures show that the Little Bonanza mine is among those of the district in which base-metal production is important, somewhat similar to the Condon mine.

In spite of the relatively high grade of ore produced from the Little Bonanza mine, the small size of the ore shoots or lenses found to date has undoubtedly retarded investment in exploration and development. No development has been attempted below the lower adit level.

OTHER MINES

Three caved adits, a small shaft, and numerous pits and trenches have been dug along two northwest-striking veins dipping steeply north, which crop out near the top of the ridge east of Weasel Creek, and south of the Stray Horse claims (Fig. 14). One of these is identified by a claim-location notice as the Gena Lode. None of these workings were accessible at the time visited, but the small size of dumps shows that development has been slight.

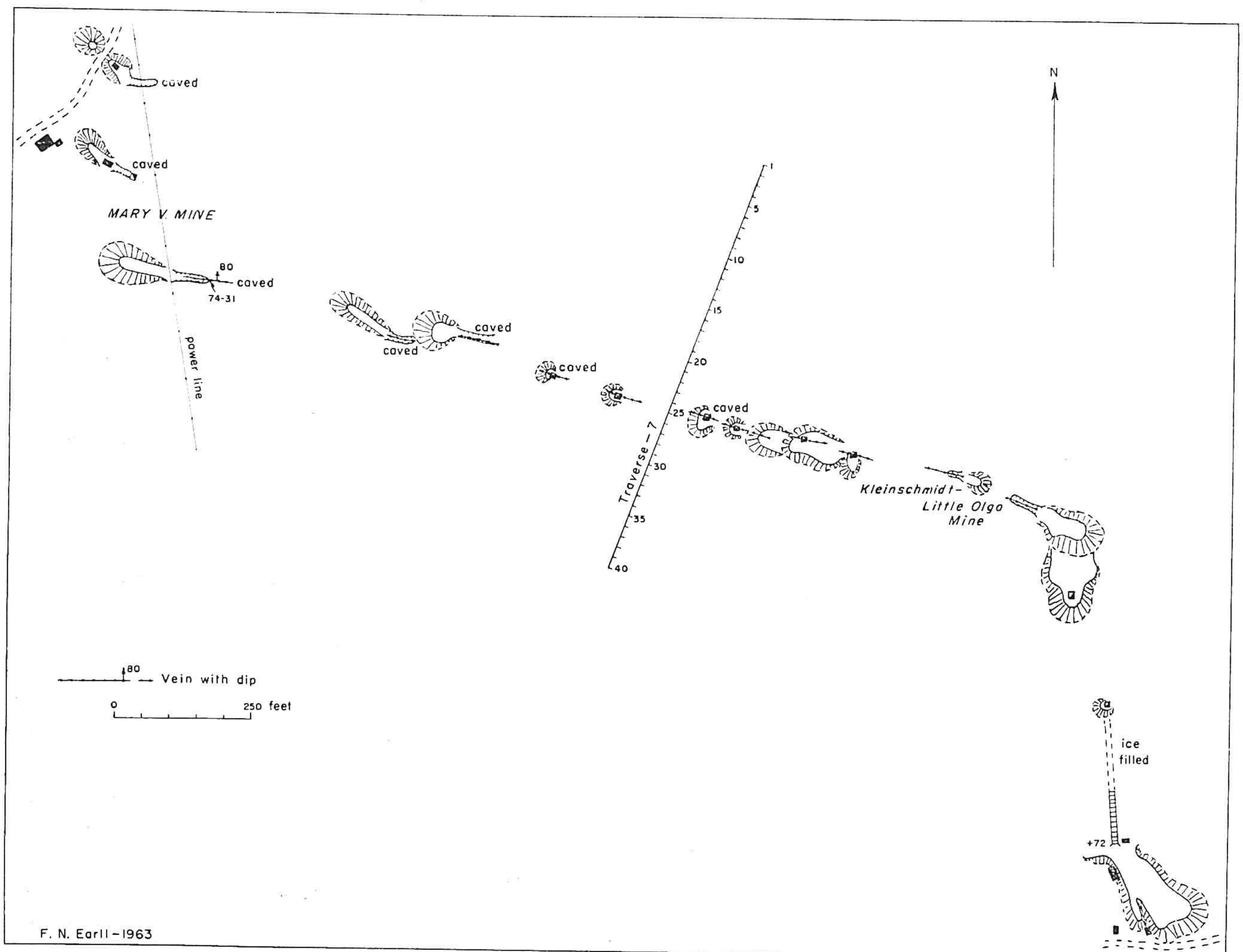

Figure 16.—Map of surface workings Little Olga vein, Kleinschmidt and Mary V. mines, Winston mining district, sec. 3, T. 8 N., R. 1 W.

KLEINSCHMIDT-VOSBURG GROUP

GENERAL COMMENT

The Kleinschmidt-Vosburg group includes several mines and mine groups developed along steeply dipping, generally east-striking veins, entirely within the large granodiorite Little Olga stock. Most of these mines were operated prior to 1900 when their product was of value mainly for its contained precious metals. In more recent times, mining was carried to somewhat greater depth, and production of both lead and zinc became an important factor. This was particularly true of the Kleinschmidt (Little Olga) mine, from which the group gets its name. The other mines of the group, insofar as they have been developed, seem to have been of interest only as producers of gold and silver.

KLEINSCHMIDT (Little Olga) MINE

The Kleinschmidt mine is located near the crest of the divide between Whitehorse Creek and Weasel Creek. Although several nearby properties are involved, which at one time or another have been worked as a consolidated unit, one of them, the Little Olga, has been the principal producer. This property was operated by the Kleinschmidt brothers from 1910 to 1927, approximately (Pardee and Schrader, 1933, p. 222), and since that time the mine has generally been known as the Kleinschmidt mine.

Although the mine has exploited other parallel veins to some extent, the major production has come from the Little Olga vein. This vein strikes approximately N. 80° W. and dips 80° N. where observed at the surface. The vein was traced on the surface for a strike distance of 1,600 feet (Fig. 16). Unfortunately, none of the mine workings were accessible at the time of the writer's visit. All the shafts have caved; an adit level, driven from the head of Whitehorse Creek to intersect the vein on the 290-foot level, was seemingly in good condition but was blocked by a solid wall of ice about 100 feet inside the portal; a second adit, driven from the head of Weasel Creek, intersects the vein approximately at the 500-foot level. This adit, generally known as the Carlson crosscut, extends 3,300 feet to reach the vein and is probably open for at least most of its length. Ventilation equipment has been removed however, and after entering the adit about 800 feet, the writer and his companion found the air too deficient in oxygen to allow further progress.

Figure 17, reproduced from Pardee and Schrader (1933, Fig. 30) is a longitudinal section view of the Little Olga vein showing workings on the vein down to the 290-foot adit level. Accord-

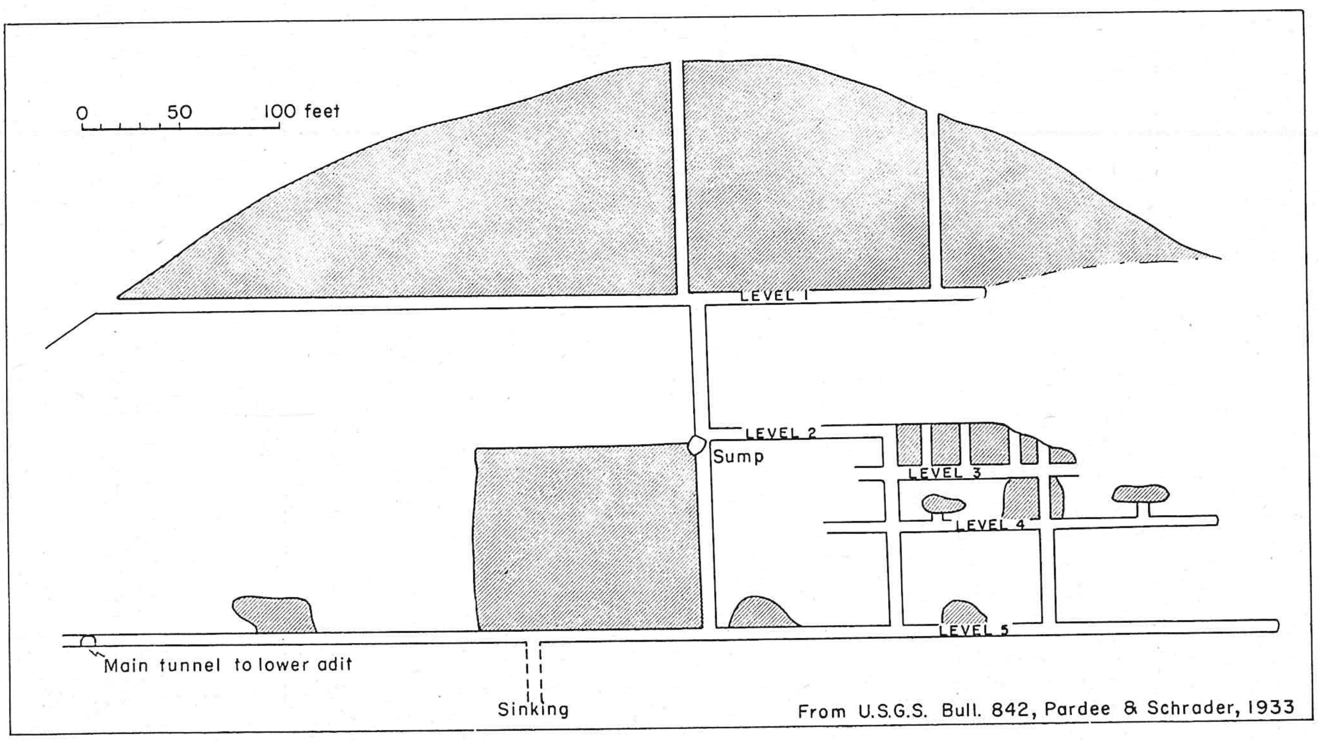

Figure 17.—Longitudinal section of Kleinschmidt mine.

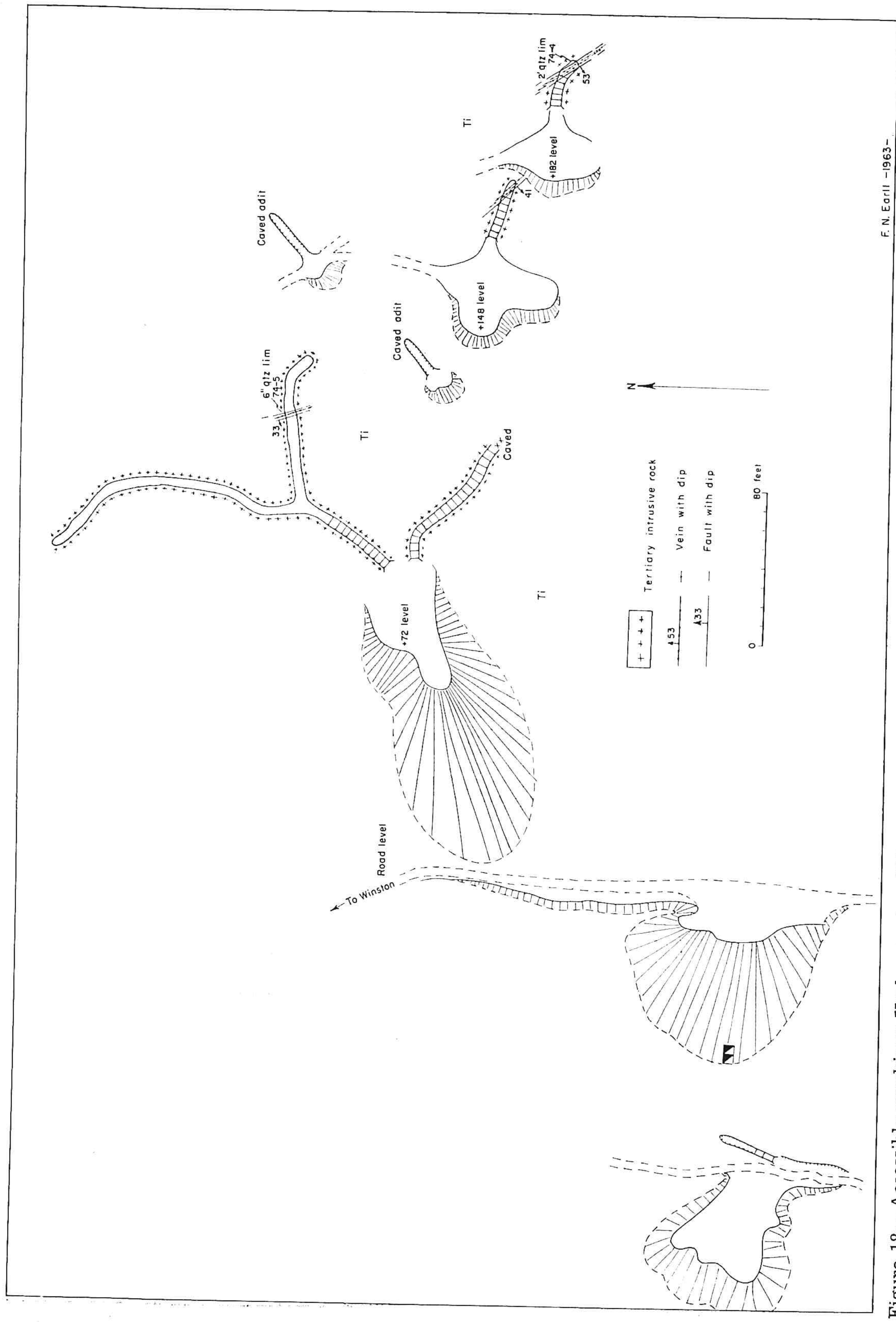

Figure 18.—Accessible workings Vosburg mine, Winston mining district, sec. 34, T. 8 N., R. 1 W., and sec. 3, T. 7 N., R. 1 W.

ing to their report, the vein was 1 to 4 feet wide, and contained argentiferous galena, pyrite, and chalcopyrite, both the pyrite and chalcopyrite being auriferous. In addition, they list as lesser minerals, tetrahedrite, arsenopyrite, and sphalerite.

Reed (1951, p. 16) lists production of the mine between 1901 and 1948 as totaling 4,354 tons of ore averaging 0.047 oz. gold, 18.7 oz. silver, and 6.7 percent lead. To this, probably, should be added the production of years prior to 1910 as reported by Stone (1911, p. 86). He notes that in years previous to his investigation, the mine had produced $25,000 worth of gold and silver, from ores that contained 5 pounds of lead to the ounce of silver, and approximately 0.7 percent copper.

It has been reported that the vein, where intersected by the Carlson crosscut (Klepper, 1964) was composed mainly of gouge and broken country rock containing minor stringers of the ore sulfides. Some ore was mined from lenses or pods of ore above this adit level. At the time of the writer's visit, two cars of ore were sitting at the adit portal. A composite sample taken of this broken ore assayed 0.50 oz. gold, 5.8 oz. silver, 7.7 percent lead, and 8.75 percent zinc (sample 74-10, Appendix IV).

VOSBURG MINE

The Vosburg mine is located just within the Little Olga stock, on the east side of the East Fork of Badger Creek. Little notice of this mine has been taken in the published literature, which at first might seem odd, because it is one of the larger producing mines of the district. This seeming lack of recognition is understandable, however, when it is noted that the mine's record of production began in 1933 and ended in 1946. At the time of Reed's visit, around 1950, most of the workings were inaccessible, as they are today, and its mill had already been taken down (Reed, 1951, p. 42). In its relatively short lifetime, however, the mine produced almost 24,000 tons of ore that averaged 0.28 oz. gold, 1.5 oz. silver, and minor amounts of lead, zinc, and copper.

Mapping of the location of mine dumps and adit portals, plus those portions of the underground workings that remain open, (Fig. 18) indicates that the mine developed a narrow quartz vein that strikes N. 15 to 30° W. and dips 33 to 53° SW. A sample across a 2-foot width of this vein exposed in the highest (5th) level assayed 0.78 oz. gold and 2.8 oz. silver. Another sample, taken on the third level, from a 6-inch width of the same vein assayed only a trace in gold and 0.1 oz. silver.

From the number of adits, and the volume of dumps and mill tailings, it does not seem likely that much of the vein remains unexplored above creek level. Deeper development might uncover additional ore, but cost would of necessity be great. The average grade of ore indicated by past production suggests that such development would not be well advised.

LAME DEER MINE

The Lame Deer mine explores a narrow, northwest-striking vein that dips 20 to 30° SW. The mine is on the east slope, above the East Fork of Badger Creek, about one-eighth mile north of the Vosburg mine. The vein has been explored by four short adit levels, over a vertical distance of 80 feet, and by a bulldozer cut and small prospect pit 100 feet above the lowest adit. Three samples were taken of the vein; sample 74-6 at the uppermost development, sample 74-8 in the intermediate level adit, and sample 74-9 in the lowest adit (see Fig. 19 for sample locations and mine detail). None of these samples disclosed rock of mineable grade (Appendix IV).

Ore mined to date has been extracted from a single ore shoot, exposed in the road-level (3rd) adit. This shoot was 50 feet wide along the strike, and not more than 100 feet long down the dip of the vein. Although no production figures for the mine were available, the total probably did not exceed 1,000 tons. Published records show that the mine produced an unspecified amount of ore during 1946, which was probably the most active year.

OTHER MINES

Additional mines located on other, more or less parallel veins in the group include the Cynosure, Emil H., Irish Syndicate, Mary V, Quartette, and Tramway mines.

The Emil H. mine is located somewhat southwest of the Kleinschmidt mine and is said to have had 800 feet of underground workings and to have produced ore worth approximately $20,000, mostly in gold and silver (Stone, 1911, p. 86). The mine is not known to have been worked since Stone's visit.

The Irish Syndicate mine explores an east-west vein located about one-quarter mile north of the Little Olga vein. In 1911, this mine had been developed to a depth of 150 feet, and was credited with production valued at $45,000, mostly silver

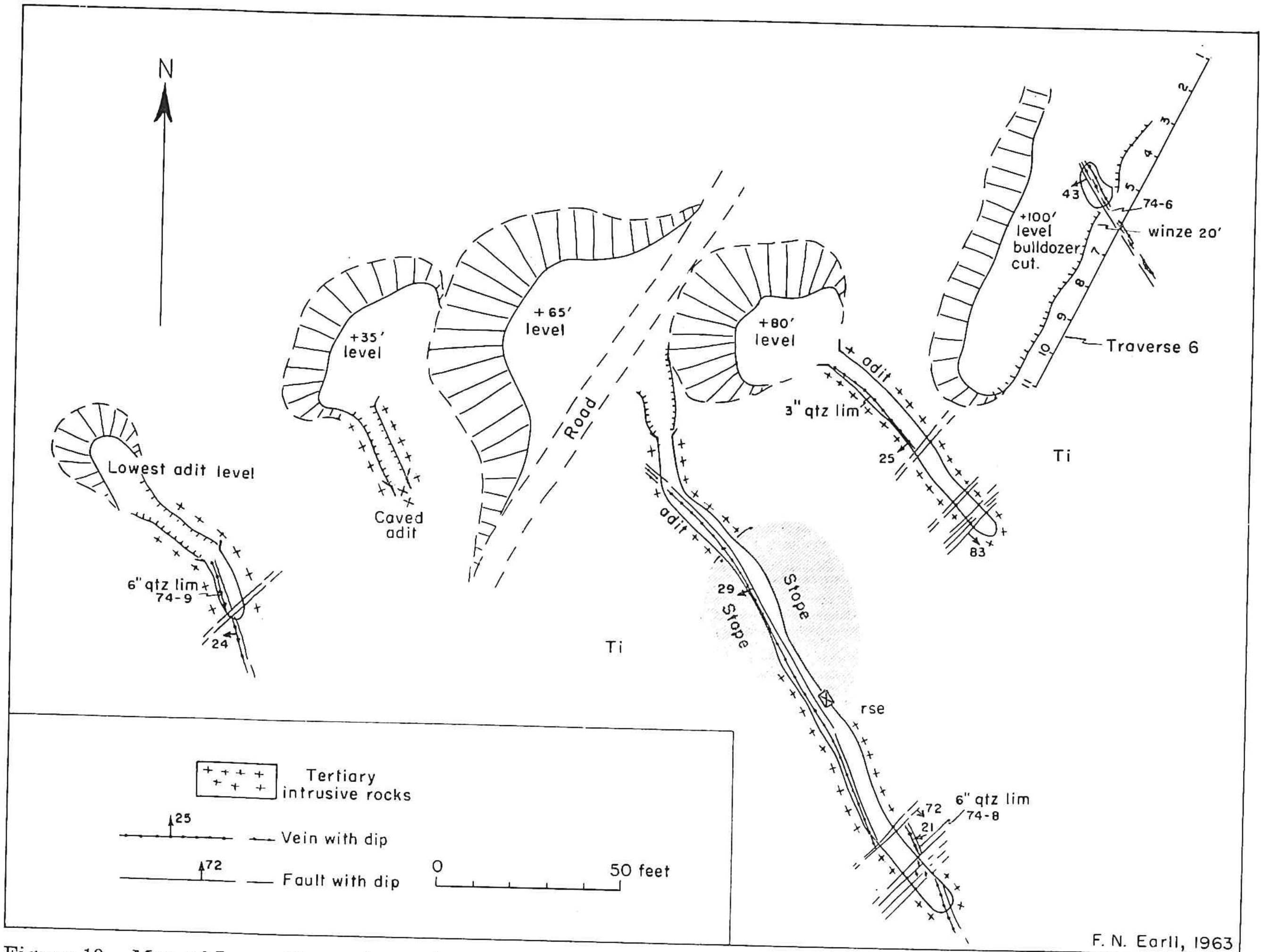

Figure 19.—Map of Lame Deer mine, Winston mining district, sec. 34, T. 8 N., R. 1 W.

(Stone, 1911, p. 86). This mine too is not known to have been operated since Stone's visit.

The Cynosure mine explores an east-west vein that lies between the Irish Syndiate and Little Olga veins. Although the mine is known to have been operating through 1913, no record of its production has been found. Stone (1911, p. 86) remarked that the ore was valued at $35.00 per ton, presumably in silver and gold.

The Mary V, Quartette, and Tramway mines have been operated more recently, production being recorded from the Quartette as recently as 1930, and from the Mary V and Tramway in 1934. No specific record of the amount of production was available, however, but the nature of dump material suggests that value was mainly in gold and silver. No workings were accessible in 1962-63. The Mary V mine explores the westward extension of the Little Olga vein, by means of a series of adits distributed along its outcrop.

OTHER MINES

GENERAL COMMENTS

Several mines in the district, because they are remote from other mines, do not lend themselves to discussion with the principal mine groups. These mines are discussed, briefly, in the following paragraphs.

1962 LODE MINE

The 1962 Lode mine is located near the source of the West Fork of Badger Creek in sec. 4, T. 7 N., R. 1 W. Early development of the mine was through three adit levels and two shallow inclined shafts, all now caved. No data on production have been found, but operation probably occurred prior to Stone's study of the district in 1910-11.

The vein explored strikes approximately east and dips 40 to 60° S. (Fig. 20). A sample of material taken from an open cut across the vein (sample 74-34) assayed 0.025 oz. gold, 24.3 oz. sil-

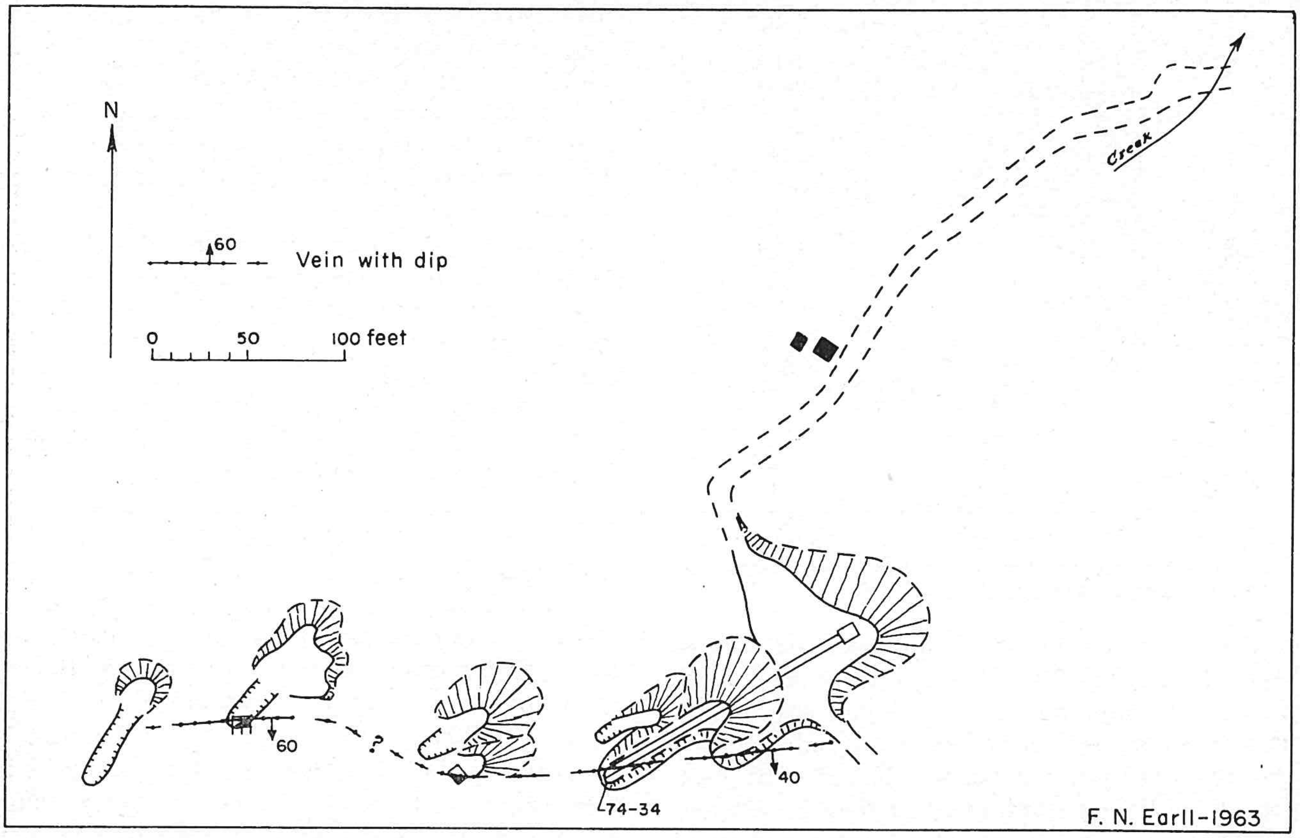

Figure 20.—Map of surface workings 1962 Lode mine, Winston mining district, sec. 4, T. 7 N., R. 1 W.

ver, and 13.75 percent lead. Another sample (74-7) of material selected from the various dumps, assayed 0.01 oz. gold, 3.2 oz. silver, and 6.61 percent lead. The vein, where observed, was composed of quartz and limonite (from the oxidation of original pyrite) and some galena.

During the summers of 1962 and 1963, the property was held under lode claim by Mr. Fred Schneider of Townsend, Montana. Development work accomplished at the time of the writer's visit consisted of the installation of a gasoline-powered dragline and the opening of a cut approximately 100 feet long to and across the vein. An attempt had also been made to reopen the lowest level adit, but the ground proved to be too heavy to hold with the light timber used.

From the nature of the surface evidence, a narrow, east-plunging ore shoot is indicated. It also seems likely that this shoot has been thoroughly explored down to the lowest existing level, but there is no evidence of any effort at deeper level exploration.

SUNSHINE MINE

The Sunshine mine is located high on the slope east of Weasel Creek, near the center of the NW¼ sec 23, T. 8 N., R. 1 W. The mine explores an east-striking, gently south dipping, quartz-limonite vein that seems to be generally similar to the 'flat' veins of the Custer-Hyantha group mines farther east.

Unfortunately, none of the workings could be safely entered at the time visited. It could be determined that a considerable tonnage of ore had been taken from the slightly inclined, narrow, stulled stopes extending almost to the surface (Fig. 21). The vein has been prospected at several points farther east along the strike from the known shoot, but without encouraging results.

Reed (1951, p. 42) lists mine production as totaling 1,600 tons of ore averaging 0.5 oz. gold, 10.5 oz. silver, and 4.2 percent lead.

MAINE-SULLIVAN MINE

Little can be said of the Maine-Sullivan mine at this time other than to note the fact of its existence. The mine is located across a narrow gulch

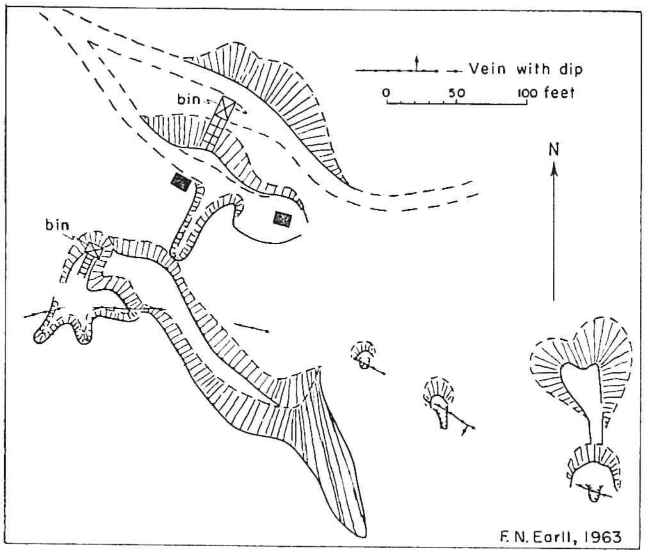

Figure 21.—Surface workings Sunshine mine, Winston mining district, sec. 23, T. 8 N., R. 1 W.

from the Sunshine mine, in the southeast corner of sec. 14, T. 8 N., R. 1 W. The mine was developed by two adit levels, but from the small size of the dumps remaining, it is obvious that underground workings were not extensive. Neither adit was open at the time visited, nor had they been open for many years, and no record of past production is available. It can be safely assumed, however, that total production was small.

KELLY MINE

The Kelly mine, located near the mouth of Kelly Gulch in the southwest corner of sec. 19, T. 8 N., R. 1 E., was not accessible at the time of the writer's visit, although the lower adit level was accessible when visited by Reed (1951, p. 39), presumably in 1949 or 1950. A map of these workings, from Reed's report, is reproduced here for the reader's convenience (Fig. 22).

Two sub-parallel narrow northwest-striking veins have been explored. The veins dip 65 to 77° NE., and the width ranges from 2 to 36 inches, according to Reed.

Although a considerable amount of exploration work has been accomplished at the mine, seemingly not much ore was found. Known production includes six sacks of 'high grade' ore produced during the early 1900's, and a test shipment of unknown size, made in 1949. Grade of this shipment was 0.25 oz. gold, 3.0 oz. silver, 0.1 percent copper, and 5.8 percent lead (Reed, 1951, p. 39).

ORPHAN BOY MINE

The Orphan Boy mine is located in the NE¼ sec. 4, T. 8 N., R. 1 W. Although located on one of a group of 14 patented mining claims, the Orphan Boy was the only one to achieve the status of a mine, and its total production was probably small.

Stone (1911, p. 84) mentions a mine that he identifies as the Dolly Boy but which, from the location given and the associations mentioned, is undoubtedly the Orphan Boy. He described development as being ". . . a shaft and two slopes (inclined shafts) on a 3-foot vein of quartz carrying sulphides, which looks like a fair grade of ore. . .". He further credited the mine and adjacent properties with a total of 1,000 feet of underground workings and ore carrying $10.00 in gold, 37 oz. silver, and 8 percent copper.

At the time of the writer's visit, a 46° inclined shaft was found to be open, but was judged to be

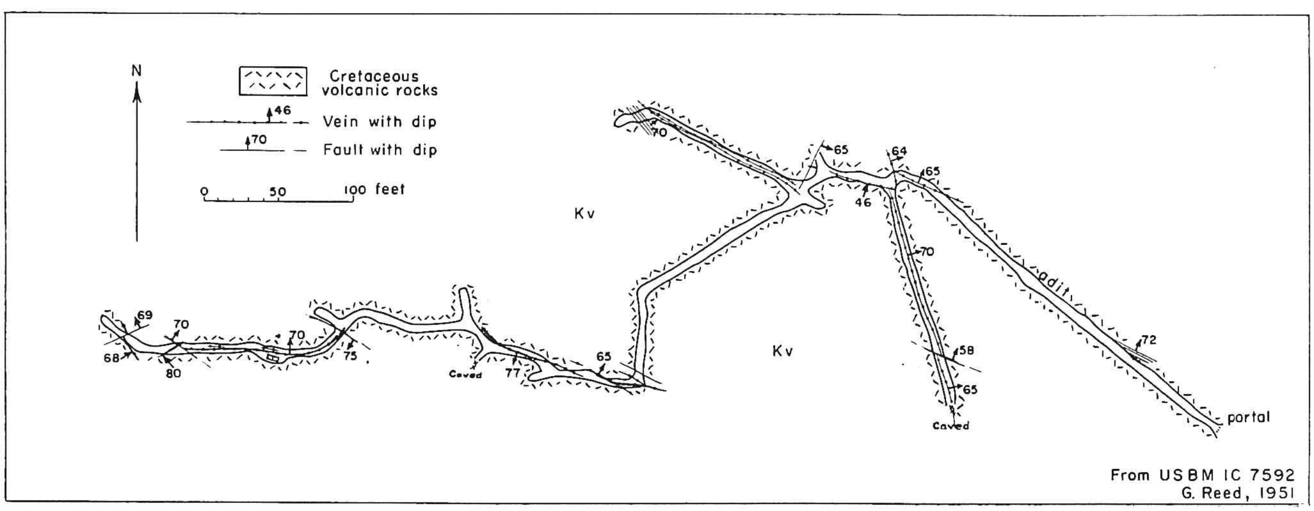

Figure 22.—Workings of Kelly mine.

unsafe to enter. Further, the workings are said to be flooded to a relatively shallow depth. A sample of the vein (sample 74-32), taken adjacent to the shaft at surface, over a 2½ foot width assayed 0.08 oz. gold and 1.6 oz. silver.

GOLD BUG MINE

The Gold Bug mine, on Staubach Creek in the NW¼ of sec. 9, T. 8 N., R. 1 W., was not visited by the writer. According to Reed's report (1951, p. 40), the vein was a steeply south dipping, east-striking vein in quartz monzonite. The workings were inaccessible at the time of his visit, but local reports credit the property with production valued at $20,000, presumably mainly in gold.

AUGUST RUST MINE

The August Rust mine or lode is a name taken from a no-longer-valid lode claim notice found at the portal of the main adit on the property. The mine is developed by one adit and several shallow pits and prospect adits, along a northwest-striking probably steeply dipping vein (Fig. 23). All openings were caved at the time the property was visited. The mine is located on North Pole Creek, in the NW¼ sec. 16, T. 8 N., R. 1 W.

A sample was taken of selected specimens of what seemed to be the best ore on the dump. This sample, number 74-33, assayed a trace in gold, 16.7 oz. silver, 1.16 percent lead, and 4.6 percent zinc.

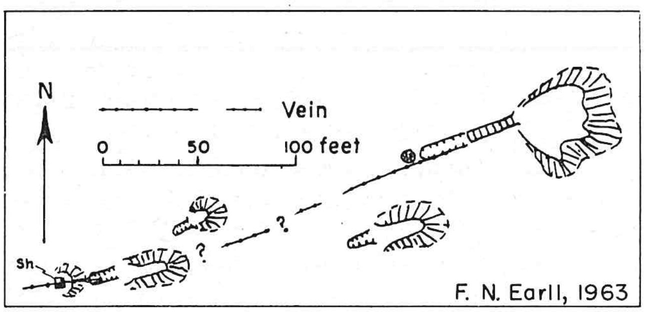

Figure 23.—Surface workings August Rust mine, Winston mining district, sec. 16, T. 8 N., R. 1 W.

NATIVE SILVER MINE

The Native Silver mine, on the South Fork of South Pole Creek, in the southeast corner of sec. 16, T. 8 N., R. 1 W., was not visited by the writer. According to Reed (1951, p. 40), the workings, which were inaccessible at the time of his visit, explored an east-striking, steeply north dipping, fracture-filling vein in andesite. Production is unknown but small.

HOMESTEAD MINE

The Homestead mine, located in the NW¼ sec. 10, T. 8 N., R. 1 W., also was not visited by the writer. According to Reed (1951, p. 40), the mine explored a complex intersecting fissure system by means of 600 feet of underground workings. The workings were noted to be in poor condition in 1950.

This mine has been credited with production not exceeding 10 tons of ore carrying as much as ½ oz. gold per ton.

DENVER MINE

The Denver mine, located in the SE¼ sec. 21, T. 8 N., R. 1 W., seems to have been abandoned for more than 50 years, and was not visited during the present study. The mine is located on one of a group of six patented claims, dating to the early days of the district.

Stone (1911, p. 85) visited the property during his study of the district and noted that most of the tunnels and shafts had long since been abandoned, and were caved at that time. He made no mention of recorded production from the property.

SPOKANE MINE

The Spokane mine is not located in the Winston district, strictly speaking, but slightly northwest of the district. As the mine is not in any organized mining district, however, and as it does lie near Winston, it can appropriately be mentioned here.

Early workings at the mine include an adit level and a 78° inclined shaft to a depth of 65 feet with levels (reported) at 35 and 65 feet. These workings explore a shear-zone-like vein in weathered quartz monzonite or granodiorite. The vein strikes east-west and dips 53° N.

The present operators were constructing a combined gravity-separation and flotation mill on the property at the time of the writer's visit in 1963, with the intention of mining surface and near-surface ore along the outcrop of the vein. Samples taken at the property by the writer were not encouraging (samples 74-24 and 74-25, Appendix IV).

The mine is probably located in sec. 30, T. 9 N., R. 1 W., although its exact location was not determined.

GEOCHEMICAL STUDIES OF THE DISTRICT

GRID SURVEY

General comment: The geochemical grid survey of the Winston district was the first known full-scale field test of a procedure first attempted in the Butte district by the author (unpublished) between 1957 and 1961. The purpose was to determine whether soil samples, taken on a widely spaced grid pattern without reference to structure, lithology, or topography, would serve to indicate promising areas in a large exploration region.

In the study of the Butte district, because the mineralized area was known to be large and the mineralization intense, the initial spacing of samples was set at 2 miles, and provision was made for taking additional samples at 1-mile spacing as needed. In practice, no 1-mile samples were ever taken, as contouring of the results of analysis of the 2-mile samples outlined the productive area of the Butte district very satisfactorily.

The grid spacing chosen for the study of the Winston district was set, initially, at ½-mile intervals, and provision was made for taking additional samples at ¼-mile spacing as needed. This spacing was chosen in part because the area of the study was small (35 square miles as compared to 432 square miles for the Butte study), but more importantly because the mineralization in the district was known to be somewhat spotty and relatively weak.

When the grid survey of the Winston district was completed, a total of 216 grid samples had been taken—165 samples on the ½-mile spacing, 41 samples at ¼-mile spacing between ½-mile samples where early analyses suggested the need for additional information, and 10 of the original ½-mile samples were retaken as a check on their accuracy where early results of analysis departed radically from the anticipated. In general, retaken samples corroborated results of initial sampling within reason, although samples 119-119A and 120-120A show a major divergence in citrate-soluble metal. The resulting anomaly in this area is discussed further in the following section.

Sampling procedure was extremely simple. The grid pattern called for samples to be taken at section corners and quarter corners and at the center of each section of land within the district. These points were first marked on air photos of the area, and then samplers took the photos into the field with them to aid in locating the point to be sampled. Extreme accuracy of location was not attempted, it being assumed that with a sample spacing of 2,640 feet, an error of location of 200 feet in any direction from the actual corner should not introduce a significant error into the results. The grid pattern method of sampling was chosen to avoid unintentional bias. Granted that an equal number of samples taken at random locations in the district should produce the same result, the use of a fixed grid prevents the sampler from biasing the result by his choice of sample location.

Ideally, soil samples should be taken consistently from identical soil horizons, but because soil, technically speaking, is virtually absent from the Winston district, this ideal could not be achieved. The sample - taking procedure used called for scraping away the surface accumulation of humic and vegetable debris, in most places 3 to 6 inches in thickness, and taking the sample from whatever remained above bedrock—a thin accumulation of fairly fine grained alluvium or partly decomposed bedrock. Samples were taken in small cloth sacks marked with the number and location of the sample. Later, they were screened to a minus 80 mesh through a non-metal screen, and the fine fraction was retained for analysis.

Three analyses were performed on each sample, all involving the use of diphenylthiocarbazone (Dithizone) to give a colorimetric indication of metal content. The first analysis performed was the so-called citrate-soluble total heavy metal analysis. This procedure provides a measure of the total amount of copper, lead, and zinc present in the soil in a form that is readily soluble in cold, weakly acid solutions. This analysis (Appendix II) provides results given in milliliters of reagent required to achieve a predetermined endpoint (Robertson and others, 1956). This analysis was performed at the camp in the field to provide a rapid indication of places where duplicate samples or ¼-mile samples should be taken.

Later, after samples had been brought to the analytical laboratory of the Bureau in Butte, all samples were analyzed for total (actually, nearly total) amount of lead and zinc, by means of the pyrosulfate fusion method of extraction. This procedure has been developed to its present form by Dr. Harold Bloom of the U. S. Geological Survey, Denver. By this method, very nearly all of the contained lead or zinc (or copper if desired) in the soil can be determined, the result being given in parts per million (ppm) of metal in the soil (10,000 ppm = 1 percent).

Finally, maps were prepared on which contours (actually lines connecting points presumed to have equal metal content in the soil) were drawn. These lines were drawn on the assumption that metal content of the soil would vary linearly from one sample location to the next. Actually, this assumption would be valid only where samples were taken at very close intervals, but it is felt that no serious error of interpretation has resulted from this simplifying assumption in the present study. By and large, it is believed that the 'peaks', or areas of unusually large metal content indicated on the attached maps (compare Plate I with Fig. 24-26), fairly delineate the interesting areas of the district, except as noted in the discussion of individual maps to follow.

Analysis of heavy-metal anomalies: The results of analyses for citrate-soluble total heavy metal of soil samples are given in table form in Appendix II, and in the form of a geochemical contour map as Figure 24. In addition to the contours on the map, areas thought to show a 'significant anomaly' are marked with a cross. In selecting the value that would constitute a significant anomaly, it was first necessary to establish the 'threshold' or normal background for the district. It was found that on the margins of the district, outside the mineralized area, and adjacent to the district, the assays ranged from a trace to 2 milliliters (2 ml), which was taken to be the regional background. Within the central part of the district, but away from known mineralization, values were found to range from 3 to 4 ml. This value of 4 ml was taken to represent the local threshold as defined by Hawkes and Webb (1962), above which values might be considered anomalous. In order to avoid interpretation of random variations as anomalies, only those anomalies having peaks three times this threshold (12 ml) were regarded as significant.

Referring to Fig. 24, the reader will note that significant anomalies occur over the Stray Horse-Little Bonanza group mines, over the January and Sunrise mines, the Custer-Hyantha group mines, and upslope and on strike behind the August Rust mine.

Two additional anomalies indicated on the map require comment. One of these is along the line between sec. 2 and sec. 3, T. 8 N., R. 1 W. This anomaly is probably false. There is no evidence of mineralization at this location, and the 'soil' is alluvium derived from adjacent areas, mainly to the west. It will be noted that this anomaly occurs along the access road to the Orphan Boy mine and associated prospects. It may well be that an ore truck overturned nearby, or a small plant to beneficiate the ores of the area may have been built beside the creek there, many years ago. In any event, there is little evidence to suggest that further prospecting of the location is justified.

The second unexplained anomaly is located in the northwest corner of sec. 33, T. 8 N., R. 1 W. This anomaly, too, may be false. The sample location is covered by volcanic 'slide rock', and no soil as such is present. The sample taken was composed of fine rock flour and vegetable debris (pine duff) scraped from the under side of boulders of volcanic rock. Such material would tend to give a relatively high analysis regardless of whether in a mineralized area or not. Several prospect pits and trenches to the south of the anomaly may offer sufficient evidence of mineralization to warrant some further prospecting (see conclusions of this section).

Several other mild anomalies are present in the area. Among those that may deserve comment are the 8-ml anomalies near the Orphan Boy mine and above Sunshine mine, and the 10-ml anomaly where the Weasel Creek road turns toward Winston at the line between sec. 14 and sec. 15, T. 8 N., R. 1 W. This latter high is probably false, similar to the one 2 miles to the north.

Perhaps the most embarrassing failure of this phase of the survey is the lack of anomalies over the Kleinschmidt-Vosburg group mines and over the East Pacific mine. The lack of an anomaly over the Kleinschmidt-Vosburg area can possibly be explained by the fact that the intrusive rock in which these veins have been developed is more resistant to weathering, and less broken by joints and fractures, than the volcanic rocks. It might, therefore, be expected that anomalies would not extend as far from the area of mineralization, and less of the metal would be in a form ammenable to detection by the citrate-soluble method. No such handy excuse presents itself to explain the lack of an anomaly at the East Pacific mine, however. Not only is the vein located in jointed and weathered volcanic rocks, but one of the sample locations fell almost at the portal of one of the mine tunnels.

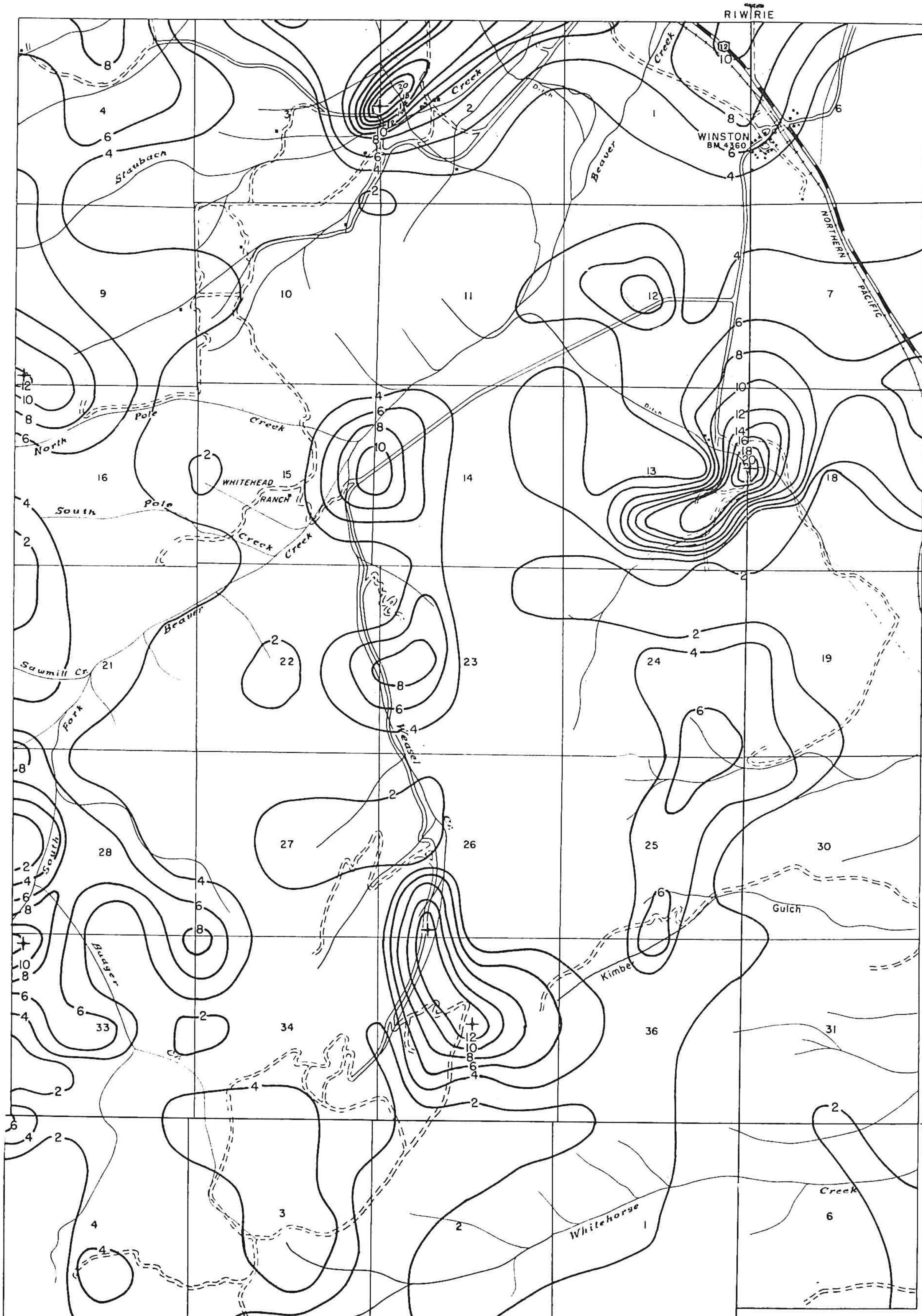

Figure 24.—Geochemical contour map analyses for citrate-soluble total heavy metals. Values: milliliters equivalent. Locations of significant anomalies marked +.

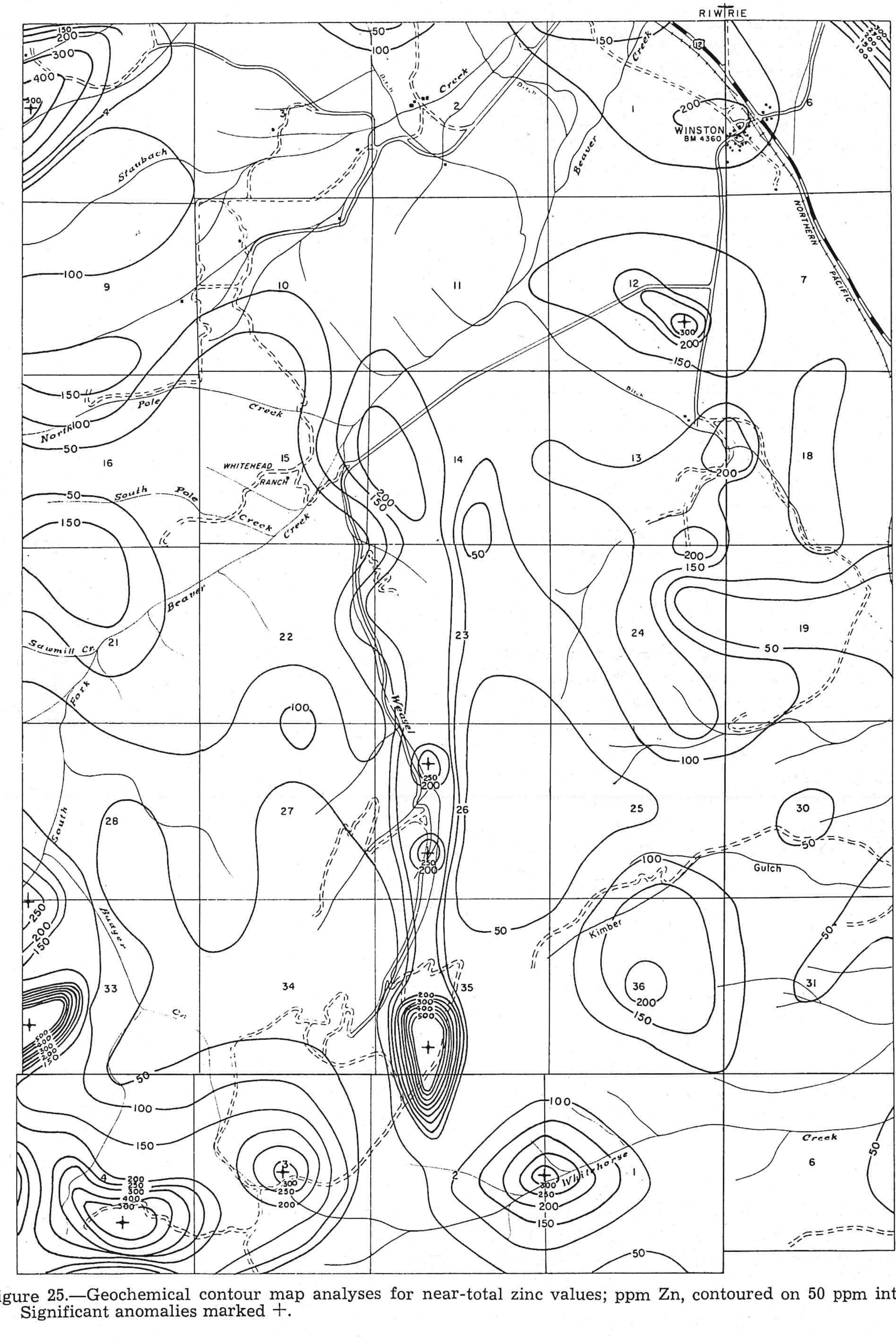

Figure 25.—Geochemical contour map analyses for near-total zinc values; ppm Zn, contoured on 50 ppm interval. Significant anomalies marked +.

Analysis of zinc anomalies: The second analysis performed on grid-survey soil samples was to determine the near-total content of zinc, by the pyro-sulfate fusion method. Zinc was chosen for analysis for several reasons. First, zinc is a so-called mobile element, and as such, evidence of its presence would be expected to extend for a greater distance from its source than would be the case for less readily transported elements. It was hoped, therefore, that the zinc-anomaly map would indicate broad anomalous areas within which more specific studies might be indicated. Second, zinc is present in at least trace quantities in most, if not all, known veins in the district. Furthermore, there is a close association between zinc mineralization and gold-silver ore, particularly in the central part of the district (Kleinschmidt and East Pacific) where citrate-soluble analysis failed to produce the expected anomaly.

Inspection of the zinc-anomaly map (Fig. 25) will disclose that normal background zinc content is on the order of 50 parts per million (ppm), and that the threshold, or plateau of greater zinc content surrounding areas of known mineralization is approximately 100 ppm. From this, and with consideration of the fact that the mobility of zinc would tend to broaden the area affected and to subdue the peaks observed, it was concluded that values of 250 ppm or greater should probably be regarded as significantly anomalous.

Examination of the map shows that strong anomalies again occur in the vicinity of the Stray Horse-Little Bonanza group mines, and at the January and Sunrise mines. In addition, an anomaly is found at the East Pacific mine, and one at the Kleinschmidt mine. Additional anomalies also deserve comment. A strong anomaly in sec. 4, T. 8 N., R. 1 W., west of the Orphan Boy mine, is broad and encompasses most of the known mineralized ground in the local area. The anomaly in the northwest corner of sec. 33 found by citrate-soluble analysis is repeated, and a strong anomaly occurs ¾ mile to the south in the vicinity of the numerous prospect pits and trenches mentioned earlier. Another strong anomaly is found in sec. 4, T. 7 N., R. 1 W., centered close to the 1962 Lode mine. All four of these areas seem to merit further study.

The three remaining anomalies are, perhaps, of less interest. The one on Whitehorse Creek, in sec. 1 and 2, T. 7 N., R. 1 W., may be of significance. One prospect is present within the broad anomaly area, but the anomaly itself centers upon Whitehorse Creek. It should be noted that the Kleinschmidt mill was located upstream from this point, and it is likely that some contamination of the soil may have been derived from this source. Further, the fact that this anomaly is not repeated on either the citrate-soluble or lead anomaly maps suggests that the peak may be more apparent than real. The anomaly in the SE¼ sec. 12, T. 8 N., R. 1 W., is probably due to contamination lying as it does out on the alluvium-covered valley floor and near a road junction. Finally, an anomaly in the extreme northeast corner of the map is based upon one sample, and although possibly significant, falls outside of the area considered in the present study.

The lack of anomalies in areas found anomalous on the citrate-soluble anomaly map is also of interest. Although a broad anomaly extends over the area along Iron Age Gulch, no significant anomalous peak is found. This is as might have been predicted, as these mines constitute the only group in the district where zinc mineralization is virtually absent. A low-grade anomaly also occurs along North Pole Creek in the vicinity of the August Rust mine. This vein is known to contain considerable zinc; the lack of a sharp peak here may indicate that mineralization is narrowly restricted in area. Finally, the suspected false anomaly in sec. 2 and 3, T. 8 N., R. 1 W., on the citrate-soluble anomaly map fails to appear on the zinc map. This may be taken as further evidence that no true anomaly exists at this point.

Analysis of lead anomalies: Analysis of the grid-survey soil samples for lead was undertaken in the hope that an anomaly map would result that would provide sharp, clearly defined, localized areas of mineralization as opposed to the more regional or general anomaly pattern obtained through the other analyses. This end was at least partly realized.

Examination of the lead-anomaly map (Fig. 26) shows that background or normal amount of lead present in unmineralized areas is generally less than 25 ppm. Reference to the Table of Geochemical Analysis Values (Appendix II) shows that these background values generally range from 0 to 13 ppm. Then anomalous areas are outlined, broadly, by a threshold or plateau-like local background of 25 ppm. The minimum value for significant anomaly was taken at three times this threshold value, or 75 ppm.

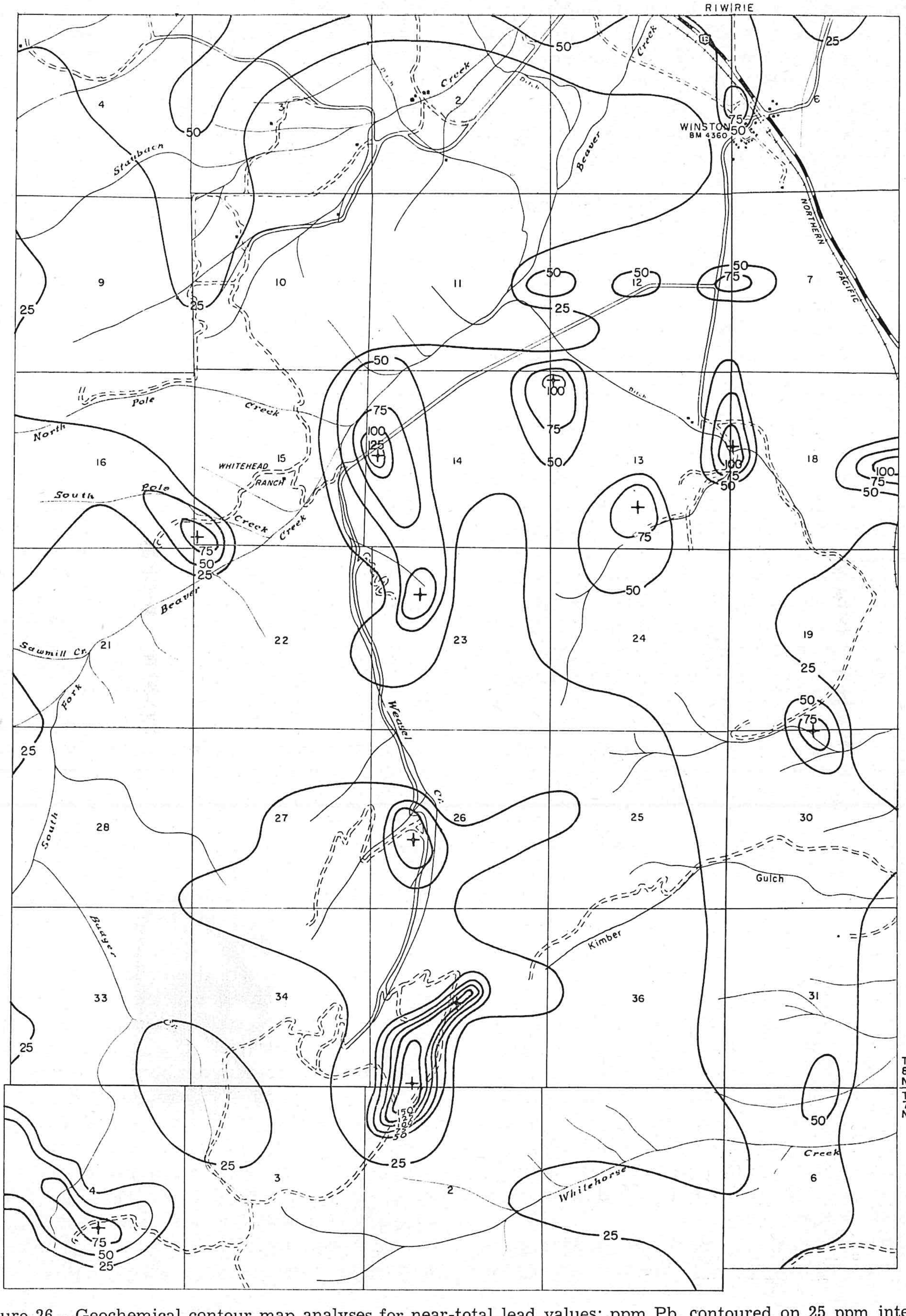

Figure 26.—Geochemical contour map analyses for near-total lead values; ppm Pb, contoured on 25 ppm interval. Significant anomalies marked +.

The reader will note that the anomalies found through analysis for near-total lead in soil are, indeed, sharp or localized. Several of these local areas are of interest, among which is the anomaly over the Custer mine. The center of the anomaly lies slightly east and down slope from the mine, but there is little doubt that it represents mineralization at the Custer and the neighboring Hyantha, Edna, Aqua Frio, and General Sherman mines. Also of interest, in the same general area, is the anomaly over the Martha W. and Aurora mines —related to the preceding anomaly, of course, but sufficiently localized to provide a separate peak. It might also be noted that no specific anomaly occurs over the Iron Age-Lily group mines. This is understandable, as these mines are notable for their lack of base metals.

Other anomalies occur over the Stray Horse-Little Bonanza group (centered over the Condon mine); over the East Pacific and Sunshine mines; and sharp anomalies occur immediately down slope below the Native Silver, 1962 Lode, and Kelly mines. All of the above strongly indicate the known mineralization. In addition to these anticipated anomalies, several others deserve comment. The anomaly in sec. 14 and 15, T. 8 N., R. 1 W., persists. This anomaly is so sharp, and so persistent, that it may deserve some further investigation despite the possibilities of contamination at this locality. Another anomaly, at the northwest corner of sec. 13, T. 8 N., R. 1 W., is down slope from some prospects lying to the south, and may be significant. Other anomalies (unmarked) occur at the railroad siding at Winston, at the junction of the roads up Weasel Creek and Iron Age Gulch, and east of the mill-tailings pond along the east side of sec. 18, T. 8 N., R. 1 E. None of the last-mentioned anomalies is thought to be significant, as contamination would appear certain.

Finally, one more anomaly of importance is to be found on the map. This anomaly lies along the line between sec. 35, T. 8 N., R. 1 W., and sec. 2, T. 7 N., R. 1 W., and its center is less than one-quarter mile south of a similar peak found through zinc analysis Although this area lies more or less on the strike of veins of the Kleinschmidt-Vosburg group mines, it is considerably to the east of major development in the area and may deserve more intensive prospecting.

Negative results of the survey must also be considered. Here it must be observed that the expected anomalies over the Kleinschmidt-Vosburg group mines and at the August Rust and Orphan Boy mines failed to materialize. The absence of anomalies at the latter two locations is not surprising, as neither has been found to be either widely mineralized or particularly noted for the presence of lead. The absence of an anomaly over the Kleinschmidt-Vosburg area, however, must remain an enigma, as veins in the group are widespread, and mineralization is characterized by an abundance of lead.

Summary and conclusions: In summarizing the results of the grid survey program, it cannot be said that it was an unqualified success. As with virtually all regional exploration procedures, it failed to do all that we had hoped. A part of this failure may well derive from the fact that there is, as yet, no satisfactory method to test for the extremely minute quantities of the precious metals that could be expected in a geochemical survey. As a result, it was necessary to use the base metals as an indirect indicator of the presence of the metals sought. This factor, however, cannot be blamed for all departures from ideal results, particularly because the most glaring failure was in the Kleinschmidt-Vosburg area, where base-metal mineralization is supposedly at a maximum. A second factor that may have affected the results is that the sample interval (½ mile) may have been too large. Resampling at ¼-mile spacing, however, failed to provide noticeably improved results, suggesting that nothing short of an extreme shortening of sample interval would prove effective. Even so, the grid sampling program, as accomplished, would have led to the discovery of most, if not all, of the known producing areas in the district, and in addition it indicated several interesting areas for future prospecting.

The partial failure of the grid sampling program may be of even greater importance than its overall success, in that it allows a comparison from which an interesting, though tentative, conclusion may be drawn. At Butte, where a similar grid sampling program has been conducted, a sample spacing four times as great as that used in the Winston district proved adequate to dilineate the area of productive mineralization. Here, the magnitude of the mineralizing impulse was tremendous, not only resulting in the deposition of a vast quantity of valuable metals, but imparting a pervasive trace mineralization to rocks and their resulting soils over a large area. In the Winston district, where the total quantity of mineral matter deposited, taken as a rough gauge of relative strength of mineralization, was on the order of one one-thousandth as strong, the effect on surrounding rocks is weaker and less extensive. From this, it might be concluded that the effectiveness of widely spaced soil sampling is more or less directly proportional to the magnitude of the mineralization involved. Thus grid sampling of the type employed may be viewed as a useful regional exploration tool for rapid and inexpensive reconnaissance of large areas. Such surveys could be expected to dilineate all major mineralized areas within the area surveyed, but might not adequately outline smaller localized areas of mineralization nor pinpoint specific ore bodies within a major mineralized district.

TRAVERSE SURVEYS

General comment: A series of traverse surveys, or sequences of soil samples taken at a relatively close spacing, was made over known vein structures in the district. The purpose of these traverses was not an attempt to locate veins or ore for any mine or individual, but rather to demonstrate the effectiveness of the method as an exploration tool in the Winston and other similar districts. Veins do not crop out boldly at the surface in the Winston district as they do in many mining districts. In fact, the surface expression of most veins is so subdued that it is quite possible to stand on the surface outcrop and still see no clear indication of the vein. Under these conditions it is likely that several veins are present in the district that have not as yet been discovered. Certainly, in a district where the mineralized structures are not immediately recognizable at the surface, an exploration procedure that is not dependant upon visual recognition of veins is most desirable; soil sampling is just such a method, and in addition has the advantages of being both rapid and inexpensive.

In laying out the traverses in the district, a traverse line was first established in a direction believed to be approximately at right angles to the local vein structures. Sampling was started at a point believed to be outside the mineralized area, and samples were taken at close spacing along the line until the mineralized area had been crossed. Sample spacing on most traverses was 20 feet. Procedure for taking the samples was the same as that used in the grid survey; surface debris and humus were scraped away, and the sample taken from the soil or bedrock material remaining. Traverse exploration of any of the geochemical anomalies established in the grid survey would proceed in much the same way. Traverse lines would be established in a direction most likely to cross mineralized structures (in the Winston district this would be north-south or slightly southeast). Then sampling would proceed from one side of the anomaly to the other. Any area of mineralization located in this manner would then be further delineated by additional traverses across its course.

Traverse 1, Custer-Hyantha group: The first soil sample traverse made in the district was taken along an east-west line beginning about 200 feet north of the General Sherman mine portal and continued in an easterly direction until it had crossed the surface trace of the Custer vein (see Fig. 5 for location). Sample spacing was 20 feet. The results of analyses of these samples are given in Appendix II, samples T-1-1 through T-1-30, and in graphic form as Figure 27. In plotting the results for Figure 27, values for citrate-soluble heavy metal, expressed in milliliters, have been multiplied by 120 in order to produce background, or 'normal' values approximately equal to those resulting from individual metal analyses made for lead and zinc.

Examination of Figure 27 will show that the well-defined Custer vein appears as a strong anomaly at sample 28. The anomaly is equally pronounced in both the citrate-soluble heavy metal and the lead analyses, and a moderate peak is shown in the zinc analysis. A second sharp anomaly appears at sample 11. This anomaly is strongest in the zinc analysis, but shows to some extent in heavy-metal analysis as well. It is believed that this second anomaly marks the surface trace of the General Sherman (Edna) vein, although the vein was not observed at any point along the traverse.

Other anomalies, or apparent anomalies, are observed in the graph of this traverse. Low peaks occur at samples 1, 4-5, and 19. These may indicate small veinlets, or weakly mineralized structures, but it seems more likely that they are only random variations in local background. The high value of the final sample, sample 30, is believed to have resulted from contamination of the surface, but may indicate the location of the vein lying slightly southeast of the Custer vein (Fig. 5).

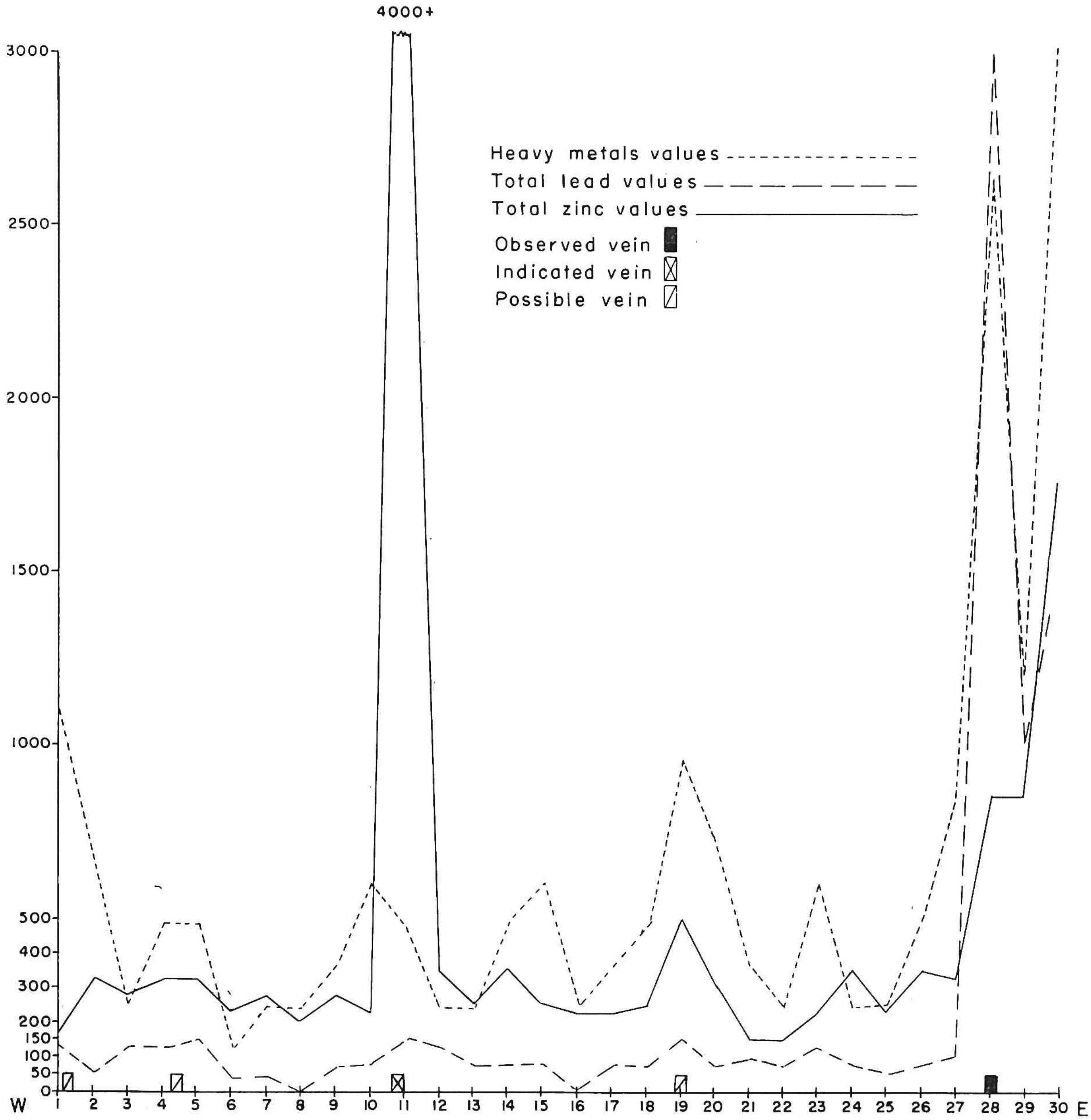

Figure 27.—Traverse 1, Custer vein.

Traverse 2, Custer-Hyantha group: The second sample traverse was started to the east and slightly north of the Hyantha shaft and proceeded westward beyond the Edna vein (see Fig. 5 for location). Sample spacing was again 20 feet. It had been hoped that the first part of the traverse would cross the Hyantha vein, but subsequent study showed that it had been started too far west to accomplish this aim. Nevertheless, the traverse was succesful in that it establishes the location of the Edna vein. Analyses of the samples of Traverse 2 are given in Appendix II, samples T-2-1 through T-2-22, and the traverse is shown graphically in Figure 28.

Examination of Figure 28 shows a strong peak over the observed location of the Edna vein, and diminishing but still high metal values for a considerable distance to the east (downslope) from the vein. This contamination or 'tailing off' of the values obtained downslope from the vein is fairly characteristic of the results of traverse surveys of this type. The reader will note that although sample 1 of the traverse is close to the location of the Hyantha vein, no such abnormal values occur here,

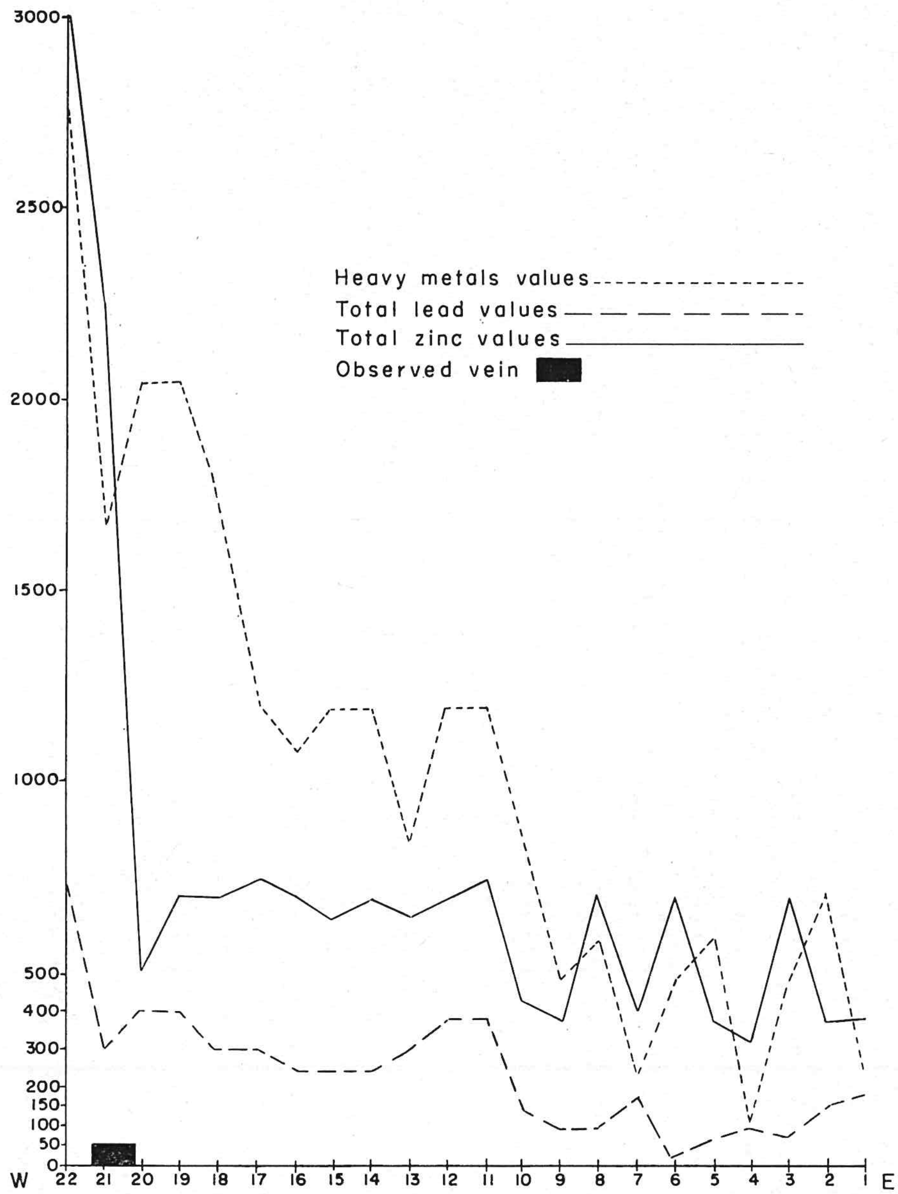

Figure 28.—Traverse 2, Edna vein.

because the sample location is upslope from the vein.

Again, citrate-soluble heavy metal and zinc analyses provide the most clear-cut indication of the location of the Edna vein. This is in accord with the known mineralization in the vein. Presumably, if the Hyantha vein had been crossed by the sample traverse its location would have been marked by a lead anomaly, as this vein is known for its lead content.

Traverses 3 and 4: Traverses 3 and 4 did not prove satisfactory and therefore these traverses have not been graphed. Sample analyses, however, are reported in Appendix II; for Traverse 3, samples T-3-1 through T-3-25, and for Traverse 4, samples T-4-1 through T-4-12.

In Traverse 3 (see Fig. 5 for location), the sample line was established from west to east about 200 feet south of the Martha W. mine. From minor surface pits and trenches, it was assumed that one or more north-striking veins would be crossed along such a traverse. Subsequent investigation suggests that no such veins exist, and that the traverse was, in fact, taken parallel to and upslope from the vein. This is born out by sample analysis results. No anomaly appears in the analyses for lead and zinc, and heavy-metal analysis shows only random variation.

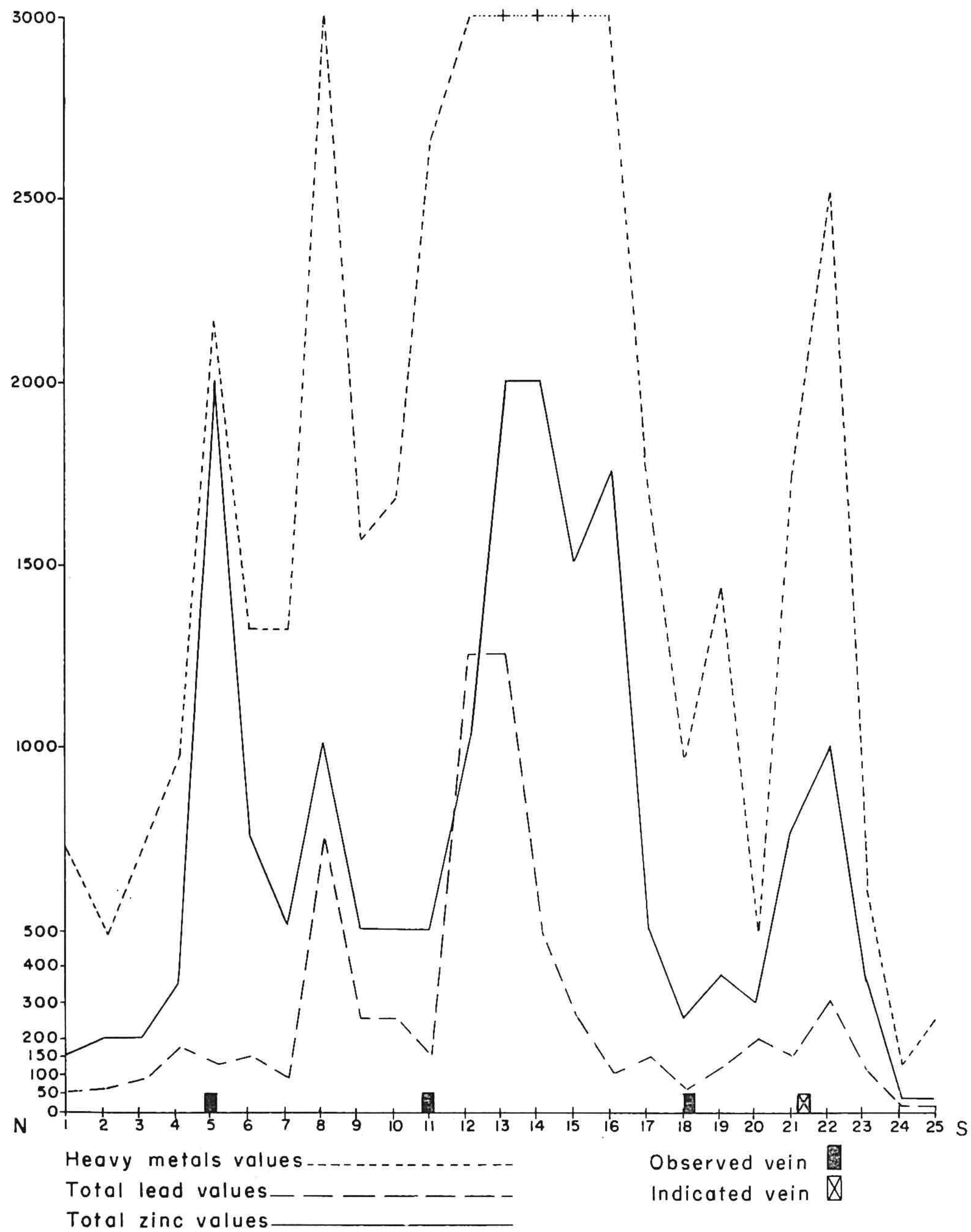

Figure 29.—Traverse 5, Stray Horse veins.

Traverse 4 was taken along a line from north to south below the caved adits of the Maine-Sullivan mine in sec. 14, T. 8 N., R. 1 W. (see Pl. 1 for mine location). No anomaly occurs along this traverse, but the reason for the lack of anomaly is uncertain. The vein is not exposed at surface, and the old mine adits are caved, therefore it was not possible to establish the strike and dip of the vein precisely. It is possible that although the traverse crossed a line that was the extension of a line connecting the two adits, it still failed to cross the vein. This possibility is supported by the fact that the nearby Sunshine vein is of the 'flat vein' type, and such veins are characterized by an irregular surface trace. Another possibility, however, is that the vein was barren, or essentially barren, at the point crossed by the sample line.

Traverse 5, Stray Horse-Little Bonanza group: The traverse made over the Stray Horse - Little Bonanza group veins was in many ways the most ideally located of the sample traverses. It was laid out from north to south (see Fig. 18 for location) along a ridge crossed by three observed veins of the group, and sample location could be correlated accurately to actual vein location. Sample analyses are given in Appendix II, samples T-5-1 through T-5-25, and in graphic form in Figure 29.

One disadvantage of the location derives from the fact that considerable surface work has been done in the area, and this increases the chance of soil contamination. Such contamination may well have produced the broad anomaly between samples 11 and 18, where two distinct peaks would normally have been expected.

Despite possible surface contamination, examination of Figure 29 will show that the sample traverse accomplished its purpose. The Condon vein or split of the Stray Horse vein is shown by a sharp anomaly in both the heavy-metal and zinc analyses. The Stray Horse vein and the south split of that vein are shown by a broad anomaly in both the heavy-metal and zinc analyses, and the main Stray Horse vein is further delineated by a peak in lead analysis.

A fourth vein is indicated 70 to 80 feet south of the southern split of the Stray Horse vein. This anomaly may result from surface contamination, as no vein was observed at this location, but the anomaly is sufficiently sharp that further exploration of this area would be warranted.

Samples along the traverses were collected during the summer of 1962, whereas the surface was not mapped until the next summer. As a result, the presence of the Gena vein 200 feet farther along the line of Traverse 5 was not known until after geochemical work had been completed. Had the presence of this vein been known at the time of sampling, Traverse 5 would have been extended to include this vein.

Traverse 6: Traverse 6, like Traverse 4, failed to indicate the presence of the known vein and therefore no graph of this traverse was prepared. The results of soil sample analyses, however, are given in Appendix II, samples T-6-1 through T-6-11. This traverse was made just above the bulldozer cut across the Lame Deer vein (see Figure 16 for location). Sample interval was 10 feet, and sample 6 of the series was taken directly over the vein. A channel sample, subsequently taken of this vein within a few feet of the soil traverse, partly explains the failure of soil samples to indicate the location of the vein. This sample, number

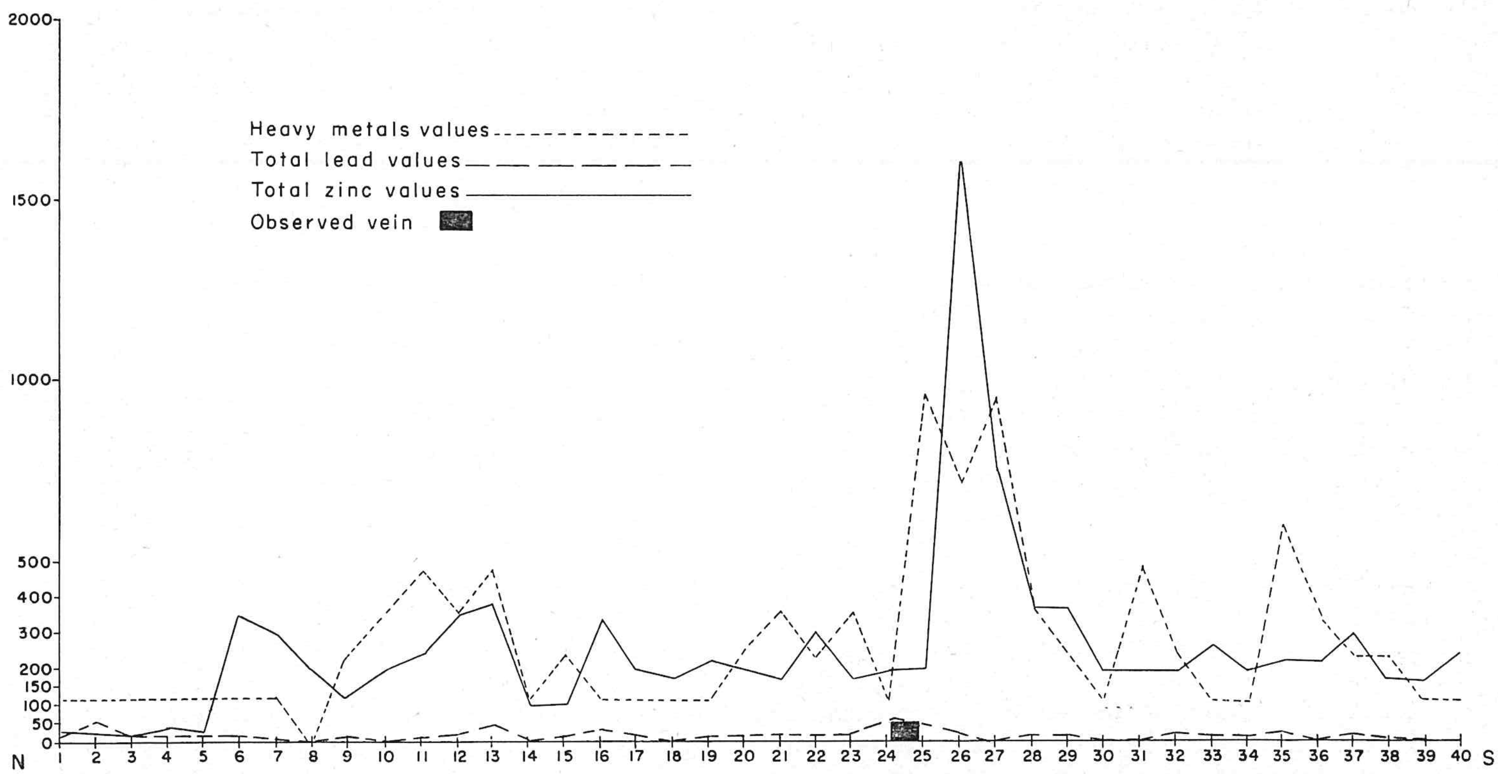

Figure 30.—Traverse 7, Kleinschmidt vein.

74-6 (Appendix IV) was low in gold and silver, and although not assayed for the base metals, seems completely lacking in their minerals.

Traverse 7, Kleinschmidt-Vosburg group: The final line traverse was made from north to south across the Little Olga (Kleinschmidt) vein. Sample analyses are given in Appendix II, samples T-7-1 through T-7-40, and a graphic representation of the traverse is shown in Figure 30. Sample spacing was 20 feet.

The primary function of this traverse was to show the location of the Little Olga vein, and this was accomplished, as the graph, Figure 30, shows a sharp peak in both heavy-metal and zinc values just downslope from the observed location of the vein. Again no clear-cut lead anomaly was obtained, which suggests a reason why lead analysis failed to indicate this mineralized area in the grid survey. The lead minerals that are so abundant in the ores from this vein at depth seemingly do not extend in any appreciable amount to the surface.

Originally it was hoped that by extending the traverse 500 feet north of the known location of the Little Olga vein, the Cynosure vein would also be indicated by this traverse. Subsequent mapping showed that the traverse began at least 100 feet south of that vein, however.

Summary and conclusions: By and large, the soil sample traverses can be said to have been successful. Sample analyses clearly indicated the location of the General Sherman, Custer, Edna, Condon, Stray Horse, Stray Horse South, and Little Olga veins.

The failure of the procedure to detect the Maine-Sullivan and Lame Deer veins cannot be ignored in an overall appraisal of the program, however, particularly because there can be no question that sampling did actually cross the outcrop of the Lame Deer vein. Of course, the low grade of this vein and the lack of base metals provide an adequate excuse for this failure, but nevertheless, if the method were perfect there should be no failure. No exploration procedure yet devised is perfect, however, and this is true of geochemical prospecting. It must be recognized, then, that under certain adverse conditions, soil sampling will not adequately indicate vein structures. The closely spaced soil-sample procedure is still a worthwhile method of prospecting in this or any other district of the same general type.

TIME AND COST ANALYSIS FOR GEOCHEMICAL SURVEYS

Persons interested in geochemical prospecting might be interested in the following data on the costs incurred and man hours spent in conducting a geochemical survey. It must be realized that cost per sample or per analysis and time spent in sample collection and sample analysis will vary considerably, depending upon the size of the program attempted, the terrain, and the experience and efficiency of the personnel involved. Nevertheless, the data that follow should prove valuable as an approximation of the cost that would be incurred on similar projects.

In the Winston district project, 381 samples were taken, and 1,414 separate analyses were made of these samples, including the three analyses regularly made on each sample plus 271 additional analyses. The additional analyses were routine repeat analysis of samples to check upon the accuracy of result, repeat analysis of samples where results of analysis obtained appeared abnormal, and all preliminary analyses necessary to provide standards of comparison.

Collection of samples required 184 man hours, or an average of 29 minutes per sample. Collecting the original samples at ½-mile intervals, however, required more travel between sample sites, hence a further time breakdown provides more useful information. Separating sampling in this way shows that the samples taken on the ½-mile grid averaged 41 minutes per sample, whereas the total time spent retaking a few ½-miles samples, plus taking ¼-mile samples and all line traverse samples averaged 19 minutes per sample.

While performing analyses on the samples, Bureau analyst D. C. Lawson averaged 80 analyses per 8-hour day. This averages 5 minutes per analysis or 19 minutes per sample.

Chemical reagents used came to 3-1/3 cents per analysis. This figure is somewhat misleading, however, because credit was given for reagent that was not used. If cost is recalculated to include the minimum quantity of reagent that can be purchased, and assuming that unused reagents would be discarded, cost per analysis would be slightly more than 5 cents. This corresponds to about 19 cents per sample.

Requirements for laboratory glassware will vary with the individual, and whether he will put up with a certain amount of inconvenience and therefore expend more time, or if he desires a well-equipped laboratory. In any event, an average cost for the present survey is about 5½ cents per analysis, or 21 cents per sample. Again this figure is somewhat misleading; barring breakage, the laboratory ware is just as good after use as it was before and is available for other projects.

Major items of laboratory equipment are by far the largest item of expense and, again, cannot properly be charged off on a per sample basis. These would include an analytical balance, a still and demineralizer to provide necessary metal-free water, a suitable heavy-duty hotplate, and a burner or heat source for fusion of samples. Total cost of these items would be approximately $700.00. The major cost item here is the analytical balance, and the prospector with a small budget could probably get necessary weighing of reagents done at a nearby laboratory or pharmacy at reasonable cost, thus saving most of this expense. It is also possible to purchase suitable distilled and demineralized water, provided that the quantity needed is sufficiently small to make this practical. Therefore, absolutely necessary expense could be reduced to 50 or 60 dollars.

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Appendix I

PRODUCTION OF METALS—WINSTON MINING DISTRICT

Year	Ore, tons	Gold, oz.	Silver, oz.	Copper, lb.	Lead, lb.	Zinc, lb.	Value	Major producers	Other producers
1889	....	....	....	....	....	....	....	Mines of the East Pacific, Kleinschmidt,	
1906	20,000*	65,000*	950,000*	....	4,000,000*	....	$2,000,000***	and Iron Age groups were active.	
1907	857	90*	8,394*	6,600*	94,756*	....	12,475*	Custer, East Pac.	
1908	976	1,306	19,314	7,056	108,191	....	44,384*	Little Olga, East Pacific	Little Bonanza, Edna, Iron Age, Eclipse
1909	546	929	8,721	3,017	44,695	....	25,425	East Pacific, Edna, Iron Age	Hard Cash, Triumph, Winston Miner
1910	534	769	13,568	2,353	120,322	....	28,315	East Pacific	No detailed record
1911	2,954	5,311	10,853	4,035	100,936	....	117,027	East Pacific, Cynosure	Iron Age, Black Friday, Martha W.
1912	888	1,599	5,453	1,097	27,778	....	36,759	Iron Age, Martha W.	East Pacific, Cynosure, Mary V, New York
1913	480	693	4,296	2,282	47,063	....	18,879	Iron Age, Custer	East Pacific, Cynosure, Mary V, Eclipse, Martha W.
1914	117	156	2,591	....	28,254	....	5,714	East Pacific, Custer	Mary V, Red Buck, Molly
1915	233	210	3,322	1,143	19,418	....	7,507	East Pacific, Little Olga	Joe Dandy, Gold Bug, Edna, Noon
1916	....	....	....	....	....	....	....	Development work and minor shipments.	
1917	1,027	496	10,168	554	269,556	15,363	43,208	Hyantha	Little Olga, Mary V, Joe Dandy
1918	74	151	1,459	....	10,198	....	5,206		Hyantha, Chance, Little Olga, Little Bonanza
1919	....	....	....	....	....	....	....	No production of record.	
1920	....	....	....	....	....	....	....	No production of record.	
1921	....	....	....	....	....	....	....	Small lots from Alice, New York, Iron Age.	
1922	....	....	....	....	....	....	....	One small lot from Edna.	
1923	....	....	....	....	....	....	....	Small lots from Little Olga and Quartette.	
1924	111	15	8,821	571	71,014	....	11,967	Little Olga, January	
1925	41	20	2,438	288	19,146	....	3,796	Little Olga	Hyantha, Little One
1926	316	166	15,585	2,992	158,769	....	26,160	Little Olga, East Pacific	Hyantha, Hot Cake, Satellite, Sunshine
1927	1,672	554	45,838	15,266	574,148	....	75,237	East Pacific, Little Olga	Quartette, Sunshine, Satellite
1928	2,917	120	22,392	3,500	225,784	4,620	29,377	Little Olga	Quartette, January

Appendix I—(Continued)

PRODUCTION OF METALS—WINSTON MINING DISTRICT

Year	Ore, tons	Gold, oz.	Silver, oz.	Copper, lb.	Lead, lb.	Zinc, lb.	Value	Major producers	Other producers
1929	225	53	3,213	1,781	45,606	65,965	10,321	East Pacific, Little Olga	Quartette, January, Gold Bug
1930	117	115	4,340	604	38,152	....	5,952	Custer, Iron Age	Midas, Black Tail, January, Quartette, Little Olga
1931	3,004	132	6,585	2,950	127,906	73,800	20,352	January	Iron Age, Custer, Midas, Joe Dandy, Martha W., etc.
1932	1,527	685	13,358	1,270	103,567	....	30,935	Not specified.	
1933	682	470	5,223	875	47,243	....	13,355	Mountain View, Vosburg, Tramway	Custer, Midas, Grey Rock, Sunshine, East Pac., Stray Horse, Martha W., etc.
1934	1,998	996	7,951	1,500	56,757	....	42,181	Mary V, Tramway	Custer, Iron Age, Marion, Pocahontus, January
1935	17,214	3,727	28,583	1,795	105,650	14,068	155,981	Vosburg	No others of record.
1936	7,851	1,686	11,623	1,152	51,739	....	70,519	Vosburg	No others of record.
1937	9,168	918	5,563	2,000	58,000	....	40,097	Custer	East Pac., Edna, Sullivan, Joe Dandy, Stray Horse, etc.
1938	10,106	2,289	12,952	1,786	110,131	....	93,729	Custer	Aqua Frio, Edna, Iron Age, Sullivan, Vosburg, Martha W., Stray Horse, Black Tail
1939	15,979	2,891	10,112	7,779	116,936	....	114,354	Custer	East Pac., Iron A., Martha W., Edna, Midas, Mystery, Stray Horse, Vosburg, Black Tail
1940	14,516	2,284	10,506	4,168	127,000	....	94,232	Custer	East Pac., Iron A., Edna, Midas, Vosburg
1941	2,957	2,859	34,117	14,000	465,400	....	152,506	East Pacific	Iron A., Custer, January, Kleinschmidt, Native Gold
1942	2,684	1,417	30,091	22,700	467,600	165,600	120,470	East Pacific, Vosburg	Custer, Iron Age, Martha W., Edna No. 2
1943	1,856	864	36,706	27,000	581,000	157,500	120,437	East Pacific, Vosburg	Custer, Silver King, Edna No. 2
1944	3,799	419	19,440	10,400	341,800	85,000	66,927	East Pacific	Vosburg, Edna No. 2, Native Silver, Joe Dandy, January
1945	6,813	395	9,225	3,600	133,000	87,000	42,314	East Pacific, January	Aurora, Edna No. 2, Vosburg, Viola, Joe Dandy, Martha

Appendix I—(Continued)
PRODUCTION OF METALS—WINSTON MINING DISTRICT

Year	Ore, tons	Gold, oz.	Silver, oz.	Copper, lb.	Lead, lb.	Zinc, lb.	Value	Major producers	Other producers
1946	4,190	660	18,734	16,500	299,000	350,500	116,262	East Pacific	Custer, Edna No. 2, Joe Dandy, Martha W., Vosburg, Lame Deer
1947	887	363	11,305	3,300	215,300	61,000	62,013	East Pacific, Little Bonanza	Custer
1948	2,195	486	10,848	3,800	186,800	51,300	67,913	East Pacific	Little Bonanza
1949	2,042	170	4,707	800	83,400	35,200	27,910	East Pacific, Kleinschmidt	
1950	1,023	192	1,496	400	25,200	6,300	12,454	East Pacific	
1951	379	162	568	....	6,000	5,000	8,132	Not specified	
1952	527	358	9,364	3,497	160,000	7,120	48,793	January	Edna, Dome
1953	824	470	14,341	7,300	215,000	86,000	69,579	January	Edna, Edna No. 2, Point, Dome, North Star
1954	958	710	19,413	5,400	334,600	54,400	95,646**	January	Edna, Edna No. 2, Little Bonanza, Martha W.
1955	1,000*	833*	5,800*	....	83,800*	26,100*	50,490*	January	Custer, Edna No. 2, Little Bonanza, Silver Saddle
1956	181	120*	476*	....	17,500*	5,300*	8,148*		January, Silver Saddle, North Star, Stray Horse, Lonesome Pine, Acme
1957	587	47	3,934	1,700	67,400	30,200	18,858	Kleinschmidt	
1958	....	....	....	....	....	....	....	Some very minor production.	
1959	....	....	....	....	....	....	....		
1960	....	....	....	....	....	....	....		
1961	....	....	....	....	....	....	....		
1962	....	....	....	....	....	....	....	Development work at Sunrise and 1962 Lode.	
1963	....	....	....	....	....	....	....	Development work at 1962 Lode.	
Total	149,032	104,356	1,483,787	198,811	10,662,915	1,387,336	$4,272,296		

* Author's estimate, based on available data.

** Available data includes minor production from Backer district.

*** Total value of early production estimated by Pardee and Schrader, 1933.

APPENDIX II

TABLE OF GEOCHEMICAL ANALYSIS VALUES

Sample no.	Location	Heavy metal	Zinc ppm	Lead ppm
S-1	NE cor. sec. 6, T8N, R1E	4	300	25
S-2	Center N. side sec. 6, T8N, R1E	6	100	5
S-3	NE cor. sec. 1, T8N, R1W	10	150	50
S-4	Center N. side sec. 1, T8N, R1W	7	100	25
S-5	NE cor. sec. 2, T8N, R1W	10	150	70
S-6	Center N. side sec. 2, T8N, R1W	14	100	25
S-7	NE cor. sec. 3, T8N, R1W	2	50	25
S-8	Center N. side sec. 3, T8N, R1W	8	100	50
S-9	NE cor. sec. 4, T8N, R1W	3	100	25
S-10	Center N. side sec. 4, T8N, R1W	8	150	25
S-11	NW cor. sec. 4, T8N, R1W	7	100	25
S-12	Center W. side sec. 4, T8N, R1W	4	500	0
S-13	Center sec. 4, T8N, R1W	6	100	25
S-14	Center W. side, sec. 3, T8N, R1W	5	100	50
S-15	Center sec. 3, T8N, R1W	1	50	5
S-16	Center W. side sec. 2, T8N, R1W	24	100	5
S-17	Center sec. 2, T8N, R1W	7	100	0
S-18	Center W. side sec. 1, T8N, R1W	2	100	0
S-19	Center sec. 1, T8N, R1W	5	150	20
S-20	Center W. side sec. 6, T8N, R1E	8	200	75
S-21	Center sec. 6, T8N, R1E	2	100	25
S-22	Center E. side sec. 6, T8N, R1E	3	100	25
S-23	NE cor. sec. 7, T8N, R1E	3	100	25
S-24	Center N. side sec. 7, T8N, R1E	2	100	25
S-25	NE cor. sec. 12, T8N, R1W	3	100	25
S-26	Center N. side sec. 12, T8N, R1W	3	100	5
S-27	NE cor. sec. 11, T8N, R1W	2	100	5
S-28	Center N. side sec. 11, T8N, R1W	2	100	5
S-29	NE cor. sec. 10, T8N, R1W	1	100	5
S-30	Center N. side sec. 10, T8N, R1W		(Sample lost)	
S-31	NE cor. sec. 9, T8N, R1W	3	100	25
S-32	Center N. side sec. 9, T8N, R1W	3	50	5
S-33	NW cor. sec. 9, T8N, R1W	6	50	5
S-34	Center W. side sec. 9, T8N, R1W	6	100	25
S-35	Center sec. 9, T8N, R1W	4	100	5
S-36	Center W. side, sec. 10, T8N, R1W	5	100	25
S-37	Center sec. 10, T8N, R1W	2	100	5
S-38	Center W. side sec. 11, T8N, R1W	2	100	5
S-39	Center sec. 11, T8N, R1W	3	100	0
S-40	Center W. side sec. 12, T8N, R1W	5	150	50
S-41	Center sec. 12, T8N, R1W	8	150	50
S-41A	Center sec. 12, T8N, R1W	11	300	50
S-42	Center W. side sec. 7, T8N, R1E	5	150	75
S-43	Center sec. 7, T8N, R1E	5	100	25
S-44	Center E. side sec. 7, T8N, R1E	5	100	25
S-45	NE cor. sec. 18, T8N, R1E	8	150	25
S-46	Center N. side sec. 18, T8N, R1E	6	150	25
S-47	NE cor. sec. 13, T8N, R1W	9	150	125
S-47A	NE cor. sec. 13, T8N, R1W	12	150	50

APPENDIX II—(Continued)

TABLE OF GEOCHEMICAL ANALYSIS VALUES

Sample no.	Location	Heavy metal	Zinc ppm	Lead ppm
S-48	Center N. side sec. 13, T8N, R1W	4	100	25
S-49	NE cor. sec. 14, T8N, R1W	4	100	100
S-50	Center N. side sec. 14, T8N, R1W	3	100	25
S-51	NE cor. sec. 15, T8N, R1W	2	100	50
S-52	Center N. side sec. 15, T8N, R1W	2	50	5
S-53	NE cor. sec. 16, T8N, R1W	1	50	0
S-54	Center N. side sec. 16, T8N, R1W	7	150	5
S-55	NW cor. sec. 16, T8N, R1W	12	150	5
S-56	Center W. side sec. 16, T8N, R1W	4	50	25
S-57	Center sec. 16, T8N, R1W	4	50	25
S-58	Center W. side sec. 15, T8N, R1W	1	50	5
S-59	Center sec. 15, T8N, R1W	2	50	5
S-60	Center W. side sec. 14, T8N, R1W	11	200	125
S-61	Center sec. 14, T8N, R1W	3	100	25
S-62	Center W. side sec. 13, T8N, R1W	4	150	50
S-63	Center sec. 13, T8N, R1W	4	150	25
S-63A	Center sec. 13, T8N, R1W	1	100	5
S-64	Center W. side sec. 18, T8N, R1E	4	150	75
S-64A	Center W. side sec 18, T8N, R1E	28	250	125
S-65	Center sec. 18, T8N, R1E	1	150	25
S-66	Center E. side sec. 18, T8N, R1E	6	175	100
S-67	NE cor. sec. 19, T8N, R1E	1	100	0
S-68	Center N. side sec. 19, T8N, R1E	1	150	50
S-69	NE cor. sec. 24, T8N, R1W	2	175	50
S-69A	NE cor. sec. 24, T8N, R1W	2	100	50
S-70	Center N. side sec. 24, T8N, R1W	3	150	75
S-70A	Center N. side sec. 24, T8N, R1W	1	150	25
S-71	NE cor. sec. 23, T8N, R1W	1	175	25
S-72	Center N. side sec. 23, T8N, R1W	2	50	0
S-73	NE cor. sec. 22, T8N, R1W	3	50	25
S-74	Center N. side sec. 22, T8N, R1W	3	50	5
S-75	NE cor. sec. 21, T8N, R1W	4	50	75
S-76	Center N. side sec. 21, T8N, R1W	4	100	0
S-77	NW cor. sec. 21, T8N, R1W	tr	100	25
S-78	Center W. side sec. 21, T8N, R1W	2	50	0
S-79	Center sec. 21, T8N, R1W	4	100	0
S-80	Center W. side sec. 22, T8N, R1W	2	50	0
S-81	Center sec. 22, T8N, R1W	tr	50	0
S-82	Center W. side sec. 23, T8N, R1W	8	100	25
S-83	Center sec. 23, T8N, R1W	3	100	0
S-84	Center W. side sec. 24, T8N, R1W	2	75	25
S-85	Center sec. 24, T8N, R1W	4	150	25
S-86	Center W. side sec. 19, T8N, R1E	4	50	25
S-87	Center sec. 19, T8N, R1E	tr	50	0
S-88	Center E. side sec. 19, T8N, R1E	tr	50	0
S-89	NE cor. sec. 30, T8N, R1E	1	75	0
S-90	Center E. side sec. 30, T8N, R1E	1	75	25
S-91	NE cor. sec. 31, T8N, R1E	1	50	0
S-92	Center E. side sec. 31, T8N, R1E	tr	75	0

APPENDIX II—(Continued)

TABLE OF GEOCHEMICAL ANALYSIS VALUES

Sample no.	Location	Heavy metal	Zinc ppm	Lead ppm
S-93	NE cor. sec. 6, T7N, R1E	1	100	0
S-94	Center E. side sec. 6, T7N, R1E	2	50	0
S-95	SE cor. sec. 6, T7N, R1E	2	100	0
S-96	Center S. side sec. 6, T7N, R1E	tr	100	0
S-97	Center sec. 6, T7N, R1E	tr	75	25
S-98	Center N. side sec. 6, T7N, R1E	2	75	50
S-99	Center sec. 31, T8N, R1E	tr	50	25
S-100	Center N. side sec. 31, T8N, R1E	tr	75	25
S-101	Center sec. 30, T8N, R1E	tr	50	25
S-102	Center N. side sec. 30, T8N, R1E	2	75	75
S-103	NE cor. sec. 25, T8N, R1W	6	175	50
S-103A	NE cor. sec. 25, T8N, R1W	3	100	25
S-104	Center E. side sec. 25, T8N, R1W	tr	75	25
S-105	NE cor. sec. 36, T8N, R1W	2	100	25
S-106	Center E. side sec. 36, T8N, R1W	1	100	25
S-107	NE cor. sec. 1, T7N, R1W	tr	100	25
S-108	Center E. side sec. 1, T7N, R1W	tr	75	5
S-109	SE cor. sec. 1, T7N, R1W	tr	75	25
S-110	Center S. side sec. 1, T7N, R1W	tr	50	5
S-111	SE cor. sec. 2, T7N, R1W	tr	75	50
S-112	Center S. side sec. 2, T7N, R1W	2	50	5
S-113	SE cor. sec. 3, T7N, R1W	tr	50	0
S-114	Center S. side sec. 3, T7N, R1W	1	50	5
S-115	SE cor. sec. 4, T7N, R1W	2	150	0
S-116	Center S. side sec. 4, T7N, R1W	2	50	5
S-117	SW cor. sec. 4, T7N, R1W	tr	150	5
S-118	Center W. side sec. 4, T7N, R1W	1	50	5
S-118A	Center W. side sec. 4, T7N, R1W	1	100	5
S-119	NE cor. sec. 4, T7N, R1W	14	100	5
S-119A	NE cor. sec. 4, T7N, R1W	1	150	13
S-120	Center W. side sec. 33, T8N, R1W	6	175	25
S-120A	Center W. side sec. 33, T8N, R1W	1	150	13
S-121	NE cor. sec. 33, T8N, R1W	13	250	5
S-122	Center W. side sec. 28, T8N, R1W	2	100	0
S-123	NE cor. sec. 28, T8N, R1W	8	75	25
S-124	Center N. side sec. 28, T8N, R1W	3	50	0
S-125	NE cor. sec. 28, T8N, R1W	2	50	13
S-126	Center N. side sec. 27, T8N, R1W	2	100	0
S-127	NE cor. sec. 27, T8N, R1W	3	50	5
S-128	Center N. side sec. 26, T8N, R1W	2	50	0
S-129	NE cor. sec. 26, T8N, R1W	2	50	0
S-130	Center N. side sec. 25, T8N, R1W	2	100	13
S-131	Center sec. 25, T8N, R1W	4	50	13
S-132	Center N. side sec. 36, T8N, R1W	7	150	0
S-133	Center sec. 36, T8N, R1W	2	200	0
S-134	Center N. side sec. 1, T7N, R1W	2	50	0
S-135	Center sec. 1, T7N, R1W	2	100	25
S-136	Center W. side sec. 1, T7N, R1W	3	300	25
S-137	Center sec. 2, T7N, R1W	2	100	0

APPENDIX II—(Continued)

TABLE OF GEOCHEMICAL ANALYSIS VALUES

Sample no.	Location	Heavy metal	Zinc ppm	Lead ppm
S-138	Center W. side sec. 2, T7N, R1W	1	50	13
S-139	Center sec. 3, T7N, R1W	4	300	13
S-140	Center W. side sec. 4, T7N, R1W	2	150	13
S-141	Center sec. 4, T7N, R1W	2	75	13
S-142	Center N. side sec. 4, T7N, R1W	2	50	13
S-143	Center sec. 33, T8N, R1W	6	75	13
S-144	Center sec. 28, T8N, R1W	6	50	13
S-145	Center W. side sec. 28, T8N, R1W	2	75	0
S-146	Center sec. 27, T8N, R1W	1	50	25
S-147	Center W. side sec. 27, T8N, R1W	1	75	25
S-148	Center sec. 26, T8N, R1W	3	50	0
S-149	Center W. side sec. 26, T8N, R1W	2	25	35
S-150	NE cor. sec. 35, T8N, R1W	3	50	13
S-151	Center W. side sec. 35, T8N, R1W	6	75	25
S-152	NE cor. sec. 2, T7N, R1W	1	75	13
S-153	Center N. side sec. 2, T7N, R1W	1	25	13
S-154	NE cor. sec. 3, T7N, R1W	2	25	25
S-155	Center N. side sec. 3, T7N, R1W	4	75	13
S-156	NE cor. sec. 4, T7N, R1W	4	75	35
S-157	Center W. side sec. 34, T8N, R1W	1	50	13
S-158	Center sec. 34, T8N, R1W	2	25	13
S-159	Center W. side sec. 35, T8N, R1W	1	50	25
S-160	Center sec. 35, T8N, R1W	12	75	175
S-161	Center N. side sec. 35, T8N, R1W	2	50	13
S-162	NE cor. sec. 34, T8N, R1W	3	50	25
S-163	Center N. side sec. 34, T8N, R1W	2	50	25
S-164	NE cor. sec. 33, T8N, R1W	8	75	35
S-165	Center N. side sec. 33, T8N, R1W	1	50	13
S-166	Center N. side SE¼ sec. 12, T8N, R1W	2	150	13
S-167	Center N. side SE¼ sec. 13, T8N, R1W	1	150	5
S-168	Center N. side SW¼ sec. 13, T8N, R1W	2	75	13
S-169	Center N. side SW¼ sec. 18, T8N, R1E	10	100	5
S-170	Center W. side SE¼ sec. 13, T8N, R1W	1	100	25
S-171	Center SE¼ sec. 13, T8N, R1W	17	50	5
S-172	Center W. side SE¼ sec. 13, T8N, R1W	15	150	75
S-173	Center N. side NE¼ sec. 24, T8N, R1W	1	50	50
S-174	Center N. side NE¼ sec. 24, T8N, R1W	1	200	25
S-175	Center NE¼ sec. 24, T8N, R1W	1	50	5
S-176	Center N. side NW¼ sec. T8N, R1E	9	50	40
S-177	Center N. side NE¼ sec. 13, T8N, R1W	6	50	13
S-178	Center E. side SE¼ sec. 12, T8N, R1W	7	75	13
S-179	Center SE¼ sec. 12, T8N, R1W	4	300	25
S-180	Center W. side SE¼ sec. 12, T8N, R1W	4	175	25
S-181	Center SW¼ sec. 12, T8N, R1W	2	125	13
S-182	Center N. side SW¼ sec. 12, T8N, R1W	7	150	25
S-183	Center SW¼ sec. 19, T8N, R1E	3	125	25
S-184	Center N. side NE¼ sec. 25, T8N, R1W	7	150	25
S-185	Center N. side NW¼ sec. 23, T8N, R1W	4	175	50
S-186	Center NW¼ sec. 23, T8N, R1W	7	150	75

APPENDIX II—(Continued)

TABLE OF GEOCHEMICAL ANALYSIS VALUES

Sample no.	Location	Heavy metal	Zinc ppm	Lead ppm
S-187	Center N. side SW¼ sec. 23, T8N, R1W	8	150	25
S-188	Center W. side NW¼ sec. 23, T8N, R1W	1	150	13
S-189	Center NW¼ sec. 26, T8N, R1W	1	275	13
S-190	Center N. side SW¼ sec. 26, T8N, R1W	1	150	75
S-191	Center SW¼ sec. 26, T8N, R1W	9	250	75
S-192	Center N. side NW¼ sec. 35, T8N, R1W	12	150	25
S-193	Center N. side SW¼ sec. 35, T8N, R1W	8	150	25
S-194	Center E. side SW¼ sec. 35, T8N, R1W	4	100	13
S-195	Center SW¼ sec. 35, T8N, R1W	6	800	125
S-196	Center N. side NW¼ sec. 2, T7N, R1W	1	750	600
S-197	Center E. side SW¼ sec. 4, T7N, R1W	4	700	75
S-198	Center SW¼ sec. 4, T7N, R1W	1	300	50
S-199	Center W. side SW¼ sec. 4, T7N, R1W	1	125	13
S-200	Center W. side NW¼ sec. 4, T7N, R1W	1	200	50
S-201	Center W. side SW¼ sec. 33, T8N, R1W	1	2000	25
S-202	Center N. side SW¼ sec. 33, T8N, R1W	6	225	0
S-203	Center SW¼ sec. 33, T8N, R1W	1	150	13
S-204	Center N. side NW¼ sec. 4, T7N, R1W	3	125	13
S-205	Center NW¼ sec. 4, T7N, R1W	1	150	0
S-206	Center N. side SW¼ sec. 4, T7N, R1W	1	350	75
T-1-1	Traverse across Custer vein from	9	150	125
T-1-2	west to east in sec. 13, T8N, R1W	6	325	50
T-1-3	"	2	275	125
T-1-4	"	4	325	125
T-1-5	"	4	325	150
T-1-6	"	1	225	25
T-1-7	"	2	275	40
T-1-8	"	2	200	0
T-1-9	"	3	275	65
T-1-10	"	5	275	75
T-1-11	"	4	4000	150
T-1-12	"	2	350	125
T-1-13	"	2	250	75
T-1-14	"	4	350	75
T-1-15	"	5	250	75
T-1-16	"	2	225	0
T-1-17	"	3	225	75
T-1-18	"	4	250	75
T-1-19	"	8	500	150
T-1-20	"	6	300	75
T-1-21	"	3	150	100
T-1-22	"	2	150	75
T-1-23	"	5	225	125
T-1-24	"	2	350	75
T-1-25	"	2	225	50
T-1-26	"	4	350	75
T-1-27	"	7	325	100
T-1-28	"	22	850	3000

APPENDIX II—(Continued)

TABLE OF GEOCHEMICAL ANALYSIS VALUES

Sample no.	Location	Heavy metal	Zinc ppm	Lead ppm
T-1-29	Traverse across Custer vein from	10	850	1000
T-1-30	west to east in sec. 13, T8N, R1W	25	1750	1500
T-2-1	Traverse across Edna vein from	2	375	175
T-2-2	east to west in sec. 13, T8N, R1W	6	375	150
T-2-3	"	4	700	75
T-2-4	"	1	325	100
T-2-5	"	5	375	75
T-2-6	"	4	700	25
T-2-7	"	2	400	175
T-2-8	"	5	700	100
T-2-9	"	4	375	100
T-2-10	"	7	425	150
T-2-11	"	10	750	375
T-2-12	"	10	700	375
T-2-13	"	7	650	300
T-2-14	"	10	700	250
T-2-15	"	10	650	250
T-2-16	"	9	700	250
T-2-17	"	10	750	300
T-2-18	"	15	700	300
T-2-19	"	17	700	400
T-2-20	"	17	500	400
T-2-21	"	14	2250	300
T-2-22	"	23	3000	750
T-3-1	Traverse south of Martha W. and	4	300	5
T-3-2	Aurora veins west to east in	8	225	25
T-3-3	sec. 13, T8N, R1W	4	225	5
T-3-4	"	1	225	25
T-3-5	"	3	225	25
T-3-6	"	5	200	13
T-3-7	"	2	125	13
T-3-8	"	1	100	5
T-3-9	"	4	175	5
T-3-10	"	1	150	13
T-3-11	"	7	125	25
T-3-12	"	2	100	13
T-3-13	"	2	125	5
T-3-14	"	2	100	5
T-3-15	"	1	175	5
T-3-16	"	1	125	5
T-3-17	"	1	100	5
T-3-18	"	1	125	5
T-3-19	"	1	150	5
T-3-20	"	2	175	13
T-3-21	"	1	150	13
T-3-22	"	1	150	25

APPENDIX II—(Continued)

TABLE OF GEOCHEMICAL ANALYSIS VALUES

Sample no.	Location	Heavy metal	Zinc ppm	Lead ppm
T-3-23	Traverse south of Martha W. and	2	125	5
T-3-24	Aurora veins west to east in	8	150	13
T-3-25	sec. 13, T8N, R1W	6	125	13
T-4-1	Traverse across Maine-Sullivan vein	4	75	25
T-4-2	from north to south in sec. 14, T8N, R1W	6	75	13
T-4-3	"	1	75	13
T-4-4	"	2	75	5
T-4-5	"	1	100	5
T-4-6	"	1	125	5
T-4-7	"	5	125	5
T-4-8	"	1	125	5
T-4-9	"	1	125	0
T-4-10	"	4	125	5
T-4-11	"	3	125	5
T-4-12	"	1	125	13
T-5-1	Traverse across Stray Horse vein	6	150	50
T-5-2	from north to south in sec. 35, T8N, R1W	4	200	60
T-5-3	"	6	200	80
T-5-4	"	8	350	175
T-5-5	"	18	2000	125
T-5-6	"	11	750	150
T-5-7	"	11	500	85
T-5-8	"	25+	1000	750
T-5-9	"	13	500	250
T-5-10	"	14	500	250
T-5-11	"	22	500	150
T-5-12	"	25+	1000	1250
T-5-13	"	25+	2000	1250
T-5-14	"	25+	2000	500
T-5-15	"	25	1500	250
T-5-16	"	25	1750	100
T-5-17	"	14	500	150
T-5-18	"	8	250	50
T-5-19	"	12	375	125
T-5-20	"	4	300	200
T-5-21	"	14	750	150
T-5-22	"	21	1000	300
T-5-23	"	5	350	110
T-5-24	"	1	35	13
T-5-25	"	2	35	13
T-6-1	Traverse across Lame Deer vein	1	25	50
T-6-2	from north to south in sec. 34, T8N, R1W	2	50	25
T-6-3	"	4	150	13
T-6-4	"	1	60	25
T-6-5	"	1	60	13
T-6-6	"	3	175	85

APPENDIX II—(Continued)

TABLE OF GEOCHEMICAL ANALYSIS VALUES

Sample no.	Location	Heavy metal	Zinc ppm	Lead ppm
T-6-7	Traverse across Lame Deer vein	2	60	25
T-6-8	from north to south in sec. 34, T8N, R1W	3	175	100
T-6-9	"	3	200	60
T-6-10	"	4	200	50
T-6-11	"	4	25	40
T-7-1	Traverse across Kleinschmidt-Vosburg	1	25	13
T-7-2	vein from north to south in sec. 3,	1	25	60
T-7-3	T7N, R1W.	1	13	13
T-7-4	"	1	40	13
T-7-5	"	1	25	13
T-7-6	"	1	350	13
T-7-7	"	1	300	5
T-7-8	"	0	200	0
T-7-9	"	2	125	13
T-7-10	"	3	200	0
T-7-11	"	4	250	5
T-7-12	"	3	350	25
T-7-13	"	4	375	50
T-7-14	"	1	100	5
T-7-15	"	2	100	13
T-7-16	"	1	350	14
T-7-17	"	1	200	25
T-7-18	"	1	175	0
T-7-19	"	1	225	13
T-7-20	"	2	200	13
T-7-21	"	3	175	13
T-7-22	"	2	300	13
T-7-23	"	3	175	25
T-7-24	"	1	200	60
T-7-25	"	8	200	15
T-7-26	"	6	1600	13
T-7-27	"	8	750	0
T-7-28	"	3	375	5
T-7-29	"	2	375	5
T-7-30	"	1	200	0
T-7-31	"	4	200	0
T-7-32	"	2	200	25
T-7-33	"	1	275	13
T-7-34	"	1	200	13
T-7-35	"	5	225	25
T-7-36	"	3	225	5
T-7-37	"	2	300	13
T-7-38	"	2	175	5
T-7-39	"	1	175	0
T-7-40	"	1	250	0

APPENDIX III

LIST OF PATENTED MINING CLAIMS

Winston Mining District

Listed numerically by survey number

Survey no.	Name	Survey no.	Name	Survey no.	Name
1016-1	Eclipse Mill Site	4745	Star of the West	9038-1	Neptun
1016-2	Eclipse	4761	Little Bonanza Ext.	9038-2	Green Mountain
1017	Iron Age	4823	Stray Horse	9038-3	Silver Smith
1018-1	Aurora Mill Site	4836	Richmond	9038-4	Washington
1018-2	Aurora	4866	January	9038-5	Bell Abraham
1158	Aqua Frio	4931	February	9038-6	Gold Hill
1159	General Custer	4932	March	9038-7	Homestead
1701-A	East Pacific	4933	April	9337	Orphan Boy
1701-B	East Pacific M.S.	5041	Allie	9406	Security
2743	R. J. Ingersoll	5042	M.E.P.	9408-1	Transvaal
2745	Buckeye	5089	Alliance	9408-2	Kruger
2746	Joe Dandy	5231	Point	9408-3	Kruger Fraction
2747	General Sherman	5383	Big Casino	10178	Iron Age Mill Site
3134	East Pacific No. 2	5384	Little Casino	10225-1	Last Chance
3135	Blenheim	5495	Maine	10225-2	Maury
3136	John L.	6081	Stolen Sweets	10226-1	Robert
3137	Winston	6592	Winchester	10226-2	Hope
3138	Kendrick	6827	Big Four	10226-3	Tempe
3139	Hope	6828	Tip Top	10241	Fraction
3140	Quick Sand	6980	Silver King	10710-1	Monarch
3301	Hyantha	6981	Keystone	10710-2	Weasel Creek
3604	Helena	7064	Frieburg	10710-3	W. J. Kirby
3799	Edna	7065	Frieburg Extension	10710-4	Kootenay
3800	O.K. Fraction	7110	Little Olga	10710-5	Syndicate No. 1
4071	Yankee Girl	7111	Emil H.	10710-6	Cynosure
4085	Lily	7114	Jameson	10710-7	Dew Drop
4086	Gladstone	7115	South African	10710-8	Bobbed Hair
4090	Little Bonanza	7116	Majuba	10710-9	Filler No. 2
4091	Bed Rock	7214	Broadway	10710-10	Filler No. 1
4215	Edna No. 2	7215	East Broadway	10710-11	El Potraro
4221	Joe Dandy Fraction	8148	M.E.P. Fraction	10710-12	Oregon
4230	Washington	8206	St. John	10710-13	Northland
4351	E. W. Toole	8239	Martha W.	10710-14	Clarke Fraction
4352	Western Chief	8413	Monte Cristo	10737-1	Twin Fraction
4353	Beattie	8414	Winston Miner	10737-2	Mystery Fraction
4354	General Harris	8775	Mint	10804-1	May
4502	Stillwater	8789	Wild Cat	10804-2	Double Gross
4503	Denver	8853-1	Naples	10804-3	June
4744	Meteor	8853-2	Bridgton		

APPENDIX IV

ASSAYS OF ORE SAMPLES

Sample no.	Mine name	Sample description	Gold oz.	Silver oz.	Copper %	Lead %	Zinc %
74-1	Condon mine	6″ vein W. of shaft	0.050	11.60	0.39	14.70	tr
74-2	Condon	Sample from dump	0.080	10.70	0.27	17.67	tr
74-3	(Sample lost)						
74-4	Vosburg mine	2′ vein, upper level	0.785	2.80	....	....	....
74-5	Vosburg	6″ vein, 3rd level	tr	0.10	....	....	....
74-6	Lame Deer	1′ vein, dozer pit	0.120	2.40	....	....	....
74-7	1962 Lode	Sample from dump	0.01	3.20	....	6.61	0.10
74-8	Lame Deer	6″ vein, road level	0.090	1.40	....	....	....
74-9	Lame Deer	6″ vein, lowest adit	0.065	0.50	....	....	....
74-10	Kleinschmidt	Car sample, Carlson	0.050	5.80	....	7.77	8.75
74-11	Stray Horse	1½′ vein, lower adit	tr	0.15	....	0.42	tr
74-12	Gold King	Sample from dump	0.105	5.40	....	0.63	tr
74-13	Little Bonanza	8″ vein, lower level	0.055	4.80	....	10.71	tr
74-14	Edna mine	8″ vein, middle adit	0.545	2.50	....	....	....
74-15	Sunrise mine	1′ vein, at face	tr	0.10	....	....	....
74-16	Sunrise	1½′ vein, adit level	0.095	0.30	....	0.21	tr
74-17	Edna mine	8″ vein, N. adit	0.190	0.20	....	....	....
74-18	Edna	1′ vein S. adit	0.155	0.20	....	....	0.42
74-19	Edna No. 2 mine	Sample from muck	0.090	1.20	....	....	....
74-20	Edna No. 2	4″ vein, E. adit winze	3.160	4.80	....	....	....
74-21	Edna No. 2	6″ vein, bottom shaft	1.040	0.70	....	....	....
74-22	Stolen Sweets	4″ vein, bottom level	0.545	0.50	0.27	0.10	tr
74-23	Iron Age mine	6″ vein, Iron A. adit	0.280	0.20	....	....	....
74-24	Spokane mine	8″ vein in adit	0.015	tr	....	....	....
74-25	Spokane	2′ vein surface cut	0.160	0.10	....	....	....
74-26	Lily mine	6″ vein end drift	1.440	0.60	....	....	....
74-27	Lily	6″ vein, 1 crosscut	0.090	0.10	....	....	....
74-28	Gen. Sherman	6″ vein, adit level	0.615	0.40	....	....	....
74-29	January mine	5′ shear zone, 4 level	tr	tr	tr	0.16	tr
74-30	January	1½′ vein, 3 level	0.080	2.30	1.07	0.16	6.40
74-31	Mary V mine	3′ vein, 2nd level	tr	0.30	....	0.21	tr
74-32	Orphan Boy mine	2½′ vein at shaft	0.085	1.60	....	....	....
74-33	August Rust	Sample of dump	tr	16.70	....	1.16	4.60
74-34	1962 Lode	Sample from open cut	0.025	24.30	....	13.75	tr

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FOR FURTHER INFORMATION, ADDRESS THE DIRECTOR, MONTANA BUREAU OF MINES AND GEOLOGY, MONTANA SCHOOL OF MINES, BUTTE.

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